



GLOSSARY OF TERMS IN SPINAL CORD INJURY RESEARCH

Wise Young, Ph.D., M.D.
W. M. Keck Center for Collaborative Neuroscience
Rutgers University, Piscataway, NJ 08854

June 20, 2002

This is a hyperlinked glossary of terms that are commonly used in spinal cord injury research. You can look up specific words but the glossary is also intended to be read by people who wish to learn the terminology of the field. Words used in the definitions are hyperlinked to definitions of the words. So, a reader can start from any word and then read the glossary by going to hyperlinked words in the definition. This is only the first version of the glossary. I will be updating this glossary over time, adding new words and links over time.

- **Action potentials.** These are the signals that [neurons](#), [axons](#), and muscles conduct, to communicate with other neurons. An action potential occurs when the membrane potential of a neuron or axon depolarizes below threshold. This causes [sodium \(Na\) channels](#) to open, allowing Na ions to enter the cell, causing further depolarization. In myelinated axons, the Na channels are located at the [nodes of Ranvier](#). [Potassium \(K\) channels](#) are located on axons underneath the myelin between the nodes. Both the Na and K channels are sensitive to [membrane potential](#). An action potential occurs when the Na channels open, causing the membrane potential to approach the Na [Nernst potential](#) +15 mV and this opens up K channels that bring the membrane potential back towards the K [Nernst potential](#) of -90 mV. The Na current depolarizes adjacent parts of the cell or, in the case of [myelinated axons](#), the next node of Ranvier. Depolarization of the next node activates an action potential that then activate the next node, etc. This process is called saltatory conduction, allowing rapid axonal conduction of signals.
- **Ambulation.** The act of walking.
- **Anterior Tibialis.** This is the muscle that flexes the ankles. Located at the front of the leg between the knee and the ankle, this muscle is what lifts the foot up during the swing phase and prevents foot drop. Its antagonist muscle is the [gastrocnemius](#).

- **Acute spinal cord injury.** The early stage of spinal cord injury. Some people use to term to refer to a period when there is still continuing damage. This time period is controversial. Some investigators consider the period to be relatively short, i.e. several hours during which treatments can be given to prevent progressive or secondary tissue damage. Other investigators may consider the acute period to extend several weeks, during which there may be Wallerian degeneration of spinal tracts that have been cut off from the cell body. The acute period of spinal cord injury precedes a “subacute” period where presumably the spinal cord injury is undergoing both degeneration and repair.

- **Aorta.** This is the large artery that comes directly from the heart, goes downward along the spinal column, and supplies blood to most of the lower body, including the thoracic and lumbar spinal cord. Occlusion of this artery for periods of 30 minutes or longer can result in ischemic damage to the spinal cord. Sometimes, in severe automobile accidents, the aorta may be damaged and blood can get into the linings of the aorta, causing an aortic aneurism. During surgical repair of the aorta, blood flow to the spinal cord may be interrupted and this may cause paralysis.

- **Artery.** This refers to blood vessels that bring blood to a tissue. The spinal cord receives blood from several arteries. One is the ventral or anterior spinal artery (ASA) which runs along the ventral or anterior midline of the spinal cord. The ASA receives blood supply from arteries that come from the [aorta](#) and enter the spinal canal alongside the [spinal roots](#). These arteries course up or down the cord for short distances before it anastomose to the ASA. The ASA supplies most of the ventral spinal cord and the [gray matter](#). Occlusion of the The other arterial supply comes from the posterior spinal arteries that also enter the spinal cord alongside the spinal roots and anastomose to dorsal arteries that run up and down the dorsal cord. The posterior or dorsal spinal arteries supply the dorsal spinal cord and white matter.

- **Axon.** This is a part of neurons, usually a long tubular process that extends many millimeters or even meters to contact other neurons or cells. The axon usually carries efferent (outgoing) signals to other neurons.

- **Babinsky reflex.** This is a complex [reflexive](#) movement of the toes when the bottom of the feet (near the toes) is scratched from the base of the little toe towards the base of the big toe. Normally, the toes tend to curl downward or not react to such scratching if the person can inhibit movements of the toes. However, in somebody who has had brain damage involving the motor cortex or the spinal cord involving the corticospinal tract, the toes show a “positive Babinsky response” which is a spreading and upward movement of the toes.

- **Blood Brain Barrier.** This barrier interposes between the brain and the rest of the body. Present on [capillaries](#), the blood brain barrier is composed of glial (astrocytic) processes that line the inner surface of endothelial cells that form the capillaries. The glial processes form tight junctions that prevent molecules from entering into the brain or spinal cord. In order to penetrate into the brain or spinal cord, the molecules must pass through the [glial cells](#). These cells regulate movement of molecules and access to

the brain. Many water-soluble drugs, for example, do not pass across the blood brain barrier. However, lipid-soluble drugs that can dissolve in membranes typically can cross the blood brain barrier.

- **Capillaries.** These are the smallest blood vessels of tissues, typically just big enough to carry blood cells, connecting arterioles and venules that in turn respectively come from arteries and veins. Blood cells coursing through the capillaries release oxygen to the cells before passing into the venous system.
- **Catecholamines.** These are a family of [neurotransmitters](#), including epinephrine, norepinephrine, serotonin, and others. These are sympathetic neurotransmitters that tend to increase the activity of smooth muscles.
- **Central Nervous System (CNS).** The CNS refers primarily to the brain and the spinal cord. The boundaries of the CNS are the blood-brain-barrier.
- **Chronic spinal cord injury.** The stage of spinal cord injury where there is no longer continuing damage or recovery. Some people use the word to refer to people who have been injured for a long time. While there is no question that people have “chronic” spinal cord injury after several years, there is no clear consensus on what constitutes the time limit for chronic.
- **Clonus.** This is an abnormal reflex pattern where a deep tendon reflex is hyperexcitable and repeats multiple times. For example, if the foot of somebody with spinal cord injury is grasped and then flexed firmly, the foot undergoes several “beats”, i.e. repeated extension and then flexion. Clonus can be seen on other muscles as well.
- **Compression.** Indentation of tissue, causing a deformation of the tissue. When the indentation is fast enough to cause cell breakage, it is usually called contusion. If the compression is slow (<0.5 m/sec), the main cause of damage is due to ischemia or loss of blood flow. The compression increases tissue pressure and the tissue pressure counters blood pressure, preventing blood flow.
- **Contusion.** A rapid indentation of tissue, causing damage to the tissue by stretching and shearing of cells and cellular processes. [Compression](#) of the cord will not cause primary tissue damage unless the velocity of compression exceeds a [critical velocity](#) of 0.5 meters per second (m/sec). Cells usually can tolerate substantial stretching and shearing as long as it is done slowly. However, at about 0.5 m/sec, cells and cellular processes may break.
- **Critical velocity.** This is the rate of movement at which cells begin to break. [Myelinated axons](#), for example, have a critical velocity of approximately 0.5 meters/second.
- **Deep Tendon Reflex.** This is a muscle reflex that is activated by sudden stretching of the tendon of a muscle. Muscles have stretch receptors that detect the tension of the muscle and these receptors send excitatory signals back to motoneurons that activate

the muscle to contract. This forms a feedback loop so that the muscle contraction is held at a constant level. When the muscle is stretched, the motoneurons fire to contract the muscle so that it opposes the stretch. A deep tendon reflex is usually tested by using a rubber tipped hammer to tap the tendon. This produces a sudden stretch of the muscle and the muscle should respond with a contraction. This reflex is also called the monosynaptic reflex because only one synapse is interposed in the reflex circuit. The monosynaptic reflex can also be activated electrically by stimulating the nerve to the muscle and recorded electrically from the muscle. Nerve stimulation activates a contraction of the muscle (M-reflex) and this is followed by the monosynaptic reflex (H-reflex).

- **DNA.** Deoxyribose Nucleic Acid. This is the chemical that encodes genetic information in living cells. The information is encoded with four nucleic acids (adenosine, thymine, cytosine, guanosine) placed in sequence on alpha helical backbone. The sequences on the DNA are transferred to [messenger RNA](#).
- **Dorsal (Posterior).** This refers to parts of the anatomy that are towards the back of the body. The word dorsal is usually applied to quadruped (four-legged) animals whereas the word “posterior” is usually used for human. Dorsal and posterior have the same meaning. Dorsal is opposite of [ventral](#).
- **Dorsal Column.** The white matter of the spinal cord is organized into columns: two dorsal columns (left and right), [lateral columns](#), and ventral columns. The dorsal columns (also called posterior columns) carry proprioceptive information.
- **Dorsal Horn.** Spinal cord gray matter has four “horns”, two dorsal horns and two [ventral horns](#). Thus, the dorsal horn refers to the gray matter in the spinal cord that is close to the back (posterior) side of the cord. The dorsal horn contains mostly sensory neurons that receive inputs for [sensory afferents](#) that come into the spinal cord through the dorsal roots.
- **Dorsal Root.** Each segment of the spinal cord has four roots, two dorsal roots and two ventral roots. The ventral roots contain the axons of motoneurons that go out to innervate muscle.
- **Dorsal Root Ganglia.** These are collections of neurons that are attached to spinal roots just outside the spinal canal. These ganglia contain the cell bodies of dorsal root sensory neurons that send one axon that splits into a peripheral and a central branch. The peripheral branch goes to receptor structures in skin, muscle, joints, and other tissues. The central branch enters the spinal cord through the dorsal root, branches to connect with neurons in the segment and send axons up and down the spinal cord in the dorsal columns. One branch of the axon ascends to the brainstem where it makes synapses with the neurons in the nucleus cuneatus or nucleus gracilis.
- **Extensors.** These refer to muscles that extend the limbs, particularly the legs. Leg extensor muscles include the [gluteus maximus](#), [quadriceps](#), and [gastrocnemius](#). They

are responsible for supporting the weight of the body against gravity and oppose the action of flexor muscles.

- **Flexors.** These refer to muscles that flex the limbs. Leg flexor muscles include the [psoas](#), the [hamstrings](#), and the [anterior tibialis](#).
- **Gastrocnemius.** This is the muscle that extends the ankles. Located at the back of the leg between the knee and the ankle, this muscle is what allows people to stand on tip toes and provides the foot thrust for forward locomotion. Its antagonist muscle is the [anterior tibialis](#).
- **Glia.** These are cells that were originally called glia because they were thought to be “glue” of the nervous system. Several families of glial cells have been identified and perform many functions. Astrocytes regulate the extracellular environment of the brain and spinal cord, including forming the [blood brain barrier](#). [Oligodendroglia](#) provide myelin. Microglia serve as the immune and inflammatory cells of central nervous tissues. Macroglia include cells like olfactory ensheathing glia and tanicytes and they are able to migrate, facilitate regeneration, and ensheath axons.
- **Gluteus Maximus.** This is a large muscle in the buttock that is responsible for extending the leg backward at the hip joint. It is used during locomotion for forward propulsion. It opposes the action of the psoas which brings the leg forward and flexes the hip joint.
- **Gray Matter.** This refers to areas of the brain and spinal cord that contain mostly neuronal cell bodies. It is called gray matter because these areas appear dusky gray when examined in dead bodies. The name is used in conjunction with white matter which refers to areas of the brain and spinal cord that contain mostly myelinated axons. In the spinal cord, the gray matter is situated in the central part of the cord. When the spinal cord is viewed in cross-section, the gray matter appears to be butterfly-shaped area. The wings of the butterfly that are towards the back (dorsal or posterior) are called the [dorsal horns](#). The wings that are towards the front (ventral or anterior) are called the ventral horns.
- **Hamstrings.** This the the muscle that flexes the knee and opposes the quadriceps.
- **Lateral Columns.** These are white matter columns in the spinal cord, situated on the two sides of the spinal cord. The lateral columns carry both sensory and motor information, including the [spinothalamic tract](#), the spinocerebellar tract, the corticospinal tract, the rubrospinal tract, and others.
- **Learned Non-Use.** Edward Taub first proposed this phenomenon from experiments involving the cutting of dorsal roots in monkeys and finding that the monkeys stopped using the arm that had lost sensation. These monkeys become virtually paralyzed even though the ventral motor roots remained intact. However, when these monkeys are forced to use their arms by constraining the movement of the good arm, they frequently recovered motor control in the denervated arm. He called

this phenomenon “learned non-use”. More recently, Taub and colleagues have reported that constraint-induced movement therapy can restore function in people with hemiplegic strokes.

- **Locomotion.** The act of moving from place to place. Locomotion usually refers to walking or running. Overground locomotion means walking or running on a static surface (non-moving surface). Locomotion can also be tested and performed on moving surfaces, such as treadmills. Usually, performance of locomotion is assessed and graded by the speed, duration (endurance), and metabolic energy utilized by the locomotor activity.

- **Membrane Potential.** Cells are bags of fluids. The insides of cells or cytoplasm contain high concentrations of potassium (K) ions and low concentrations of sodium (Na) ions. Extracellular fluids contain high Na and low K concentrations. Membrane potentials depend on Na and K concentration gradients across the membrane, as well as permeability of the cell membrane to these ions. If the membrane were completely permeable to K, the high K concentrations inside cells (115 mM) and low concentration outside of cells will produce an electrochemical gradient of approximately -90 mV. If the membrane were completely permeable to Na, the low Na concentrations inside cells (25 mM) compared to high extracellular Na concentrations (145 mM) will produce an electrochemical gradient of approximately $+15$ mV. In resting neurons, the Na and K permeability of membranes are such that the resting potential of the cell is about -60 mV. When Na channels open, the membrane potential depolarizes towards $+15$ mV but when K channels open, the membrane potential hyperpolarizes towards -90 mV.

- **Motoneuron.** Sometimes also called motor neurons, these neurons send axons peripherally to innervate muscles. Located in the [ventral horn](#) of the spinal cord, spinal motoneurons release the neurotransmitter acetylcholine to activate striated muscles. They receive afferent signals directly from sensory axons carrying information from muscle [stretch receptors](#).

- **Motor Recovery.** Recovery of voluntary movement. While there may not seem to be any ambiguity or difficulty with this definition, many people have asked whether spasms represent motor recovery.

- **Muscle.** These are cells that can contract and relax. Muscle cells are unusual cells. While most cells contain a single nucleus, muscle cells contain hundreds or even thousands of nuclei. Muscle fibers or myofibers are single cells with multiple nuclei. There are two kinds of muscles: [smooth muscles](#) and [striated muscles](#).

- **Myelin.** Myelin is a membrane produced by Schwann cells or oligodendroglial cells. Myelin wraps many times around the axons. Schwann cells myelinate peripheral axons while oligodendroglial cells myelinate central axons. One Schwann cell myelinates only one axon while one oligodendroglial cell may myelinate as many as 21 axons. Each of these cells myelinate only a segment of the axon. Between the myelin segments, there are areas of no myelination called [Nodes of Ranvier](#).

- **Myelinated Axon.** Axons are often ensheathed by [myelin](#). Myelinated axons are paradoxically more sensitive to stretching because the myelin prevents parts of the axon from stretching and therefore concentrates the stretch in axons between the myelin segments, i.e. the [Nodes of Ranvier](#).
- **Nernst Potential.** Ionic gradients produce electrical potentials. The electrical potential is due to the separation of electrical (ionic) charges of the ions. This potential is described by the Nernst equation $V = RT \log (C_o/C_i)$ where RT is the product of the Universal Gas Constant and temperature, C_o is the external concentration, and C_i is the internal concentration of a given ion. For example, a K ionic gradient of 124 mM on the inside of cells and 4 mM on the outside of cells will produce a electrical potential of about -90 mV while a Na ionic gradient of 25 mM inside cells and 145 mM outside cells produces an electrical potential of $+15$ mV. The expression of the potential depends on the permeability of the membrane to the ion. Normally, neurons are partially permeable to K but not as permeable to Na. Thus, neurons typically have a resting membrane potential of about -60 mV.
- **Neuron.** A neuron is a cell that communicate with other neurons, muscle cells, secretory cells, or sensory cells by means of action potentials or neurotransmitters. Most neurons express several proteins that are unique to neurons, including neurofilaments, neuron-specific enolase, and beta-tubulin.
- **Neurotransmitters.** These are chemicals that neurons release into the extracellular space to affect other cells. Neurotransmitters bind to [receptors](#) on other cells, e.g. [neurons](#) and [muscles](#); the receptors then open channels and turn on intracellular messengers that then tell the cells what to do. Common neurotransmitters include glutamate, acetylcholine, gamma-amino-butyric-acid (GABA), glycine, serotonin, norepinephrine, dopamine, substance P, and others. Much of the drugs that people take are designed to stimulate or inhibit neurotransmitter receptors, or alter the levels of neurotransmitters in the brain.
- **Nociceptive.** This adjective refers to sensations that are painful, as well as thermal (hot, cold), sensations. When a person loses nociception, this means that the person cannot sense pain (pinprick), heat, or cold. Nociceptive sensations differ from [proprioceptive](#) sensations that represent touch and position sense. In the spinal cord, axons in the spinothalamic tract in the [lateral columns](#) carry nociceptive information.
- **Nodes of Ranvier.** These are areas on axons between [myelin](#) segments. The nodes contain voltage-sensitive sodium (Na) channels that generate [action potentials](#).
- **Nucleus.** Mammalian cells contain nuclei that hold the [DNA](#) encoding the genetic information of the cell. Mammalian cells are eukaryotic cells. Unlike bacteria or other prokaryote cells, eukaryote cells have nuclei. The membrane that surrounds the nucleus, or nuclear membrane, controls the movement of nuclear transcriptional factors that can get into the nucleus.

- **Oligodendroglia.** These are specialized cells in the central nervous system that [myelinate central axons](#). A typical oligodendroglial cells may myelinate as many as 21 axons surrounding it.
- **Post-mortem.** After death. This word is usually used in conjunction to the body after death.
- **Potassium channels.** These are channels on cell membranes that allow potassium (K) to pass out of the cell. Intracellular K concentrations are normally much higher (124 mM) than extracellular K concentration (4 mM). Therefore, when these channels open, K ions move out of the cell. More important, opening of the channel will bring the membrane potential close to -90 mV, the Nernst potential due to the electrochemical gradient of K across the membrane.
- **Psoas.** This is the muscle that flexes the hip (forward), opposing the action of the gluteus maximus.
- **Primary Tissue Damage.** Cellular damage that are directly attributable to the cause of the injury is called “primary tissue damage”. In the case of a [contusion](#) injury, the primary injury is due to mechanical stretching and shearing of cellular elements. In the case of [compression](#) injury, the primary injury is due to the loss of blood flow that causes cell damage. In the case of a cut or a penetrating wound, the primary injury is due to the severance or crushing of axons and cells. Primary tissue damage initiates [secondary tissue damage](#).
- **Proprioceptive.** This adjective refers to sensations that indicate position. It also includes the ability to detect and localize touch sensation on the skin. When a person loses proprioception, this means that the person cannot tell light touch and joint position. Proprioceptive sensations differ from [nociceptive](#) sensations which are painful. In the spinal cord, axons in the dorsal (posterior) columns carry proprioceptive information.
- **Quadriceps.** This is the large muscle in the front of the leg that is responsible for extending the knee joint. It opposes the action of the hamstrings which flex the knee.
- **Receptors.** These are chemicals that are present on cell membranes or in their cytoplasm, designed to bind and react to specific molecules. Receptors respond to neurotransmitters, hormones, cell adhesion molecules, ions (such as calcium) and metabolic conditions of cells.
- **Reflex.** This refers to activity of cells that are not necessarily under conscious control. For example, a deep tendon reflex is a movement of muscle that can be evoked by stretching the muscle, mediated by neurons that are situated in the spinal cord and the dorsal root ganglia. Although the brain can inhibit or suppress of deep tendon reflex, the reflex can occur in the absence of supraspinal influence. Some reflexes are only under partial conscious control. For example, micturation (the act of passing urine) is a reflex that is mediated by neurons situated in the spinal cord and can occur in

the absence of supraspinal influences. Once started, it may be difficult for a person control micturation. Some reflexes can be activated by supraspinal events. For example, sweating of the palms is produced by nervous activity but most people cannot readily control such sweating. Some reflexes are not under conscious control. For example, the contractile response of the pupil of the eye to light is a reflex that is mediated by neurons that are situated in the brainstem and superior cervical ganglia.

- **RNA.** Ribonucleic Acid. This is the chemical that carries the genetic message from [DNA](#) into the cytoplasm and participates in the formation of proteins. The RNA that carries the DNA sequence is called messenger RNA (mRNA). The mRNA is translated into protein by transfer RNA (tRNA) which bind to specific amino acids and attach them together in the sequence specified by the mRNA. In addition, structures called ribosomes participate in the translation of the mRNA sequence into protein and the ribosomes themselves contain RNA called ribosomal RNA. Measurement of mRNA species provide an indication of gene expression. The process of transcribing genetic information from DNA to mRNA is called transcription and the process of translating mRNA to protein is called translation. Gene expression is regulated at multiple levels: transcription, RNA stability, and translation. Transcription is controlled by nuclear factors, such as NF-kappa B which is the main factor controlled by steroid receptors. RNA stability depends on enzymes called ribonucleases (Rnase). Translation is controlled by ribosomes and tRNA, as well as energy available for protein synthesis.

- **Saltatory Conduction.** Action potentials conduct in myelinated axons by jumping from node to [node of Ranvier](#). Large axons are myelinated while smaller axons are typically not myelinated by oligodendroglial cells. Saltatory conduction greatly increases the speed of signal conduction. In large sensory axons of the dorsal column, for example, saltatory conduction allows transmission of signals at speeds exceeding 100 meters/second.

- **Secondary Tissue Damage.** The injured spinal cord shows progressive tissue damage over several hours or days after injury, depending on the severity of the injury.

- **Sensory Afferents.** The term afferent refers to input or incoming signals. Sensory afferent means incoming axons that carry sensory signals.

- **Smooth Muscles.** These are the muscles used by blood vessels, heart, bladder, intestines, and other internal organs. These muscles are not [striated](#) and hence the descriptive word “smooth”. These muscles are excited by [catecholamines](#) released by the sympathetic nervous system and inhibited by acetylcholine released by the parasympathetic nervous system. The acetylcholine receptors of smooth muscles, however, differ from those of striated muscles and are called nicotinic receptors. Sympathetic innervation comes from the sympathetic ganglia that are situated alongside the vertebral column. Parasympathetic innervation comes from the vagal nerve and also from the spinal cord.

- **Sodium Channels.** These are channels that are present on excitable cells and that allow Na ions to pass through. Although there are some receptors that allow Na ions to

pass through as well, the term “sodium channel” is almost always reserved for voltage-sensitive channels that open only when the membrane potential falls below a certain level. Na channels mediate [action potential](#) conduction in neurons, axons, muscles, heart, and other excitable tissues.

- **Spasms.** Involuntary organized movements, often involving multiple muscles. Spasms may be involuntary or voluntarily. Involuntary spasms are ones that either occur spontaneously or in response to sensory input below in the injury site. Voluntary spasms are mass movements that can be induced by the person and are indicative of some supraspinal influence on the spinal cord. Spasms may be associated with [spasticity](#).
- **Spasticity.** Increased reflexes or muscle tone. Spasticity is usually assessed clinically by the Ashworth scale which scores the stiffness and rigidity of muscles in response to movement. [Deep tendon reflexes](#) are often exaggerated or may go into repetitive oscillations called [clonus](#). Complex multi-muscle reflexes such as the [Babinsky reflex](#) may appear.
- **Spinal roots.** Every segment of the spinal cord has associated spinal roots that enter and exit the spinal cord in the [dorsal](#) and [ventral](#) side. The dorsal and ventral roots join together as they approach the dura mater and become a single root outside of the spinal canal. The [dorsal spinal root](#) is associated with a dorsal root ganglion which contains the cell bodies of the sensory neurons that send axons into the peripheral nerve and into the spinal cord. The [ventral spinal root](#) contains motor axons that go from the spinal cord to muscles.
- **Spinothalamic Tract.** This spinal tract goes from the spinal cord to the thalamus. The spinothalamic neurons are situated in the [dorsal gray horn](#) and send axons that cross over to the opposite [lateral column](#) (i.e. neurons in the left dorsal horn send axons to the right lateral column and vice versa), ascend in the lateral column all the way to the [thalamus](#).
- **Stretch Receptors.** These are receptors in [striated muscles](#) that sense muscle stretch. The receptors are specialized muscle fibers called spindles. [Dorsal root ganglion neurons](#) send axons that innervate these spindles. Stretching of the spindle activates the axons to send messages to the spinal cord.
- **Striated Muscles.** These are the muscles that are able to contract rapidly and are responsible for moving they body. They differ from [smooth muscles](#) which contract and relax blood vessels and internal organs. They have visible bands that can be seen under the microscope and hence the descriptive adjective striated.
- **Stroke.** This generally refers to damage to the brain resulting from ischemia. Occasionally, the term spinal cord stroke is also used.
- **Thalamus.** This brain structure is located in the center of the brain. It receives sensory information from the body and from other sensory organs. For example,

thalamic neurons receive sensory information from the [spinothalamic tract](#), the dorsal column nuclei, the brainstem nuclei, and other central nervous system structures. They relay the sensory information to the cerebral cortex.

- **Tight junctions.** These are places where cells contact each other and form an tight adhesive connection that prevents passage of large molecules between the cells. The blood brain barrier, for example, is composed on [glial cells](#) that form tight junctions to each other. Tight junctions force molecules to go through the cells where the transport mechanisms can be better controlled.

- **Ventral** (Anterior). This refers to parts of the anatomy that are towards the front of the body. The word “ventral” is usually applied to quadriped (four-legged) animals whereas the word “anterior” (meaning front) is usually used for humans. Ventral is opposite of [dorsal](#).

- **Ventral Column.** The white matter of the spinal cord is organized into columns: two [dorsal columns](#) (left and right), [lateral columns](#), and ventral columns. The ventral columns (also called anterior columns) carry [vestibulospinal](#) and reticulospinal tracts.

- **Ventral Horn.** Spinal cord gray matter has four “horns”, two dorsal horns and two ventral horns. Thus, the ventral horn refers to the gray matter in the spinal cord that is close to the front (anterior) side of the cord. The ventral horn contains mostly motor neurons that send their axons out the [ventral roots](#) to innervate muscle.

- **Ventral Root.** Each segment of the spinal cord has four roots, two [dorsal roots](#) and two ventral roots. The ventral roots contain the axons of motoneurons that go out to innervate muscle.

- **Vestibulospinal Tract.** The vestibulospinal tract goes from neurons in the vestibular nucleus to the spinal cord. The vestibular nucleus is situated in the brainstem, receives information from the vestibular organs in the ear, and is responsible for detecting the position and acceleration of the head. It is a crucial for balance and posture. The vestibulospinal tract innervate mostly extensor motoneurons responsible to maintaining anti-gravity muscle activities.

- **Weight-supported ambulation.** This refers to suspending people or animals in a harness and placing them to walk on a treadmill. A variety of techniques may be used to facilitate walking, including manual manipulation and electrical stimulation of muscle, nerve, or spinal cord. Weight-supported ambulation on treadmill has been reported by many groups now to be able to improve or restore [overground locomotion](#) in people with chronic spinal cord injury.

- **White Matter.** The areas of the brain and spinal cord that contain mostly [myelinated axons](#). It is called “white matter” because of the appearance of these areas of the brain and spinal cord [post-mortem](#). Myelin is composed of mostly fat and therefore is whitish in color. In the spinal cord, the white matter surrounds [gray matter](#) and is organized into columns, named according to their location: dorsal (posterior), ventral

(anterior), and lateral. The dorsal columns contain most ascending [proprioceptive](#) sensory axons.