Central nervous system subdivisions

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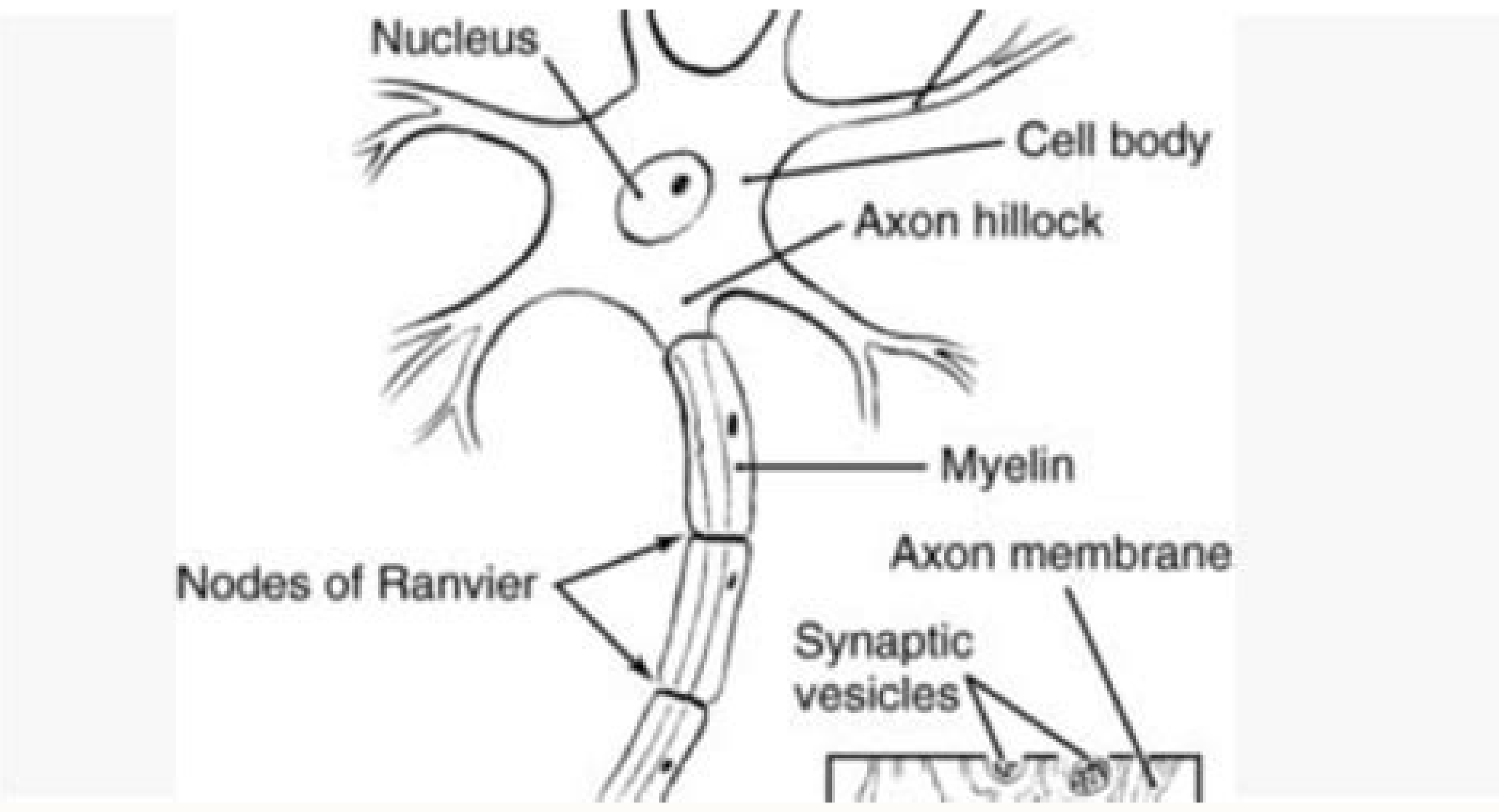
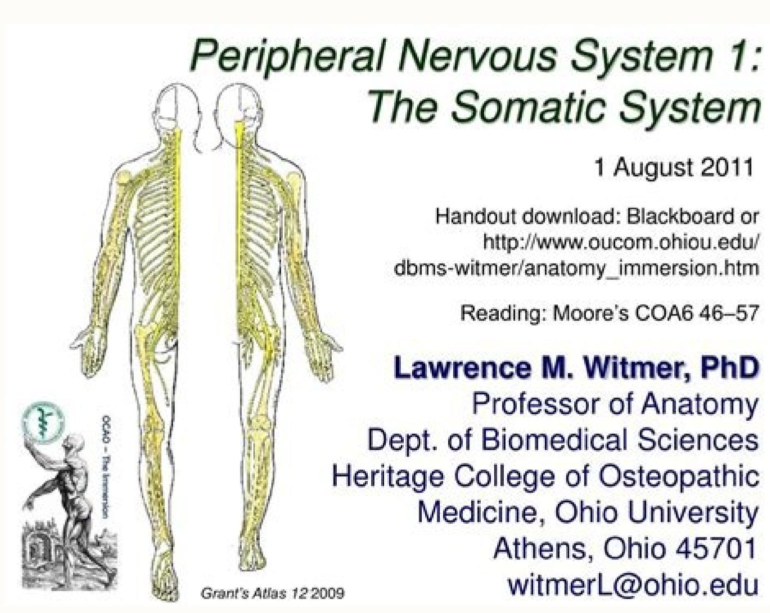

Nucleus
Cell body
Axon hillock
Myelin
Axon membrane
Nodes of Ranvier
Synaptic
vesicles


Peripheral Nervous System 1:
The Somatic System
1 August 2011
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Reading: Moore's COA6 46–57
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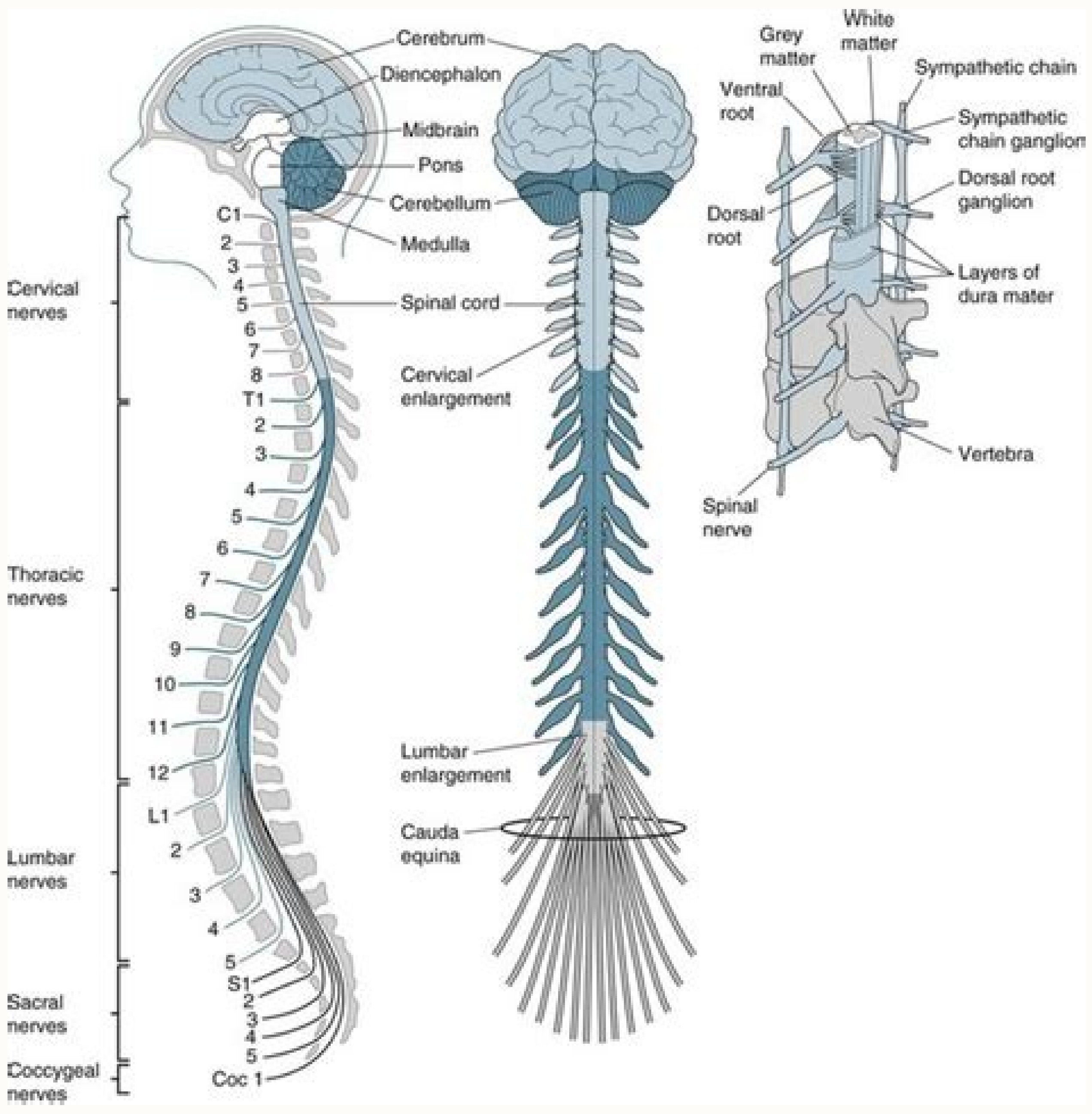
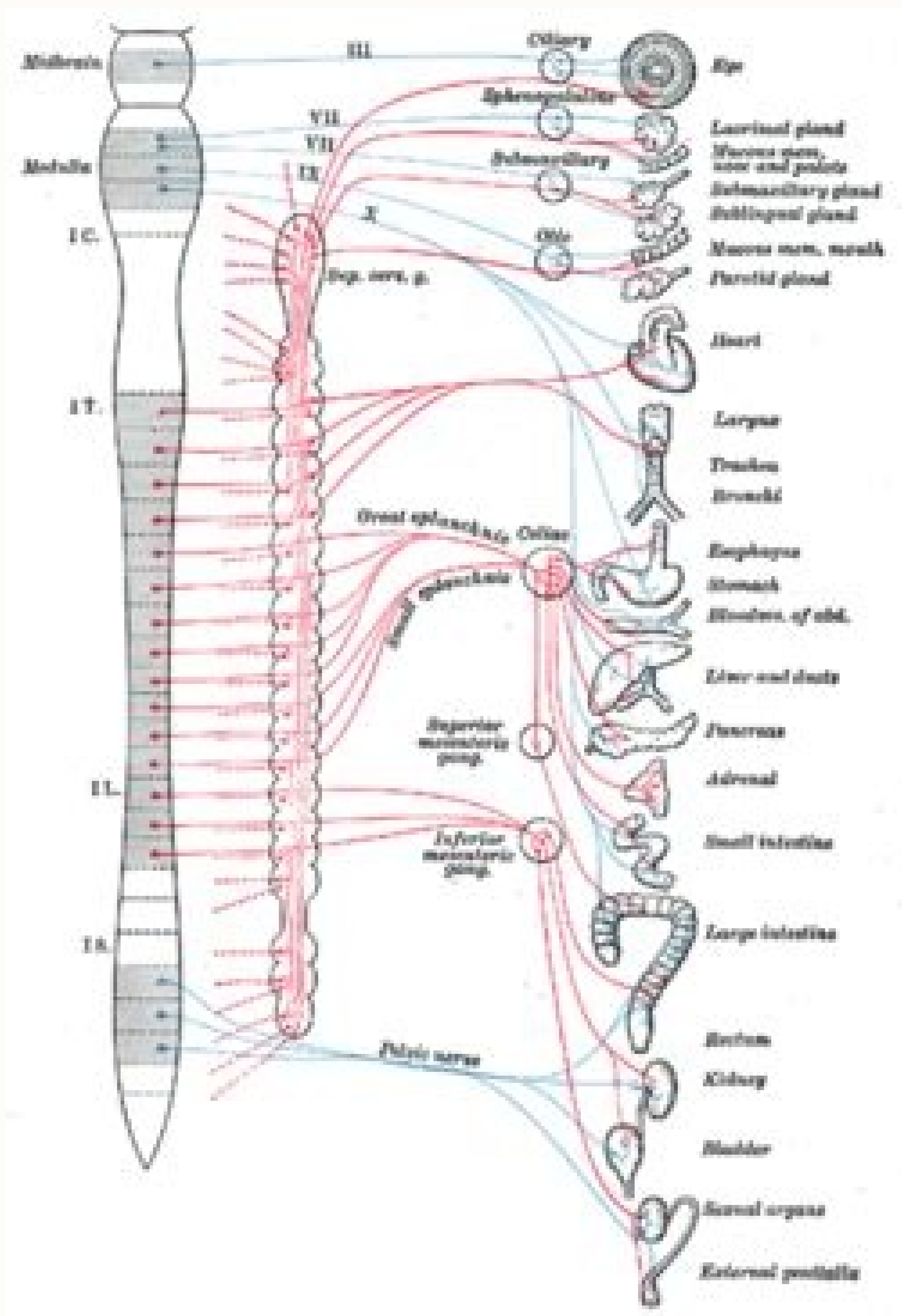
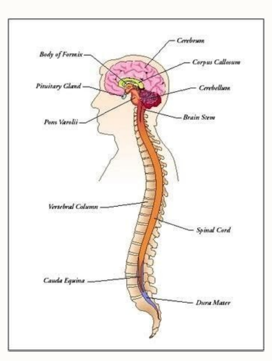

Cerebrum
Diencephalon
Midbrain
Pons
Cerebellum
Medulla
Spinal cord
Cervical
enlargement
Lumbar
enlargement
Cauda
equina
Cervical
nerves
Thoracic
nerves
Lumbar
nerves
Sacral
nerves
Coccygeal
nerves
C1
T1
L1
S1
Coc 1
Grey
matter
White
matter
Ventral
root
Sympathetic chain
Sympathetic
chain ganglion
Dorsal root
ganglion
Dorsal
root
Layers of
dura mater
Vertebra
Spinal
nerve


Midbrain
Medulla
III
VII
IX
X
Ciliary
Eye
Lacrimal gland
Submaxillary gland
Sublingual gland
Parotid gland
Heart
Larynx
Trachea
Bronchi
Esophagus
Stomach
Liver and ducts
Pancreas
Adrenal
Small intestine
Large intestine
Rectum
Kidney
Bladder
Sexual organs
External genitalia
Pelvic nerve



Numbness, tingling, and weakness are some of the most common reasons that people visit a neurologist. The first step is usually to decide if the problem is in the central nervous system (the brain and spinal cord). If not, the problem is likely to reside with the nerves that extend out into the body. The peripheral nervous system encompasses all the nerves that flow between our spinal cord and the muscles, organs, and skin. A thorough understanding of the peripheral nervous system has been said to be one of the most distinguishing features between neurologists and other medical practitioners. SEBASTIAN KAULITZKI / Getty Images There are many different types of nerve cells, each relaying slightly different information to the brain along wiry processes called axons. Furthermore, some of these axons are wrapped in a protective layer called myelin, which can speed the electrical transmission of messages along the axon. For example, motor neurons have large, myelinated axons that extend out from the spinal cord to different muscles to control their contraction. Sensory neurons come in many different categories. Large myelinated axons carry information about vibration, light touch, and our sense of our body in space (proprioception). Thinly myelinated fibers send information about sharp pain and cool temperature. Very small and unmyelinated fibers transmit messages about burning pain, a sensation of heat, or itching. In addition to motor and sensory axons, the peripheral nervous system includes autonomic nerve fibers as well. The autonomic nervous system is responsible for controlling critical daily functions that are thankfully placed mostly beyond our conscious control, such as blood pressure, heart rate, and perspiration. All these different axonal fibers travel together like bundles of wire in a cable. This "cable" is large enough to be seen without a microscope and is what is commonly referred to as a nerve. With the exception of the cranial nerves, peripheral nerves all travel to and from the spinal cord. Sensory nerves enter the spine near the back of the spinal cord, and motor fibers exit from the front of the cord. Shortly thereafter, all the fibers combine to form a nerve root. This nerve will then travel through the body, sending out branches in appropriate locations. In many places, such as the neck, arm, and leg, nerve roots combine together, intermingle, then send out new branches. This intermingling, called a plexus, is something like a complicated interchange on a freeway, and ultimately allows signals from one source (e.g axons exiting the spinal cord at the C6 level) to end up traveling along with fibers from a different spinal cord level (e.g. C8) to the same destination (e.g. a muscle like the latissimus dorsi). An injury to such a plexus can have complicated results that might confuse someone without a knowledge of that plexus. When a patient suffers from numbness and/or weakness, it's the neurologist's job to locate the source of the problem. Very often, the body part that feels weak or numb does not actually contain the culprit causing that symptom. For example, imagine that someone suddenly finds that his foot keeps dragging on the ground when he walks. The cause of this person's foot weakness is probably not in the foot, but instead due to nerve damage somewhere else in the body. By talking to such a patient and doing a careful physical examination, a neurologist can determine the source of the weakness. The doctor will recognize that muscles responsible for keeping the foot off the ground while walking include the extensor digitorum longus, which receives innervation from the common peroneal nerve. When people sit with one knee over the other, this nerve can be compressed, causing mild weakness and a foot drop. If, however, the physical examination also reveals that the patient cannot stand on tiptoe on that foot, the neurologist will no longer suspect the peroneal nerve. The muscles that point the foot are innervated by the anterior tibial nerve, which branches away before the common peroneal. Both the anterior tibial and common peroneal nerves carry fibers that are originally sent from the spinal cord at the L5 level. This means that the problem's not compression at the knee, but instead closer to where the nerves leave the spinal cord. The most likely cause is lumbar radiculopathy, which in extreme cases may require surgery to correct. The example just given is meant to demonstrate how knowledge of the peripheral nervous system, combined with a careful physical exam and listening to the patient, can make the difference between just telling a patient to stop crossing her legs, or telling her that she might need back surgery. Similar examples might be given for almost any part of the body. For this reason, all medical students, not just neurologists, are taught the importance of the peripheral nervous system. The nervous system is an organ system that handles communication in the body. There are four types of nerve cells in the nervous system: sensory nerves, motor nerves, autonomic nerves and inter-neurons (neuron is just a fancy word for nerve cell). You can divide up all the nerves in the body into roughly two parts: the central nervous system and the peripheral nervous system. Science Photo Library - PASIEKA / Brand X Pictures / Getty Images The central nervous system contains two organs—the brain and the spinal cord. It has all four types of nerve cells and is the only place you can find inter-neurons. The central nervous system is insulated from the outside world pretty well. It never even touches blood. It gets its nutrients from cerebrospinal fluid, a clear liquid that bathes the brain and spinal cord. Both organs are covered with three layers of membranes called the meninges. CITE The meninges and cerebrospinal fluid cushion the brain to keep it from being injured by a knock on the noggin. It's possible to get an infection from viruses or bacteria in the meninges called meningitis. It's also possible to have bleeding either between the meninges and the skull (called an epidural hematoma) or in between the layers of the meninges (called a subdural hematoma). Any bleeding or infection inside the skull can put pressure on the brain and cause it to malfunction. The central nervous system is like the guts of your computer. It's in there with millions of connections moving little impulses around from circuit to circuit (nerve to nerve), calculating and thinking. Your brain makes all the calculations and stores information. Your spinal cord is like a cable with lots of individual wires running to all different parts of the brain. But the computer brain inside your laptop, like the brain inside your head, is useless all by itself. You have to be able to tell your computer what you need and see or hear what your computer is trying to tell you. You need some sort of input and output devices. Your computer uses a mouse, a touchscreen or a keyboard to sense what you want it to do. It uses a screen and speakers to react. Your body works very similarly. You have sensory organs to send information to the brain—eyes, ears, nose, tongue, and skin. To react, you have muscles that make you walk, talk, focus, wink, stick your tongue out—whatever. Your input/output devices are part of your peripheral nervous system. The peripheral nervous system is everything connected to the central nervous system. It has motor nerves, sensory nerves, and autonomic nerves. Autonomic nerves act automatically, which is a way to remember them. They are the nerves that regulate our bodies. They are the body's version of a thermostat, a clock, and a smoke alarm. They work in the background to keep us on track and healthy, but they don't take up brain power or need to be controlled. Autonomic nerves are loosely split into either sympathetic or parasympathetic nerves. Sympathetic nerves have a tendency to speed us up. They increase heart rate, breathing, and blood pressure. These nerves are responsible for the fight-or-flight response.Parasympathetic nerves stimulate blood flow to the gut. They slow down the heart and decrease blood pressure. Think of the sympathetic nerves as the body's accelerator, and parasympathetic nerves as the brake pedal. Your body is always stimulating both the parasympathetic side and the sympathetic side at the same time—just like my grandmother used to drive, with a foot on each pedal. Motor nerves start from the central nervous system and go out toward the far reaches of the body. They're called motor nerves because they always end in muscles. If you think about it, the only signals your brain sends to the outside world consist of making things move. Walking, talking, fighting, running, or singing all take muscles. Sensory nerves go the other direction. They carry signals from the outside toward the central nervous system. They always start in a sensory organ—eyes, ears, nose, tongue or skin. Each of those organs has more than one type of sensory nerves—for instance, the skin can sense pressure, temperature, and pain. The spinal cord is the connection between the central nervous system and the peripheral. It is technically part of the CNS, but it is how most of the motor and sensory nerves get to the brain. Inside the spinal cord are some of those inter-neurons mentioned above. In the brain, inter-neurons are like the microscopic switches in a computer chip, helping to make calculations and do the heavy thinking. In the spinal cord, inter-neurons have a different function. Here they act like a planned short circuit, letting us react to some things faster than we could if the signal had to travel all the way to the brain and back. Inter-neurons in the spinal cord are responsible for reflexes—the reason you jerk back when you touch a hot pan before you even realize what happened. Nerves carry messages via signals called impulses. Like a computer the signal is binary; it's either on or off. A single nerve cell can't send a weaker signal or a stronger signal. It can change frequency—ten impulses per second, for example, or thirty—but each impulse is exactly the same. Impulses travel along a nerve in exactly the same way as muscle cells contract, through chemistry. Nerve cells use ionized minerals (salts like calcium, potassium, and sodium) to propel the impulse along. I won't get too deep into the physiology, but the body needs a proper balance of all three of these minerals for the process to work correctly. Too much or too little of any of these and neither muscles nor nerves will function properly. Nerve cells can be pretty long, but it still takes several to reach from the tip of your finger to your spinal cord. The cells don't touch each other. Instead, the impulse is chemically sent (transmitted) from one nerve cell to the next using substances known as neurotransmitters. Adding neurotransmitters to the bloodstream can cause nerves to send signals. For example, many of the sympathetic nerve cells mentioned above (the fight-or-flight cells) react to a neurotransmitter called adrenaline, which is released into the bloodstream from the adrenal glands when we get scared, stressed, or startled. If you have a solid grasp of how the nervous system works, it's a small leap to understanding why certain substances or medications affect us the way they do. It's also easier to understand how strokes or concussions affect the brain. The body is a dynamic collection of chemicals constantly interacting. The nervous system is the most basic of those interactions. This is the foundation for understanding physiology as a whole.

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