

WONDROUS**MACHINE**

Lainna
Callentine
M.Ed., M.D.

The Electrifying Nervous System

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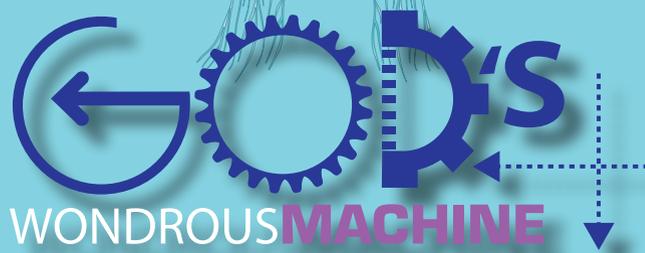


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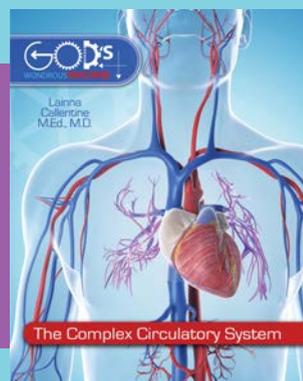
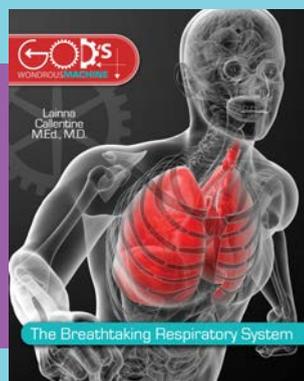
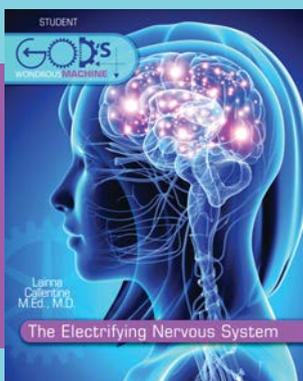
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How to Use This Book (All about Us!)

About this *God's Wondrous Machine* series:

Developed by a master's-trained teacher and homeschooling mother who happens to be a pediatrician, this is the first book in an innovative anatomy curriculum that focuses on the human body's nervous system. It will create engaging opportunities for children to discover the wonders and workings of the human body.

Each book in this series delves into one of the major systems of the body; the first three of this nine-book series under development include:



The book series will be bursting with vibrant color images, interesting historical and weird facts, anatomy, physiology, and modern innovations. You will engage your senses and have a multitude of choices for hands-on exploration. You will discover aspects of the human body from a doctor's perspective. Each book will discuss a particular system of the body, discussing how it works and how it doesn't at times. Common questions kids ask are answered to stimulate curiosity and it will engage your senses as the world of medicine is demystified.

It gives many perspectives in science education by connecting to other fields of study (i.e., history, sociology, psychology, theology, etc.) and it encourages the reader to appreciate God's magnificent handiwork: your body.

God's Wondrous Machine series recognizes that every learner is not the same. Whether used in a homeschool or classroom setting, the series' hands-on activities are based on the educational theory of Multiple Intelligence by Howard Gardner (which states there are many types of intelligences and recognizes different ways of learning styles: musical-rhythmic, visual-spatial, verbal-linguistic, logical-mathematical, bodily-kinesthetic, interpersonal, intrapersonal, and naturalistic). It is flexible enough for endless customization for the skills, interests, and abilities of each student.

Using the Curriculum guide

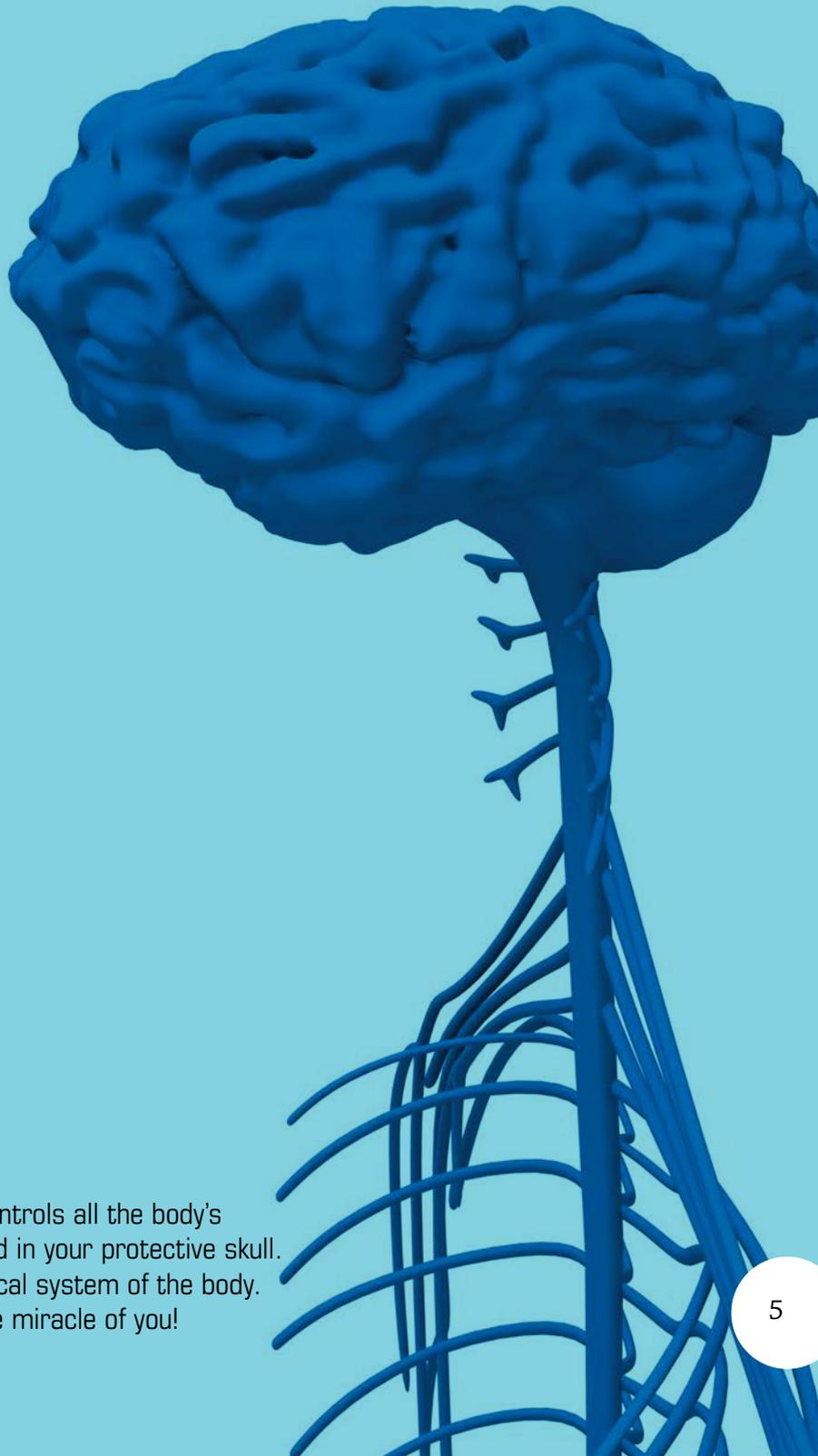
This developing nine-book series will challenge the child in all facets of multiple intelligence. The parent/instructor is able to choose and customize hands-on activities that engage a multitude of learning styles and challenge the student to explore life's big issues. The program is specially designed for lower and upper elementary level students, including advanced learners with middle school proficiency!

You can use this book as an interesting:

- ▶ Unit Study
- ▶ Curriculum
- ▶ Supplemental Resource

An associated parent lesson planner (PLP) book is available. It contains perforated sheets for worksheets, and tests, in addition to a flexible educational calendar. This additional material allows for a multiple array of assessment for the instructor (i.e. project based, traditional testing, or portfolio assessment). It is designed to maximize the learning opportunities and retention of information from the book, as kids have fun learning about the mechanics and mysteries of themselves!

From laughing to crying, your brain controls all the body's functions. Your brain lays safely tucked in your protective skull. You will take a trip through the electrical system of the body. Come learn how God has designed the miracle of you!



VOCABULARY LEVELS

Choose the word list based on your skill level. Every student should be able to master Level 1 words. Add words from Levels 2 and 3 as needed. More proficient students should be able to learn all three levels.

Level 1 Vocabulary

- Arbor Vitae
- Central Nervous System
- Cerebral Hemispheres
- Cerebellum
- Cerebrum
- Frontal Lobe
- Gray Matter
- Neurons
- Occipital Lobe
- Parietal Lobe
- White Matter

Level 2 Vocabulary

Review and Know

Level 1 Vocabulary

- Autonomic Nervous System
- Blood-Brain Barrier
- Cerebral Spinal Fluid
- Corpus Callosum
- Dermatomes
- Homunculus
- Meninges
- Pituitary Gland

Level 3 Vocabulary

Review and Know

Level 1 and 2 Vocabulary

- Astroglia
- Axon
- Broca's and Wernicke's Areas
- Cerebral Palsy
- Dendrites
- Diencephalon
- Ependymal Cells
- Gyrus
- Hypothalamus
- Medulla Oblongata
- Mesencephalon
- Microglia
- Myelin Sheath
- Neuroglia
- Oligodendroglia
- Pons
- Pyrogens
- Shingles
- Synapse
- Temporal Lobe
- Thalamus
- Ventricles



God created you with much care, love, and incredible design! The human brain has 1 quadrillion synapses (that is a 1 followed by 15 zeroes or 1,000,000,000,000,000). All those synapses fit into the tiny compartment of your brain. In comparison to man's design, a typical computer has approximately 16,000,000,000 bytes of memory. It would take a million computers to have the equivalent amount of connections to rival the brain!

1 Let's Start at the Beginning: Historical Points of Interest

Thinking, crying, breathing, running, skipping, singing, smiling, itching, sneezing, and your beating heart — all of these activities have one thing in common: your brain. Tipping the scales at a mere 3 pounds, it is the integral organ of your body. Your brain operates 24 hours a day, 7 days a week, 365 days a year. It works tirelessly, day in and day out. Serving as the central control center of your body, this marvelous machine is composed of billions of cells that make hundreds of billions of connections without any traffic jams. Through this super highway of connections, we perceive and process impulses that originate inside and outside our bodies.

In this unit, we will explore the mysteries of the brain through investigation of its anatomy (name and location of parts of the body), physiology (how the body functions), histology (microscopic cell structure), and pathology (abnormal health consequences of disease). Let's pick our brains and peer into the ultimate multi-tasker.



A curator for the Smithsonian Institution in 1935 looking at a skull from Alaska that possibly shows signs of brain surgery from thousands of years ago. Other skulls have been found that also detail new bone growth, indicating that patients survived the initial procedure.

The brain and nervous system are an important control center for your body. It can send signals throughout the body at over 320 feet per second. That is nearly the distance of a football field!



History tells the story of the past. Over time, we have learned a great many things about how the brain works. Our knowledge of the inner workings of the brain continues to grow.

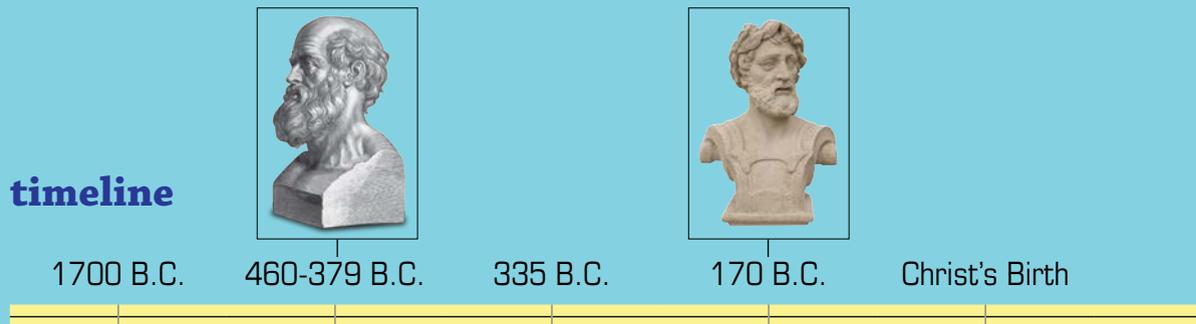


But we have this treasure in jars of clay to show that this all-surpassing power is from God and not from us. We are hard pressed on every side, but not crushed; perplexed, but not in despair; persecuted, but not abandoned; struck down, but not destroyed. We always carry around in our body the death of Jesus, so that the life of Jesus may also be revealed in our body (2 Corinthians 4:7-10; NIV).

Mankind has been on a quest since the beginning of time to understand our external and internal environments. Understanding the brain has been one of those perplexing pursuits. The Bible reminds us that God's power is "all surpassing" and that the life of Jesus is revealed in our bodies. Throughout time, man has continued to gain insight and understanding about the brain and its functions. Yet, even with the achievements of modern neuroscience, the inner workings of the mind are still great mysteries.

Without a doubt, the quality of life for men has improved dramatically through the centuries because of the advances and discoveries that men have made in medicine. The time-line below depicts some of the discoveries made in neuroscience. It provides an idea of how we have acquired knowledge through time.

timeline

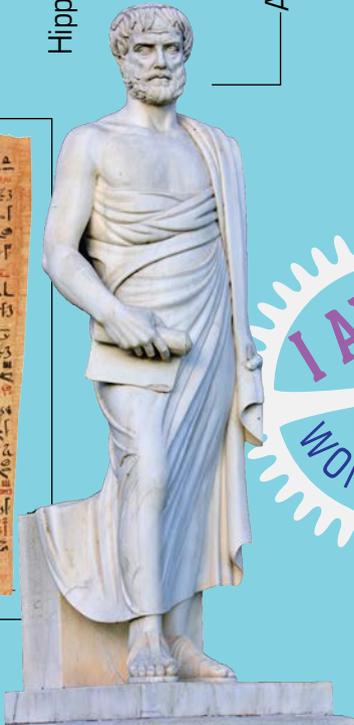
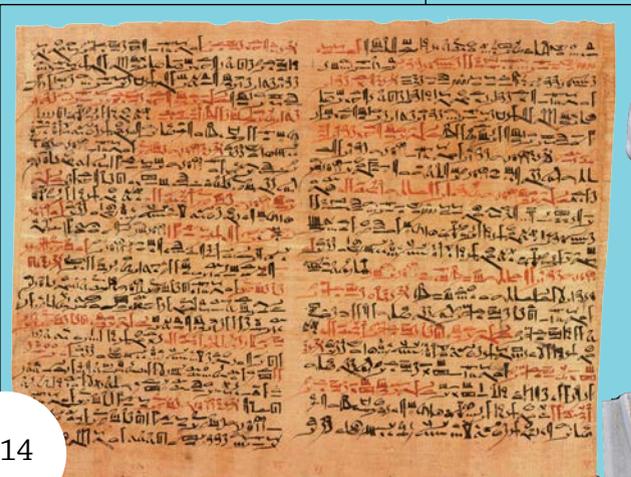


Edwin Smith

Hippocrates

Aristotle

Galen



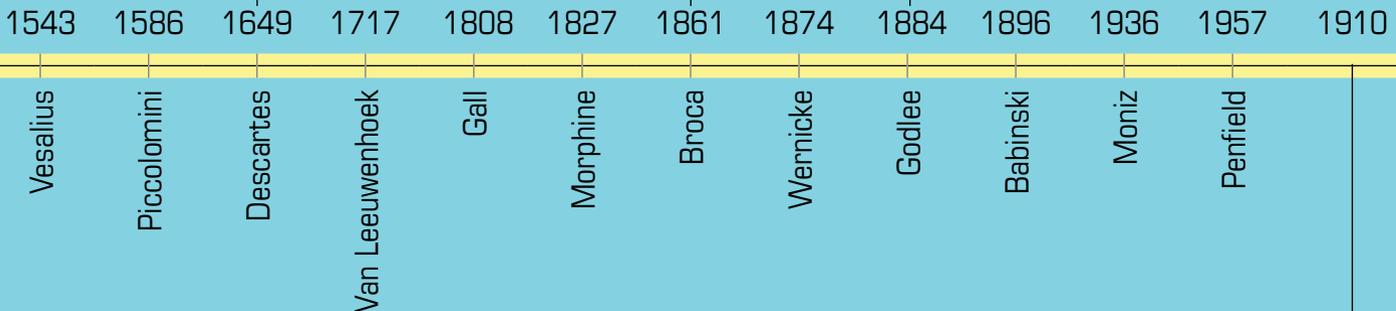
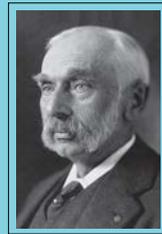
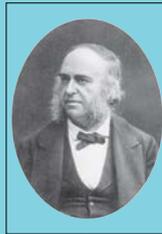
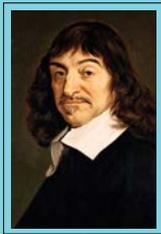
The body is a unit, though it is made up of many parts; and though all its parts are many, they form one body. So it is with Christ.... (1 Corinthians 12:12; NIV)

Traveling through the course of time, in 1700 B.C. the Edwin Smith Surgical Papyrus was written. It is the first written record of the nervous system to appear in Egyptian documents that describe cases of brain injury.

Hippocrates (460–379 B.C.) was born 460 years prior to Jesus’ birth and was an early doctor known as the “Father of Medicine.” Hippocrates felt that it was important that all doctors take an oath, or special promise before they began practicing medicine. He developed the Hippocratic Oath, in which all doctors promise never to use their knowledge to cause harm to anyone under their medical care.

In addition, Hippocrates discussed epilepsy as a problem in the brain. He also believed that the ability to feel sensations and intelligence originated in the brain. This was a very revolutionary idea, because prior to this the consciousness of the mind was believed to reside in the heart.

In 335 B.C., Aristotle wrote about sleep, but believed that mental processes originated in the heart, and that the brain was merely a place to cool hot blood pumped from the heart.



Lead Poisoning

Alice Hamilton (1869-1970), a physician who was the world’s leading authority on industrial medicine. In 1910, she discovered the cause of a common illness that produced deadly outcomes in factory workers. The workers would suffer from shakiness, headaches, and loss of muscle control that sometimes lead to paralysis and death. She discovered “plumbism” or lead poisoning. *Plumbum* is the Latin word for lead.



A Roman physician to the gladiators named **Galen** dissected the brains of animals in 170 B.C. From his studies, he believed the cerebellum controlled the muscles and the cerebrum, which allows us to sense our environment.

In 1543, **Andreas Vesalius** published his book, *On the Workings of the Human Body*, which discussed human anatomy, including the brain's structures in detail. Vesalius is credited with being the "father of anatomy." He broke from the traditions of the time by carrying out anatomical dissections. This was a sharp deviation from medical practices because dissection, much less touching of a deceased specimen, was considered unclean and taboo.

Piccolomini was the first to point out the differences between the cerebral cortex and white matter in 1586.

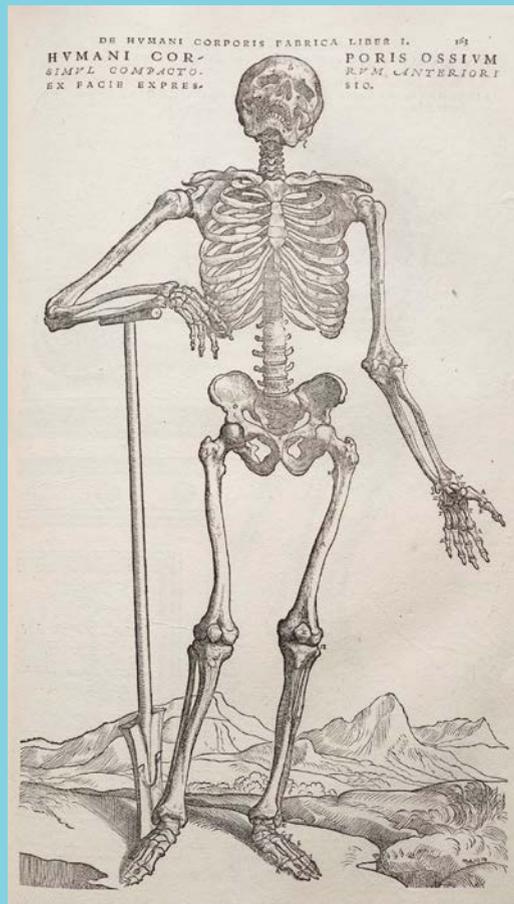


Image from Andreas Vesalius' *De humani corporis fabrica* (1543), page 163

Rene Descartes, in 1649, described the Pineal gland as the control center of the body and mind. The Pineal gland, located in the brain, produces Melatonin, which regulates the sleep cycle (circadian rhythm). A cross-section of a nerve cell was seen in one of the first microscopes by **Antonie Van Leeuwenhoek** in 1717. Although we know it is now incorrect, **Franz Joseph Gall** published his work on phrenology. He believed he could distinguish the traits of a person by feeling the bumps on their head.

Paul Broca discovered that different regions of the brain performed specific processes. He discovered "Broca's" Area (named after him) in 1861. This region is located in the frontal lobe of the left hemisphere of the brain and is intimately involved in speech articulation (talking). Near that same time, in 1874, **Carl Wernicke** published *Der Aphasische Symptomencomplex*, a book on aphasias. Aphasia is the term used to identify a difficulty in forming and understanding language. Wernicke's Area is located close to Broca's Area.



Observe the picture above. Do you see anything missing (a lack of masks, gloves, substances...)? Unlike very advanced and sterile (germ-free) environments for modern surgery, proper sanitary procedures were not practiced.



Medical staff sterilizing hands and arms before surgery

Your brain is a very complex and delicate organ. Unlike other parts of the body, disorders of the brain could not be treated or even diagnosed correctly. It wasn't until 1884 when the first successful surgical removal of a brain tumor was performed by **Sir Rickman John Godlee**. **Joseph Babinski** was the first to describe the Babinski Reflex. It is a normal reflex in infants but an abnormal reflex in older children and adults. We will learn more on this reflex later.

One of the most grotesque practices in neuroscience was developed in 1936 by **Dr. Antonio Egas Moniz**, who invented the procedure of frontal lobotomies for the treatment of mental illnesses. This caused changes in the person's personality and sometimes death. Fortunately, this is not practiced today.

Dr. Wilder Penfield developed a visual representation of the brain — called the homunculus — that identifies the sensory regions. We will visit with Dr. Penfield in an upcoming section.



The British Army's first mobile brain surgery unit shown being stocked in 1940. It was staffed with five specialist doctors and two nurses.



And last on our timeline is **Dr. Raymond Damadian**, who became a pioneer in the field of magnetic resonance imaging (MRI) through his development of several patents and a working machine named Indomitable that could be used for non-invasive detection of cancer in the human body. The first commercial MRI scanner was produced in 1980. This important technology can show disease or any damage in the brain in several ways without using surgery.



Continuing improvements to MRI technology are helping to discover new details of how our bodies function and ways to discover when there are problems. At left, Dr. Damadian with his pioneering machine, Indomitable.

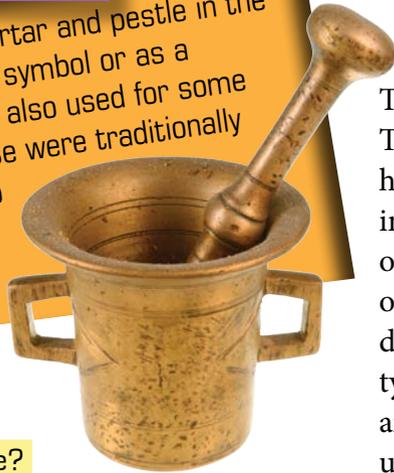
Word Wise!

ANATOMY refers to the study of the body structure, systems, and organs of living things. The word developed from the Greek words “ana” meaning “up,” and “tomia” for cutting.



MODERN MARVELS

You may have seen a mortar and pestle in the drug store – either as a symbol or as a decorative object. While also used for some cooking techniques, these were traditionally used in many cultures to mix up the ingredients in medicine.



Good or Bad Medicine?

When a doctor gives you a prescription for medicine, you go to a pharmacy. Pharmacists are a type of doctor who have special training in drugs and its effects on the body. Before there were pharmacists, there were apothecaries. If you lived in the 15th century, in the times of Christopher Columbus, and became ill, you may have gone to an apothecary. They mixed their own medicines and gave advice on healthcare. Many doctors were able to formulate their own medicines as well. Evidence of prescriptions and instructions for how they were made have even been found on clay tablets as early as ancient Babylon.

There were no rules in how this had to be done. This meant that while a doctor in one place might have created a specific type of medicine, a doctor in a nearby town might make the same medicine only it would be slightly different in its formula of ingredients. Both might have prescribed a different amount of the medicine for the same type of injury. Now there are strict regulations and professional standards that help to insure uniformity in the formulas and prescriptions for medicine. Drugs for mental health, or psychotropic drugs, are a relatively new invention. Drugs developed for the specific treatment of mental health problems only came into existence after World War II.

Today many medicines are developed by huge corporations who spend billions of dollars in formulating these new drugs. They then have to go through a strict testing and approval process. The Food and Drug Administration is the government agency tasked with approving new medicines in the United States.



BIBLICAL REFERENCES: The Bible has a multitude of references to the body's organs and systems. However, it does not directly mention the brain.

| Mind | Think | Meditate |
|---------------|---------------------|---|
| Psalm 26:2 | Romans 12:3 | Psalm 48:9 |
| Matthew 22:37 | Philippians 4:8 | Psalm 143:5 |
| Luke 10:27 | Proverbs 23:7 | Psalm 119:15, 23, 27, 48, 78, 97, 99, 148 |
| 1 Peter 4:7 | 2 Peter 3:1 | |
| Psalm 7:9 | 1 Corinthians 14:20 | Colossians 3:2 |