The Nervous System

The extent of its responsibilities is as vast as the system itself. More than 50 billion cells make up the nervous system, and they influence the activity of virtually everything we do, right down to the level of individual cells. When we breathe, digest food, when our heart beats or we walk down a flight of stairs, our nervous system is there, communicating vital information, directing how our body should perform or behave.

Everything that we experience in the world around us must be processed by the nervous system. When we smell, see, hear, taste, or touch, our perceptions of each of these senses is filtered and interpreted by our nervous system. It is our body’s master communicator, and it commands the actions of much of what our body does.

The Brain

The human brain is the world’s greatest computer. It processes more data in an instant than a personal computer can process in ten years of constant operation. In complexity, it makes even our most advanced technology pale by comparison. The brain, made up of 30 billion neurons and five to ten times that many glial cells, can handle data every minute that would swamp the world’s telephone exchanges. Each neuron is connected with as many as 60,000 other neurons, creating a communication network without parallel. For comparison, there aren’t 10,000 connections in an entire computer. So intricate is this amazing organ that, as one neurological researcher commented, “It’s so complex, it may not be capable of comprehending itself.”

The brain’s function is to register incoming information and then to direct the proper response. So, for example, if you begin to slip while walking on ice, receptors send this information to the brain, which then processes the information, recognizes that you are experiencing a loss of balance, and sends orders for the proper response.

The brain is the body’s master controller. It receives information
from throughout the body, and from our external environment, and then orders various organs or systems to make changes to their function or operation in order to compensate for the changing environment around us. For example, if carbon dioxide begins to build up in the bloodstream, the brain detects this build-up and reacts by ordering the lungs to breathe more rapidly. Similarly, if the nerve receptors detect a drop in body temperature, the brain will direct the muscles to begin shivering to help generate heat.

The brain carries out many of its functions independent and automatically without us consciously thinking about them. Our heart beats under the brain’s direction, yet we don’t “think” about making our heart beat. The muscles in our digestive system contract during the digestion of food, but we don’t have to “tell” our stomach or small intestine to do anything; the brain directs the digestion of our food automatically.

Of course the brain also handles a tremendous number of conscious activities. If we decide to turn our head, pick up an object, walk down stairs, jog, run, or any other of an infinite number of movements or activities, the impulse that directs the muscles to contract or create action emanates from the brain.

The brain is also our memory bank, storing past experiences in a tremendous maze of neurons that, combined, store the information that results in learning. Much of this information comes to the brain via the external senses—sight, taste, touch, smell, and hearing. Despite the important role these senses play in guiding us through the physical world, the amount of space devoted to the senses is actually relatively small. Much larger areas are “association” regions of the brain that scientists believe are responsible for interpreting the sensory data. It is in these areas that sights can be combined with smells or we can compare how something looks with how we expect it to feel. Thus, we learn not to stick our finger in a flame based on how it looks, and our memory and ability to make associations is so powerful that we generally only need to experience the heat of a flame once to make this association.

Although it is often thought of as a single, gray mass of tissue, the brain is actually made up of a number of interacting parts, each carrying out vital functions. Still, there is much research left to discover all the functional areas of the brain, and scientists have only begun to discover what responsibilities are carried out by certain areas.

Interestingly a fair amount of what has been learned about the brain has been discovered through surgery on patients not under anesthesia. Although the brain is the receptor of pain impulses from around the body, it does not register any pain itself. This means that during surgery, patients are kept awake and can communicate with the surgeon as they touch sensors in the brain. Such experiments have uncovered a greater understanding of how the brain functions. For example, if a weak electrical charge is applied to a particular part of the brain, the patient may suddenly experience a smell or hear a sound that is not present. A long-forgotten memory may return, or a sudden emotion may come welling up to the surface.
Scientists have now located some of the functions of general areas of the brain. The back or occipital lobe of the brain processes vision. The top or parietal lobe of the brain handles skin sensations. The frontal lobe directs muscle movement, and the temporal lobe, at the bottom of the brain, registers and interprets sounds.

**Spinal Cord and Nerves**

The brain communicates with the rest of the body through the nervous system. The system is the conduits and electrical cords through which messages travel throughout the body. The human body has thousands of miles of nerves, each carrying messages related to the specific function.

Both the brain and the nervous system work on a weak electrical current that is generated through chemical reactions (mainly electrolytes or minerals) that react in a way similar to the reaction that generates electricity in a car battery. This electrical energy is transmitted like the electricity that flows through the circuits in a house. In your body, however, there are more of these circuits than in the electrical system of a major city.

Physiologists and other researchers have been able to trace some of this circuitry, allowing them to determine which nerves control which motor or sensory functions. In the brain, for example, twelve major sets of nerves have been identified and tied to specific functions. The sixth cranial nerve controls the movement of the eyes. The ninth cranial nerve operates the tongue, pharynx, and sinuses. The first, or olfactory, cranial nerve receives information that becomes our sensation of smell.

Patients who receive a traumatic blow to their head may exhibit symptoms related to damage of a specific set of nerves. For example, injury to the sixth cranial nerve causes the eye to turn out, due to paralysis of the muscles that control the movement of the eye. Injury to the eighth set of cranial nerves can lead to deafness.

In the same way that specific nerves in the cranium control specific functions, so do the rest of the nerves that connect the brain with the trillions of cells throughout the body.

These nerves all originate at the
stem of the brain and travel in large branches down the spinal cord. In an adult, the spinal cord is about eighteen inches long. Packed inside a protective bony structure (the spine), the nerves inside the spinal cord can be likened to major freeways that then branch into smaller side roads.

Like the cranial nerves, the major nerves that run through the spinal canal have been identified and traced to the sensory or motor function that they perform. Essentially, the nerves derive their names based on the name of the section of the spine where they exit, branching into smaller and smaller nerves throughout the body. So, for example, the nerves that exit nearest the head, from the cervical segment of the spine, are the cervical nerves. Next furthest down are the thoracic nerves, near the middle of the back, then the lumbar nerves, which leave the spinal cord and branch down the legs all the way to the feet. Finally, there are the sacral nerves, which, after exiting the spinal cord, terminate in the buttocks and groin.

Each of these nerves performs a specific function. Cervical nerves guide the operation of much of the upper body, like the deltoid muscles in the shoulder, the chest muscles, and then extending down the arm, the muscles of the forearm and even the little finger. When you feel a pin-prick on your arm, the sensation is being carried by one of the cervical nerves.

The twelve major thoracic nerves also service much of the upper body with the cervical nerves tending to be connected with the front of your body and the thoracic tending to be connected with the back. Where the cervical nerves operate the muscles in the chest, the thoracic nerves operate the muscles in the back. Similarly, where the cervical nerves make the forearm function, the thoracic nerves stimulate the movement of the muscles on the underside of your arm. The thoracic nerves also direct the movement of most of your fingers.

The lumbar and sacral nerves make the lower body function. Together, they control the thighs and calves, with the lumbar nerves extending to the tip of the big toe. This is why people who have sustained injury to the nerves in or just exiting the spinal cord experience pain in areas greatly removed from the actual sight of nerve damage. In the case of ruptured vertebrae in the cervical area, for example, the pain that is actually experienced can extend across the chest and down the arms, often creating a sensation that feels much like a heart attack. When the nerve damage is to a lumbar or sacral nerve, the patient will often experience the injury as numbness or shooting pain that extends down the leg or thigh.

The nervous system is a vast and resilient system, although it can sustain damage that can be repaired. Still, science has not discovered
how to repair a severed spinal cord. Today, researchers search for answers to such neurological diseases as Alzheimer’s, Parkinson’s, and multiple sclerosis, which can damage the brain and nerves in differing ways.

Despite applying vast resources and tremendous amounts of research into understanding the brain, we have a long way to go before we truly understand the workings of this, the world’s greatest computer.