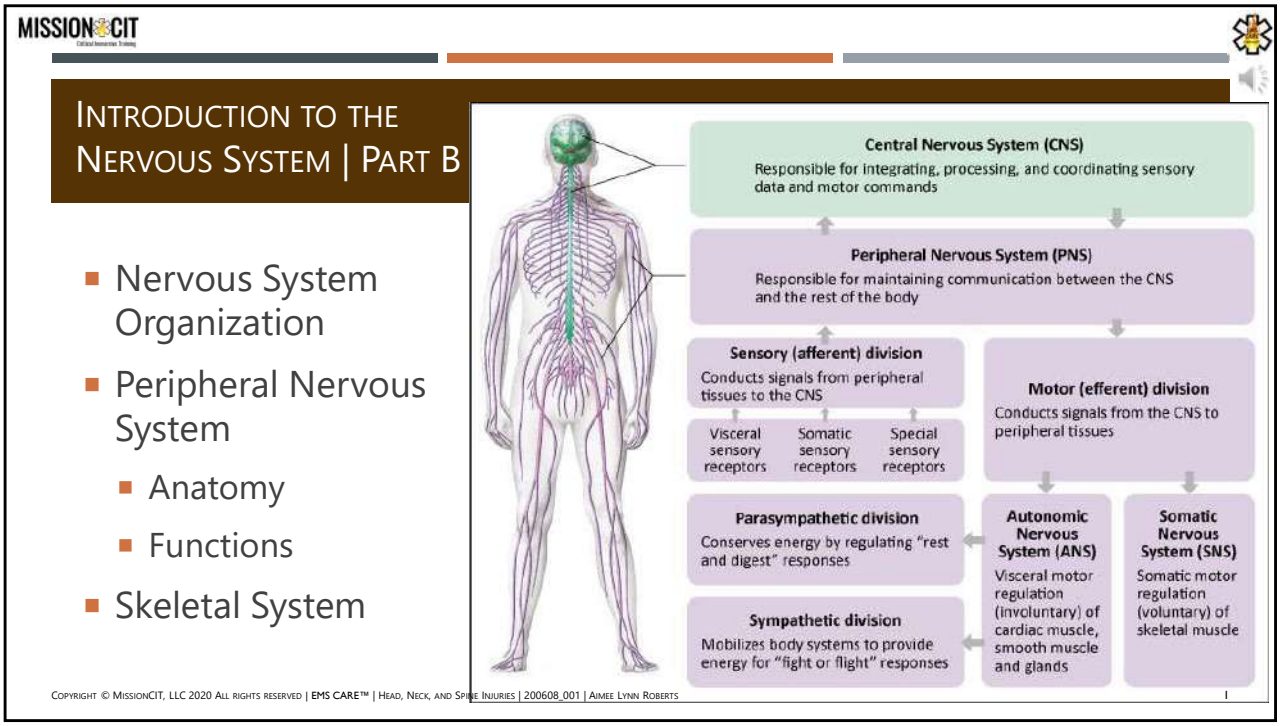


Welcome back. In part b of this lesson, we look at the Nervous System Organization, Peripheral Nervous system and the skeletal system. Let's continue with the functional organization of the Nervous System.

The central nervous system (CNS), as we covered in Part A of this lesson consists of the controlling processes associated with the brain and the spinal cord.

The peripheral nervous system refers to the parts of the nervous system that are outside the central nervous

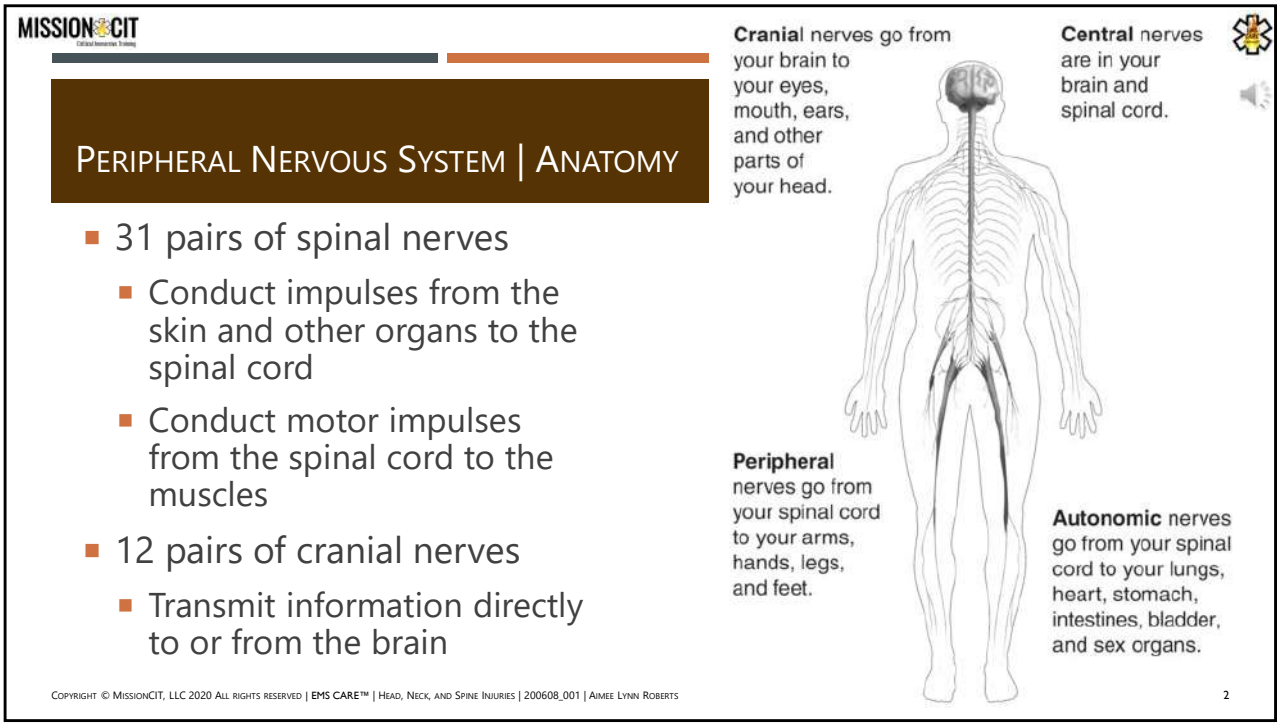
system, that is, those outside the brain and spinal cord. These nerves form the communication network between the CNS and the body parts.

The peripheral nervous system is broken into the motor and sensory neurons.

The motor neurons are further divided into the Somatic and Autonomic nervous systems.

And finally, the Autonomic Nervous system is further divided into two parts, the Sympathetic and Parasympathetic divisions.

We next discuss the Peripheral Nervous System Anatomy and Functions.



The anatomy of the Peripheral Nervous System includes 31 pairs of spinal nerves. They conduct impulses from the skin and other organs to the spinal cord, as well as motor impulses from the spinal cord to the muscles. In addition, there are 12 pairs of cranial nerves that Transmit information directly to or from the brain.

Thus, the peripheral nervous system anatomy includes

- Cranial Nerves that connect the head, face, eyes, nose, muscles, and ears to the brain. These refer to

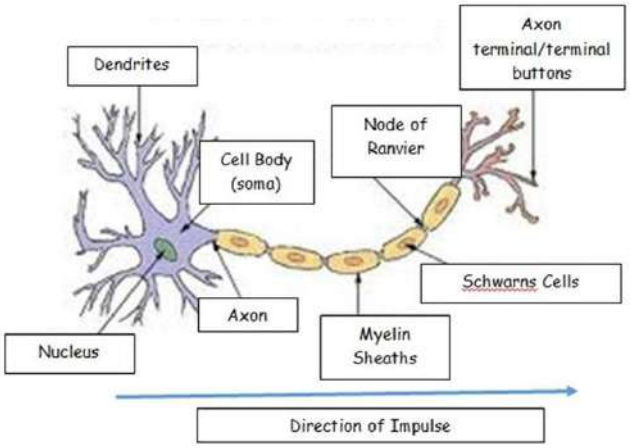
the Sensory Neurons in the chart.

- Peripheral Nerves that connect the spinal cord to the rest of the body, including the 31 pairs of spinal nerves. These are part of the Somatic Nervous System.
- Autonomic nerves going from the spinal cord to the lungs, heart, stomach, intestines, bladder, and sex organs.
- Central or Connecting Nerves are found only in the brain and spinal cord. They connect the sensory and motor nerves with the short fibers in the CNS.

Note that the anatomy and functionality overlap, which we describe further over the next slides.

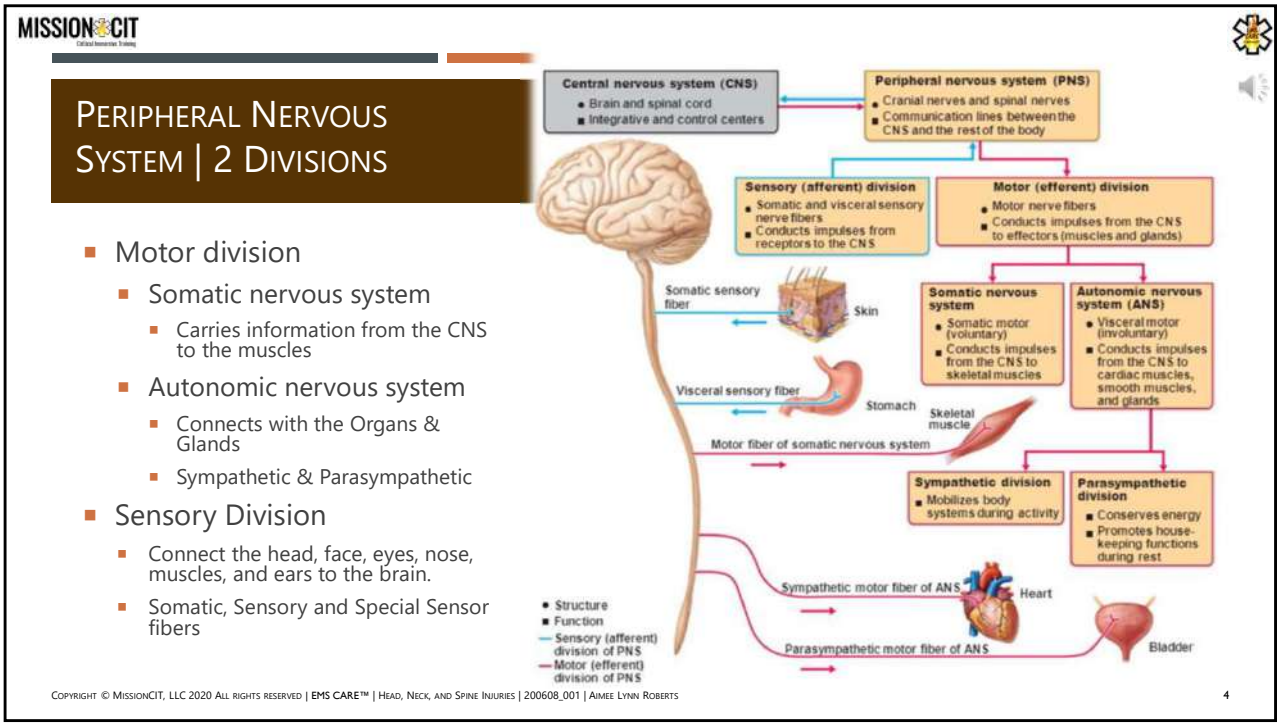
Typical Structure of a Nerve Cell

- Large Cell Body (neuron)
- Nerve Fibers
- Elongated extension – sending impulses (axon)
- Many branches – receiving impulses (dendrites)
- Membranes – like insulation (myelin)



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A nerve cell (neuron) consists of a large cell body and nerve fibers—one elongated extension (axon) for sending impulses and usually many branches (dendrites) for receiving impulses.
Each large axon is surrounded by oligodendrocytes in the brain and spinal cord and by Schwann cells in the peripheral nervous system. The membranes of these cells consist of a fat (lipoprotein) called myelin. The membranes are wrapped tightly around the axon, forming a multilayered sheath. This myelin sheath resembles insulation, such as that around an electrical wire. Nerve impulses travel much faster in nerves with a myelin sheath than in those without one.
If the myelin sheath of a nerve is damaged, nerve transmission slows or stops. The myelin sheath may be damaged by various conditions that damage the brain or peripheral nerves including
•Multiple sclerosis
•Certain types of strokes
•Certain autoimmune disorders (such as Guillain-Barré syndrome)



Now that we have a basic understanding of the Nervous System Anatomy, lets get back to the functions.

The peripheral nervous system is broken into the motor and sensory divisions. The motor division is further divided into the Somatic and Autonomic nervous systems. And finally, the Autonomic Nervous system is further divided into two parts, the Sympathetic and Parasympathetic divisions.

The sensory or afferent division connects the head, face,

eyes, nose, muscles, and ears to the brain. It carries information about body position, light, touch, temperature, and pain to the brain.

It has 3 types of nerve fibers

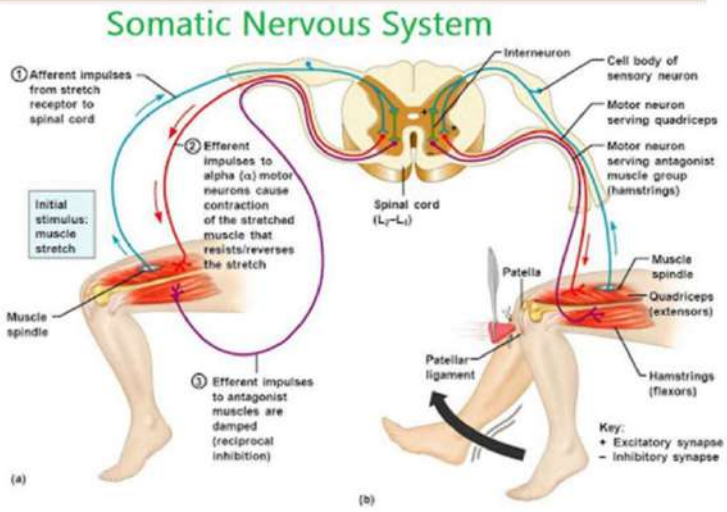
1. Visceral which are the involuntary sensors
2. Somatic, which enables voluntary movements, and
3. Special receptors, as an example, photo-receptor cells in the eye

Please note that the Visceral or Autonomic and Somatic nerve fibers in the Sensory Division have similar functions as in the Motor Division, which we cover next. The functionality will apply to both the Motor and the Sensory systems.

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Peripheral Nervous System | Somatic Nervous System

- Carries information from the CNS to the muscles
- Voluntary Nervous System
- Both Sensory & Motor Nerves
- Regulates body movements
- Reflex Arc



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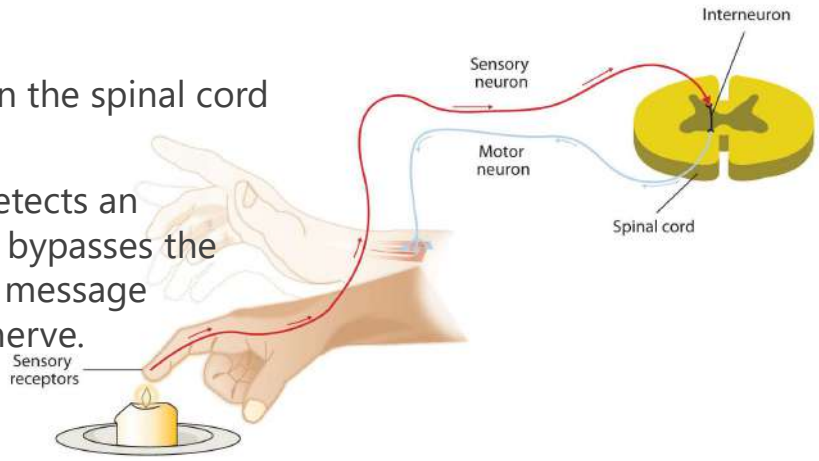
The somatic nervous system (SNS) is also known as the voluntary nervous system. This system controls all the things that we are aware of and can consciously influence, such as moving our arms, legs and other parts of the body.

The somatic nervous system consists of both afferent (sensory) and efferent (motor) nerves. In addition to regulating the voluntary movements of the body, the somatic nervous system is also responsible for a specific type of involuntary muscle response known as reflexes,

controlled by a neural pathway known as the reflex arc.

Somatic Nervous System | Reflex Arc

- Connecting nerves in the spinal cord form a reflex arc.
- If a sensory nerve detects an irritating stimulus, it bypasses the brain and sends the message directly to a motor nerve.



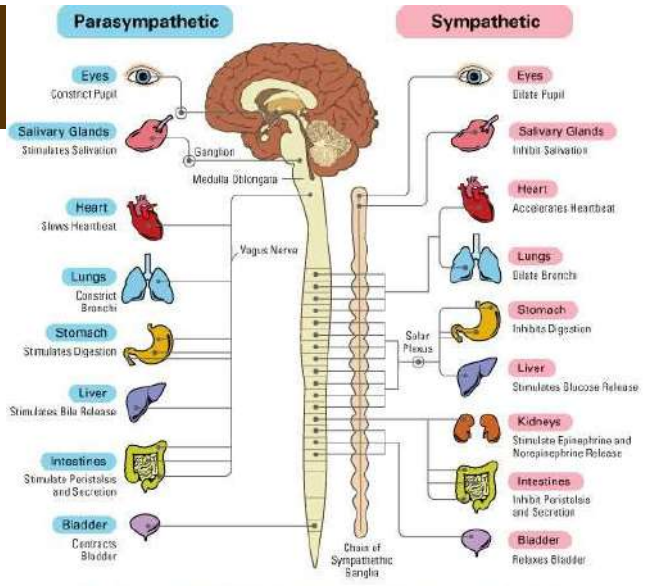
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A reflex arc includes a sensory neuron that sends a signal straight to the spinal cord, while bypassing the brain. This then generates a response such as a quick muscle contraction, so fast that it's subconscious. One common example is the knee reflex. When hitting the patellar tendon just below the kneecap with a reflex hammer, leads to an automatic contraction of the quadriceps – which results in the lower leg kicking out.

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AUTONOMIC NERVOUS SYSTEM

- Autonomic (involuntary) nervous system handles body functions
  - Sympathetic nervous system reacts to stress with a fight-or-flight response.
  - Parasympathetic nervous system has the opposite effect on the body.



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The Autonomic, or involuntary nervous system regulates the processes in the body that we cannot consciously influence. It is constantly active, regulating things such as breathing, heartbeat and metabolic processes.

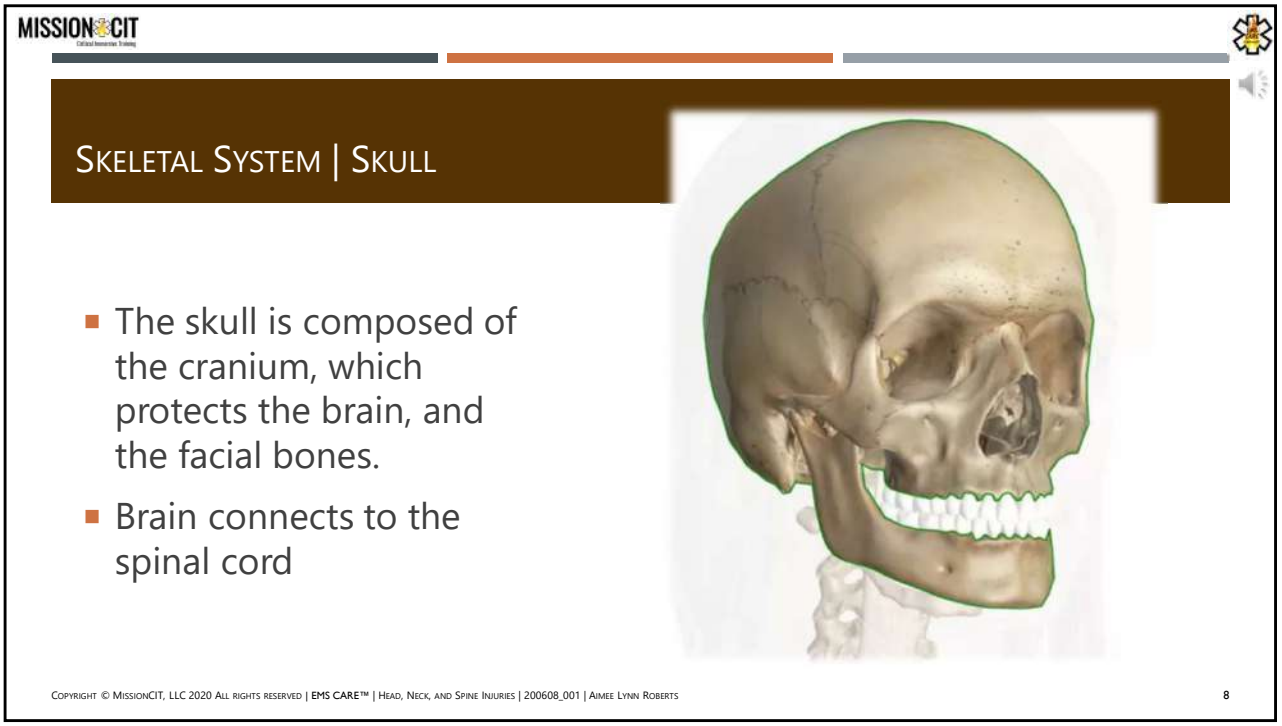
It does this by receiving signals from the brain and passing them on to the body. It can also send signals in the other direction – from the body to the brain – providing your brain with information about how full your bladder is - or how quickly your heart is beating. The involuntary nervous system can react quickly to

changes, altering processes in the body to adapt. For instance, if your body gets too hot, your involuntary nervous system increases the blood circulation to your skin, and makes you sweat more to cool your body down again.

This system consists of the sympathetic and parasympathetic nervous systems, which usually do opposite things in the body.

The sympathetic nervous system prepares your body for physical and mental activity. It makes your heart beat faster and stronger, opens your airways so you can breathe more easily, and inhibits digestion. When confronted with a threatening situation, the sympathetic nervous system reacts to the stress with a fight-or-flight response.

The parasympathetic nervous system is responsible for bodily functions when we are at rest. It stimulates digestion, activates various metabolic processes, and helps us to relax. It also causes blood vessels to dilate, slowing the heart rate, and relaxing the muscle sphincters.



The skull is composed of the cranium, which protects the brain, and the facial bones. It supports and protects the face and the brain. The brain connects to the spinal cord through a large opening at the base of the skull called the foramen magnum.

The adult skull is a collection of 22 bones, protecting the brain and supporting the other soft tissues of the head. The only bone that remains separate from the rest of the skull is the mandible, or jawbone.

During fetal development, the bones of the skull form within tough, fibrous membranes in a fetus' head. Early

separation of the bones provides the fetal skull with the flexibility necessary to pass through the tight confines of the birth canal.

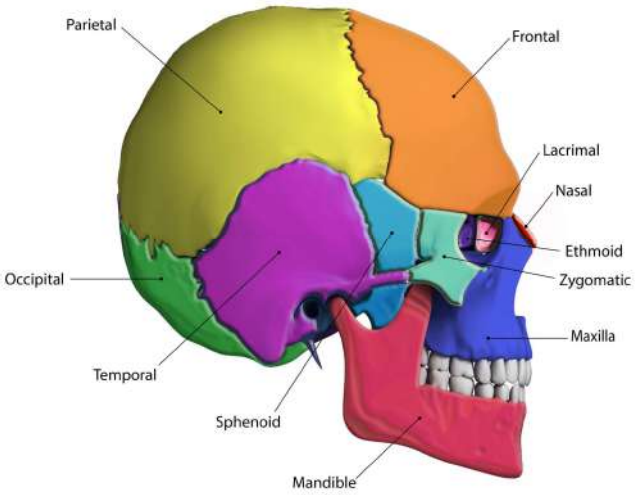
During childhood development, the skull bones remain somewhat separated, allowing for growth of the brain and skull. As these bones grow throughout fetal and childhood development, they begin to fuse together, forming a single skull. Ultimately producing a rigid protective shell for the soft nervous tissue of our brain.

Functions of the skull include protection of the brain, fixing the distance between the eyes to allow stereoscopic vision, and fixing the position of the ears to enable sound localization of the direction and distance of sounds.

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Skeletal System | Skull | Cranium

- Eight major bones
- Solid bony wall around the brain
- Few openings for nerves and blood vessels



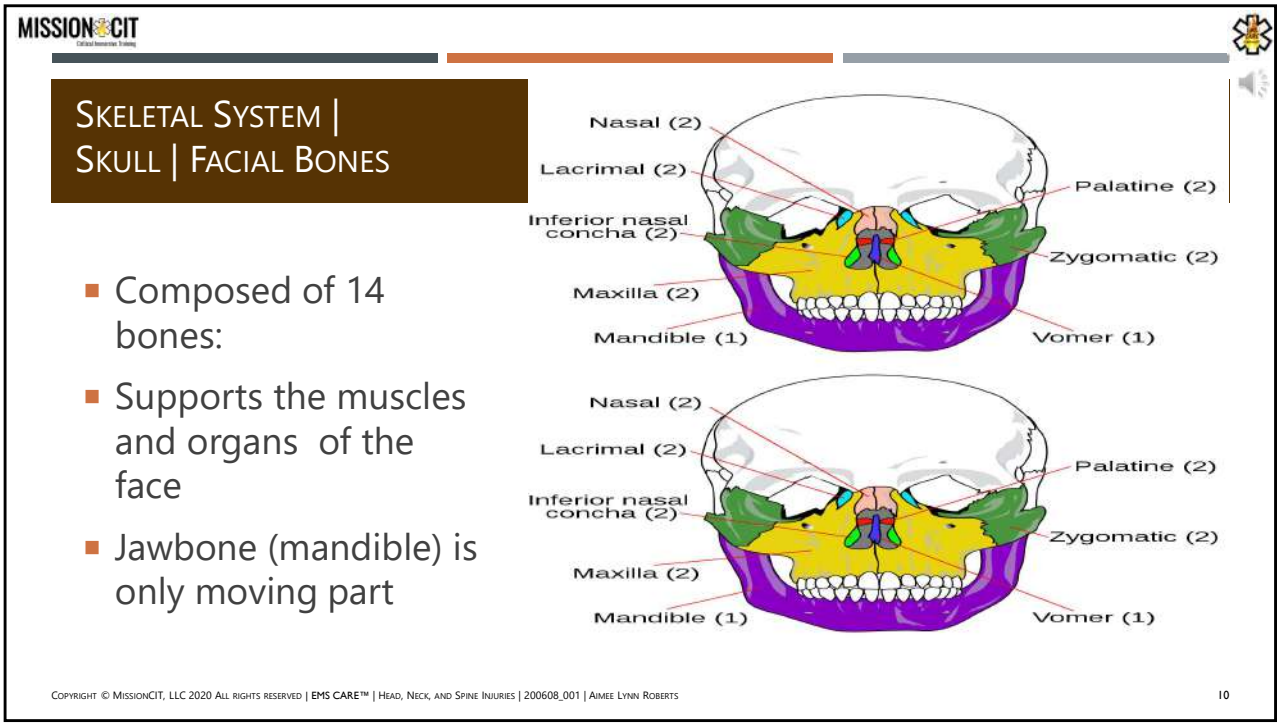
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Surrounding the brain is a region of the skull known as the cranium. In this region we have eight cranial bones: These are the

- Frontal bone,
- Two parietal bones,
- Two temporal bones,
- Occipital bone,
- Ethmoid bone, and the
- Sphenoid bone.

Collectively, these bones provide a solid bony wall around the brain, with only a few openings for nerves and blood vessels. Our occipital bone contains the foramen magnum, the hole through which the spinal cord enters the skull to attach to the brain. The occipital bone also forms the atlanto-occipital joint with the atlas (the first cervical vertebra in our spine).

The frontal, ethmoid, and sphenoid bones contain small hollow spaces known as paranasal sinuses. The sinuses help to reduce the weight of these bones and increase the resonance of the voice during speech, singing, and humming.

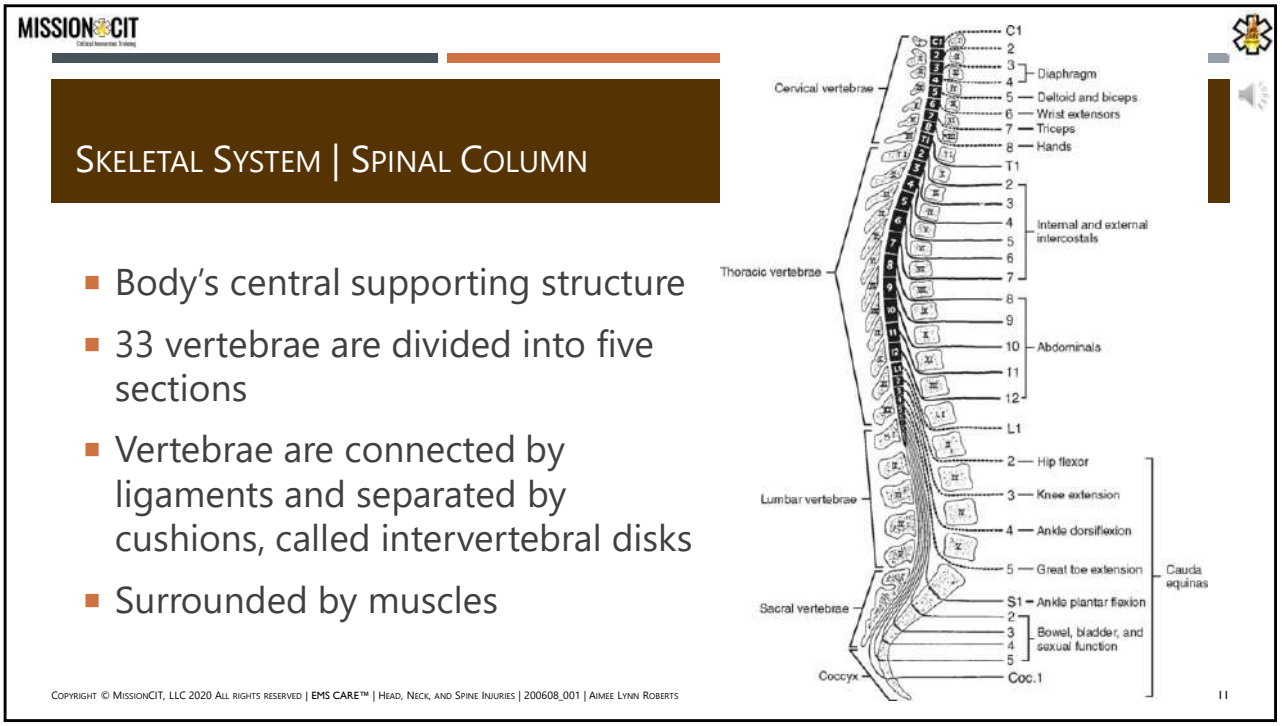


Surrounding the brain is a region of the skull known as the cranium. In this region we have eight cranial bones: These bones are the frontal, two parietal bones, two temporal bones, occipital, ethmoid, and the sphenoid bone.

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The spinal column is the body's central supporting structure made up of 33 vertebrae divided into five sections. It provides the base support for the entire body. Hence, enabling one to stand, bend, and twist without causing harm to the spinal cord.

The 5 different regions of the spinal column are:

1. the cervical region (neck),
2. the thoracic region (chest),
3. the lumbar region (lower back),

4. the sacral region (pelvic). And
5. the coccyx

The front part of each vertebra consists of a round, solid block of bone called the vertebral body; the back part forms a bony arch. The series of arches form a tunnel called the spinal canal, which encases and protects the spinal cord. The vertebrae are connected by ligaments and separated by cushions, called intervertebral disks.

Each part plays a key role in the function and health of the spine, and any of the parts can be affected by strain, injury, and/or disease.

So that's it for this lesson on the Anatomy and Physiology of the Head Neck and Spine. Missah will be joining you in the next lesson on Head Neck and Back injuries.

Good Studying!