Name:_____ Date:_____

SKILL and PRACTICE

Antonie van Leeuwenhoek

Antonie van Leeuwenhoek, with very little scientific training, designed his own simple microscopes and was one of the first to observe single celled organisms. His research showed that decaying matter does not spontaneously generate living organisms, but it took many years before scientists were convinced.

Working-class upbringing

Antonie van Leeuwenhoek (Layu-wen-hook) was born in Delft, Holland, in 1632. Antonie's real name was Thonis Philipszoon but as an adult he signed all of his writings as Antonie van Leeuwenhoek. Leeuwenhoek means, "from Lion's corner," which describes the location of the house where he was born in Delft.

His parents were tradespeople; his father made wicker baskets and his mother's family were brewers. His early education took place in the town of Warmond. Lacking money, his parents could not pay for him to go to university. In 1648, his father died and Leeuwenhoek was sent to be an apprentice in a fabric merchant's shop. There he developed an interest in magnifying lenses. Merchants used magnifying lenses to count the threads in woven linen cloth. In 1654, Leeuwenhoek returned to Delft and opened his own business as a fabric salesman.

Improved magnifying glasses

Leeuwenhoek's interest in magnifying lenses led him to improve the way lenses are made and ground. He assembled close to 250 microscopes. His simple microscopes were held by hand to the eye and could magnify objects up to 270 times their original size. Leeuwenhoek's technique for grinding lenses was far better than any other at the time. His secret technique and microscopes were ones "which I only keep for myself." He gave away some microscopes but never sold any of them during his lifetime. For this reason, nearly 100 years passed before anyone could view or recreate his microscopes. There are fewer than nine remaining today.

Corresponded with Hooke

With his microscopes, Leeuwenhoek observed bacteria, protozoa, ant pupae, and many other tiny organisms. He wrote over 100 letters to the Royal Society in London and the French Academy from 1673 until his death in 1723. Leeuwenhoek wrote in Dutch because he never learned Latin, the scientific language of the day. Leeuwenhoek also differed from other scientists because he did not travel to share his scientific work. He made one trip to London around 1668, where he picked up a copy of Robert Hooke's book, *Micrographia*. Leeuwenhoek was inspired to make microscopic observations and to begin writing to Robert Hooke.

Leeuwenhoek's observations are remarkably descriptive. In dental plaque, Leeuwenhoek wrote there were "many very little living animalcules, very prettily a-moving. The biggest sort had a very strong and swift motion, and shot through the water like a pike does through the water...."

Challenged theory of spontaneous generation

Leeuwenhoek's experiments and independent thinking led him to question the theory of spontaneous generation that said decaying organic matter spontaneously produced maggots and other small living organisms. In 1692 he wrote that animalcules formed from seeds or germs of other animalcules and, "we are too credulous and therefore assume that living creatures originate from putrefied materials and so on." Many years later, Louis Pasteur's work in the 1860's fully convinced scientists that spontaneous generation wasn't true.

Recognition

Leeuwenhoek's scientific work did not go unrecognized. In 1680 he was elected as a full member of the Royal Society of London. Today, the Dutch Royal Academy awards the Leeuwenhoek medal every ten years to the scientist who has made the most important discovery in microbiology for that decade.

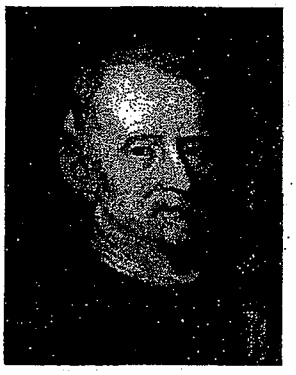
Name:_____ Date:_____

SKILL and PRACTICE

Robert Hooke

Robert Hooke was one of England's early scientific geniuses. He is remembered for his experiments across many fields of science. His book, Micrographia, gave everyday people their first view of life under a microscope.

Early years



Robert Hooke, an English scientist, was born on the Isle of Wight along the southern coast of England in 1635. His father, a minister in the local church, noticed that his son learned things quickly. Robert also had a remarkable ability to fix things and build useful tools. His father taught him school subjects at home and planned for him to become an artist.

When Robert was 13, his father died. He had very little money and went to work for Sir Peter Lely, a famous artist in London who painted landscapes and portraits.

Most of his life, Hooke's health was poor. He suffered from smallpox, which left scars on his face. His spine was crooked, perhaps from scoliosis or from an injury. He complained that artists' paint and varnishes made it hard for him to breathe. So, soon after arriving in London to study art, he changed his mind and enrolled at Westminster School to prepare for college.

England's Leonardo Da Vinci

Hooke did well at his studies. He learned Greek and Latin. He impressed his teachers by learning six old books on mathematics, called *Euclid's Elements*, in only one week. He even designed flying machines in his spare time! Because of his inventions and experiments, some people have called Hooke England's Leonardo Da Vinci.

University life

At age 18, Hooke started college at Oxford University in England. At the university, he met other people doing important scientific research. One of his first jobs was to design an air pump (without electricity!) to produce a vacuum for Robert Boyle who was studying gases. With Boyle and other English scientists like Isaac Newton, Edmond Halley, and Christopher Wren, Hooke helped to start the Royal Society in London which still exists today.

Microscopic world made known

Hooke is most well-known for his book, *Micrographia*, published in 1665. The book was printed in English so that scientists and non-scientists could appreciate his observations using a compound microscope.

His book contains a large collection of beautiful and accurate illustrations of tiny, everyday organisms; a flea, the compound eyes of insects, mold, the honeycomb-like structure of cork which he said was made up of "cells" like a monastery, and many other drawings.

Hooke's law

Students of physics and chemistry use Hooke's law. This law describes the force between two objects joined by a spring. It is used to solve problems about mechanical objects and to describe bonds between atoms in molecules.

Hooke worked on projects in many scientific fields throughout his life. In 1664, he became a professor of geometry. From 1662 until his death in 1703, he was also Curator of Experiments for the Royal Society. He demonstrated up to four experiments a week to the Society. He showed how a pendulum is used to measure gravity. He made major improvements to the compound microscope. He published a book about astronomy, *Cometa*, in 1666. He formulated a wave theory of light that led to a longstanding rivalry with Isaac Newton. Hooke also had an argument with Christiaan Huygens, a famous Dutch-born physicist, over his invention of the spring-balanced watch.

A genius worth remembering

Hooke's work is sometimes overlooked because many important scientists made discoveries in his lifetime. But his accomplishments make him one of the seventeenth century's greatest thinkers.

Directions: Please read selection carefully. Answer your questions on separate paper in complete sentences. Typing (word processing) is welcome!

Reading Reflection Questions: Atonie van Leeuwenhoek

1. How did Leeuwenhoek become interested in magnifying lenses?
2. Why is a hand lens considered to be a simple microscope?
3. In what ways did Leeuwenhoek differ from other scientists during his time?
4. Leeuwenhoek's 'microscopes' enabled him to see very tiny organisms he called "animalcules". Although he was not entirely sure of what he was viewing, his observations were impeccably descriptive. Hypothesize as to the value of such descriptions to modern scientists.
5. Describe the theory of spontaneous generation (it is in the reading but you may need to look this up in your textbook or on the Internet).
6. How did Leuwenhoek's work challenge the theory or spontaneous generation?

Reading Reflection Questions: Robert Hooke

1. Who was Leonardo Da Vinci **AND** why is he so famous (other than for his magnificent art). Use the Internet to help you!
2. Robert Hooke began as an apprentice for a famous artist in London. Why did he decide to change his career path and begin studies to prepare him for college?
3. Why is Hooke considered to be England's Leonardo Da Vinci?
4. Describe the contents of Hooke's famous book, ***Micorgraphia?***
5. How did Hooke's book inspire Leeuwenhoek?
6. Hooke is credited with discovering the first "cell". Describe what you think he was looking at.
7. Although Hooke was one of his era's finest scientists, his accomplishments were often overlooked. Explain why you think this occurred.