CNS

Slide 1: CNS

Slide 2

Nervous system and Endocrine system both maintain homeostasis in the body. Nervous system by nerve impulse and Endocrine system by hormones. Since the nerve impulse is an electrical current, it moves much faster than the hormones which is distributed by blood.

Slide 3

You can follow the path of the neural signal. The sensory neurons detect a stimulus in your finger and send that information to the CNS. The interneurons determine that you finger needs to move and send an appropriate response to the motor neuron. The motor neuron then send the message to the muscle that will move your finger.

Slide 4

The two branches of nervous system are Peripheral and Central nervous system. Central nervous system includes brain and spinal cord. Peripheral nervous system governs rest of the body. It is divided into two functional division: Sensory and motor. Sensory carries sensation *to* the central nervous system (brain and spinal cord), and motor division carries information *from* the brain and spinal cord to the rest of the body.

PNS also includes Cranial nerves and spinal nerves.

Both motor and sensory division is further subdivided into Somatic and Visceral divisions. Somatic motor division carries information to skeletal muscles. It controls voluntary movements.

Visceral motor division is also called Autonomic Nervous system. This is responsible for carrying information to smooth muscles, cardiac muscles and glands. This system is autonomous. Your heart is beating, but you do not control the beating of the heart. Visceral motor division or Autonomic Nervous system is divided in to Sympathetic and Parasympathetic. Sympathetic nervous system works mainly during stress producing “Fight or flight“ response. Parasympathetic nervous system, on the other hand, maintains regular function of our body regulating resting and digesting functions.

The big questions to determine which system you are talking about is to ask “Do I or don’t I have control?”

Most tissues receive nerve fibers from both systems.

Slide 5: Spinal Cord Functions

Functions of the spinal cord include: conduction, locomotion, and reflexes
The spinal cord contains bundles of nerve fibers called tracts that carry information up or down the cord, this function is referred to as **conduction**. The spinal cord contains groups of neurons that control output to the flexor and extensor muscles that allow for alternating movements of the limbs. For example, when walking the brain may initiate the action, but then the spinal cord takes over continuation of that action. This function is referred to as **locomotion**. The spinal cord also plays an important role in regulating automatic involuntary responses for posture, movement and protection. This function is referred to as **reflexes**.

Slide 6: Spinal Cord Structure

The spinal cord is divided into four **regions**: cervical, thoracic, lumbar, and sacral.

Within the spinal cord there are 2 **enlargements**: The cervical enlargement (C5-C7), contains the start of the nerve branches that go to the upper limbs (arms). The lumbar enlargement (L1-L2), is the start of nerve branches that go to lower limbs (pelvis and legs).

It also has an area called the **cauda equina**. The cauda equina appears like a horses tail, hence its name. This is a bundle of spinal nerves that arise from the medullary cone and innervates the lower limbs (pelvis and legs). The cauda equine contains lumber nerves 2-5, all of the sacral nerves and the coccygeal nerves.

The spinal cord gives rise to 31 pairs of spinal nerves.

Slide 7: Spinal Cord Structure (image)

Here is the diagram of the spinal cord.

Notice that the spinal cord is continuous with the brain stem. It starts at an opening in the occipital bone called the foramen magnum and ends at a tapered region near the first lumbar vertebra called the **medullary cone**. The spinal cord is housed within the vertebral foramina.

Notice the regions, enlargements, and cauda equina

Slide 8: Spinal Cord Anatomy

Surrounding the spinal cord are the **meninges**. The meninges are protective fibrous coverings that cover the brain and spinal cord. It consists of three layers: dura mater, arachnoid mater, and pia mater. The **dura mater** is the outer later, contains collagen and provides physical protection for the brain and spinal cord. The **arachnoid mater** is the middle layer, consists of loosely organized collagen and elastin fibers. This middle layer contains the subarachnoid space which are gaps between the arachnoid mater and pia mater. This space contains cerebrospinal fluid

(CSF). The pia mater is the inner layer. It is delicate and contains a highly vascular membrane that directly comes into contact with the surface of the CNS.

The spinal cord consists of two primary types of nervous tissue: white and gray matter. The gray matter (forms the H butterfly shape) is the central tissue of the spinal cord consisting of unmyelinated tissue. This area contains the synapses of the spinal cord such as the somas, dendrites, and distal ends of axons. The gray matter surrounds the central canal, a hollow tube that runs the length of the spinal cord and contains CSF. The white matter is the outer tissue of the spinal cord consisting of myelinated bundles of axons called tracts. These tracts carry sensory and motor information. There are ascending tracts that carry sensory information from the peripheral tissues to the brain and descending tracts that carry motor information from the brain down to the effectors such as muscles or glands.

Slide 9: Spinal Nerve

Spinal nerves are bundles of myelinated axons that arise from the spinal cord. All spinal nerves are mixed nerves, meaning they contain sensory and motor axons. Each nerve is connected to the spinal cord by two roots: the anterior root and the posterior root. The anterior root contains motor axons and the posterior root contains sensory axons. The posterior root also has an area outside of the CNS where there are clusters of somas called the posterior root ganglion.
There are 31 pairs of spinal nerves: 8 cervical nerves that branch out through C1-C8, 12 thoracic nerves that branch out through T1-T12, 5 lumbar nerves that branch out through L1-L5, 5 sacral nerves that branch out through S1-S5. and 1 coccygeal nerve.

Slide 10: Brain

The brain is a very complex structure. Similar to the spinal cord, it is protected and surrounded by the meninges.

The brain contains four internal chambers called the ventricles. The ventricles are the major site of CSF production. CSF is a clear fluid that is derived from plasma and can be found in the ventricles, central canal of the spinal cord, and the subarachnoid space of the meninges. CSF functions in: providing buoyancy so the brain can stay suspended inside the skull otherwise it would sink to the base of the skull and result in nervous tissue damage; protects the brain from bumping into the skull; and provides chemical stability by removing certain wastes from the CNS.

Slide 11: Regions

The brain is divided into four main regions: brain stem, cerebellum, diencephalon, and cerebrum.

Slide 12: Brain Stem

The brain stem is the lowest portion of the brain and is continuous with the spinal cord. It contains three major areas: the mid-brain, pons, and medulla oblongata.

The midbrain functions as a relay station between higher brain centers and the brainstem. The pons contains nuclei (groups of neurons in the brain with specific function) that aid with respiration, sleep, and posture. The medulla oblongata contains several nuclei which include the cardiac center (regulate heart rate), vasomotor center (regulates blood pressure), and the respiratory center (regulates breathing rates).

Slide 13: Diencephalon

The diencephalon contains two primary areas: the thalamus and hypothalamus.
The thalamus directs sensory impulses to the appropriate region in the cerebrum. The hypothalamus is the link between the nervous system and endocrine system in that it controls the pituitary gland. It also contains several nuclei responsible for maintaining homeostatic functions such as thermoregulation, hunger and thirst, and sleep cycles.

Slide 14: Cerebrum

The cerebrum is the largest and most complex portion of brain. The brain has landmarks that are significant in studying its function. The landmarks include: **gyri** (the ridges or folds of the cerebrum), **sulci** (the valleys or shallower grooves such as the lateral sulcus which you will be learning in lab) and **fissures** (deep grooves in the cerebrum such as the longitudinal fissure is a fissure that separates the right and left hemispheres of the cerebrum.)

The cerebrum is divided into hemispheres along the longitudinal fissure. The hemispheres are connected by a large bundle of myelinated axons called **corpus callosum**. The corpus callosum allows the hemispheres to communicate. Interestingly, the corpus callosum is larger in females than males and allows more access to emotions.

The cerebrum contains the cerebral cortex. This is a thin layer of densely-packed gray matter on surface of cerebral lobes.

Slide 15: Cerebral Lobes

The cerebrum is divided into five lobes: frontal, parietal, occipital, temporal, and insula. The **frontal lobe** controls voluntary motor functions such as skeletal muscle control and higher-level cognition. The **parietal lobe** is primary responsible for receiving and interpreting signals of the general senses. The **occipital lobe** is the principle visual center. The **temporal lobe** processes hearing and smell. The **insula** functions in understanding spoken language and taste.

Slide 16: Label the lobes of the cerebrum

Slide 17: Cerebellum
The cerebellum plays a major role in coordination of skeletal muscle functions such as balance, posture, complex movements, and speech

Slide 18: Label the parts of the brain