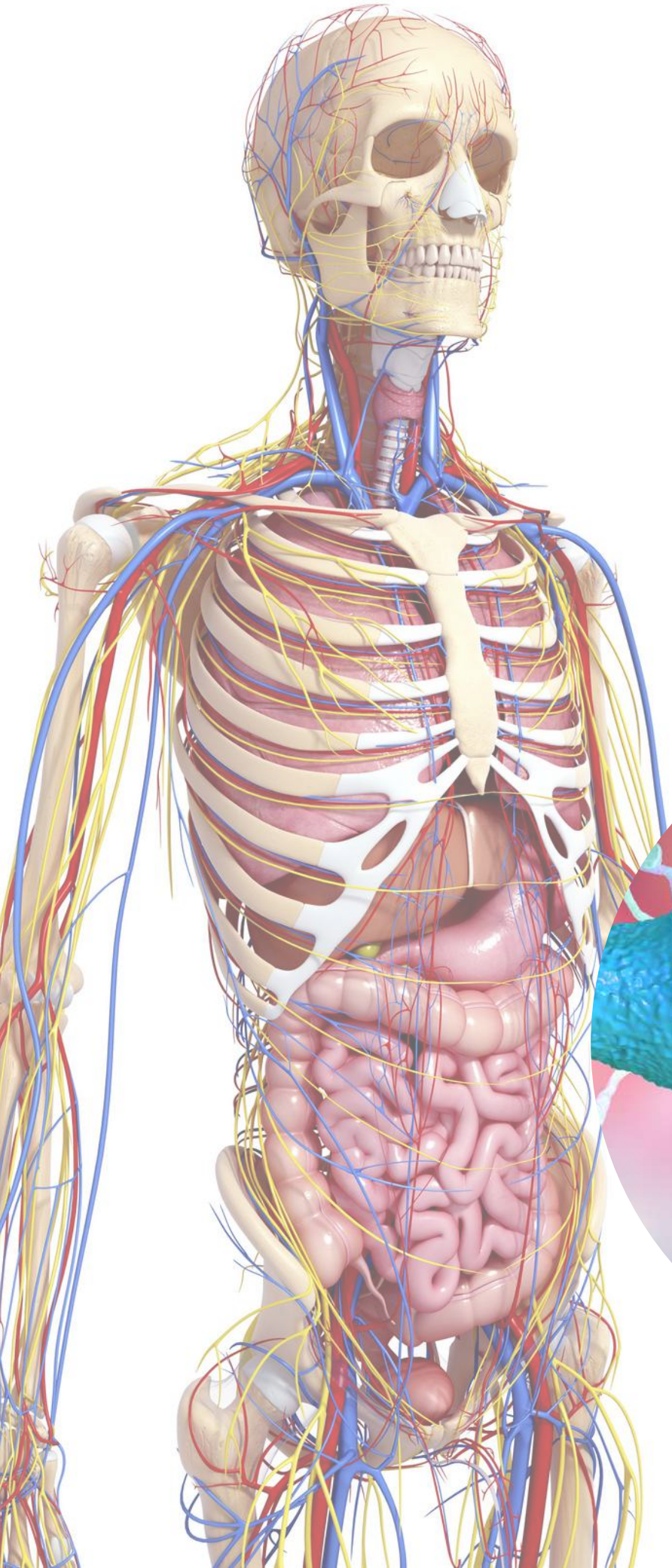
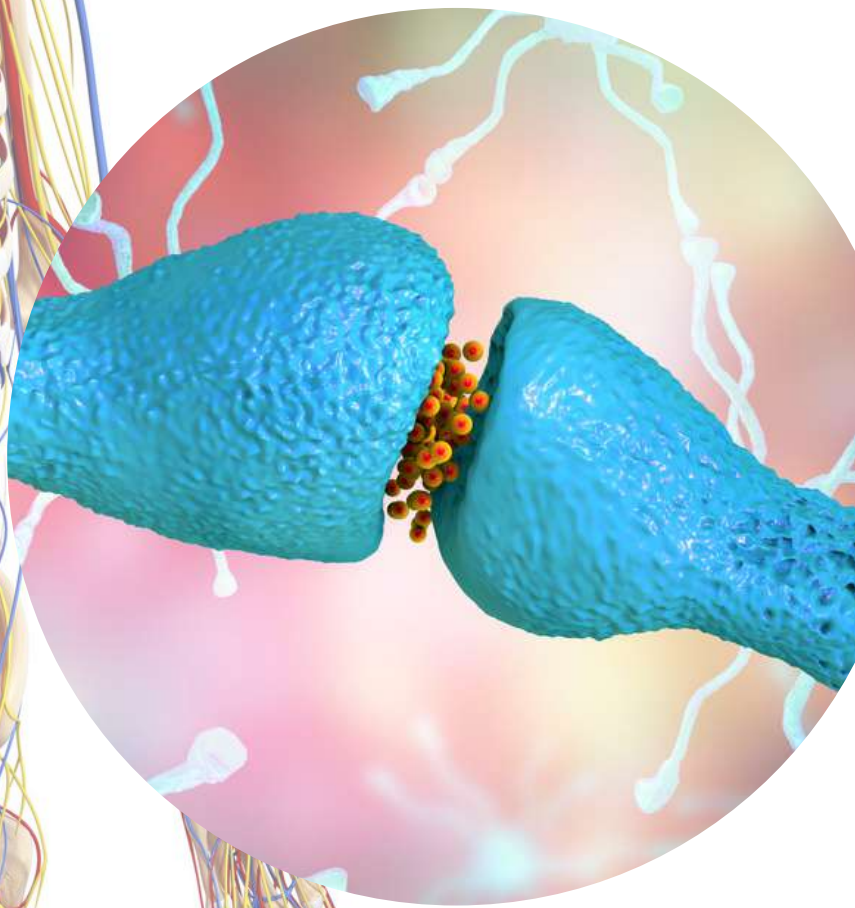
Nervous System Lesson Plan Grade 12





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The following unit plan was created in accordance with the Canadian Council on Animal Care's recommendations to replace any present procedures involving the use of animals in teaching, testing and research.

The Three Rs principle of Replacement states, if you can meet your scientific or educational goals without the use of animals, it is your ethical obligation to use non-animal methods. Grade 12 anatomy content is often taught using fetal pigs - here we offer an effective and humane alternative.

This is in alignment with the public's concern for animal welfare and a cultural respect for animals passed down from the Aboriginal perspectives of the First Peoples.

Elisabeth Ormandy created this unit plan and series of lesson plans for your use in teaching life science content to Grades 12 based on the BC Science Curriculum.

These Humane Science Education materials were developed to provide equivalent or greater standards in education for Canadian youth, without the use of animals.

Curriculum Alignment

This lesson plan can be used to create classes for Grades 12 based on the BC Science Curriculum. Specific **Big Ideas** covered in this lesson plan include:

Grade 12 - Organ systems have complex interrelationships to maintain homeostasis.
ORGAN SYSTEMS:

- Structure and function
- Structural and functional interdependence
- Maintenance of homeostasis

We have recommended specific virtual anatomy tools to use to get the most out of the unit plan. You'll find links to those on pages 5 & 6.

Lesson Plan Overview

Subject: Science

Unit Overview: Anatomy and Physiology

Unit Duration: ~90 minutes

Grade: 12

Big Idea: Organ systems have complex interrelationships to maintain homeostasis

Curricular Competencies

- *Analyze cause-and-effect relationships*
- *Construct, analyze, and interpret graphs, models, and/or diagrams*
- *Consider the changes in knowledge over time as tools and technologies have developed*

Content

- By the end of this lesson, students are expected to demonstrate understanding of the following:
  - *Nervous system:*
    - *Structure and function*
    - *Structural and functional interdependence*
    - *Maintenance of homeostasis*

Recommended Education Tools

Hardware & Workbooks:

This inventory is for a regular in-person class - use x1 iPad/tablet per student for responsible physical distancing. If teaching online, teachers can screen share their iPad/tablet or desktop.

- 6 (or more) iPads or other tablets
- 6 (or more) 3D Anatomica workbooks

Recommended Software:

- 3D Anatomica: https://3danatomica.com
- 3D4Medical Complete Anatomy: https://3d4medical.com

Lesson Plan Overview

Topic: Organ systems have complex interrelationships to maintain homeostasis. Homeostasis is maintained through physiological processes.

Content: The human nervous system: organs, structure and function

Goals	Students will be able to: • Describe the function of the nervous system and its major organs. • Describe the relationships between the different components of the nervous system. • Explain how the nervous and circulatory systems are interdependent. • Explain how the nervous system maintains homeostasis in the body
Objectives	After this lesson students will state the structure and function of each organ/tissue in the nervous system and explain how the nervous system is functionally interdependent with other body systems.
Materials	• 3DAnatomica • 3D4Medical • Nervous System Workbook
Introduction	Using the 3DAnatomica and/or 3D4Medical app(s), the teacher will introduce the topic of nervous system structure and function.
Development	Questions to support inquiry-based learning: • What is the advantage of having specialized tissues in the nervous system? • How does the nervous system help the body maintain internal balance during exercise? • What are the impacts of external stimulants (e.g. alcohol, caffeine) on the nervous system? • What lifestyle decisions would you make to improve your nervous system health? • How does the nervous system respond to infection by a pathogen (e.g. coronavirus)?
Practice	Students will work independently or in pairs to navigate 3DAnatomica and/or 3D4Medical to learn about the structure and function of the nervous system organs.

Lesson Plan Approach

If teaching regular in-person classes:

- Split students into **6 groups**.
- Give each group a **Nervous System workbook** to refer to, and one (or more) iPad(s) or tablet(s) with the **3D Anatomica app**, and **3D4Medical Complete Anatomy app** loaded and ready to use.
- Your **introduction** should include discussion of the function of the nervous system, identifying its major components, and the vocabulary you would like students to learn (~ 15 mins). **Define homeostasis**. Have the students follow along using the 3D4Medical Complete Anatomy app.
- **Discuss sequence** of organs and structures that nerve impulses moves through within the nervous system. Have students use the 3D Anatomica and 3D4Medical Complete Anatomy app to explore the nervous system, filling their 3D Anatomica workbook and/or handouts provided. This can be student or teacher led (40-45 mins).
- Explore the "**Structures in Detail**" pages using the 3D4 Medical App. The students can cut away at the structures in the app to locate structures that need to be labeled.
- Ask students to brainstorm **ways the nervous system interacts with other systems,** and go over the specific examples provided.
- Discuss different ways the nervous system helps maintain homeostasis using examples provided, then ask students to provide their own examples using what they've learned.
- **Close the class with a 20-minute recap** of what the students have learned, discuss how the parts of the nervous system work together, and check for understanding. Begin a **conversation on ethics** of animals in science using the questions provided

If teaching a physically-distanced class:

- Use x1 iPad for each student and proceed as per the directions above.

If teaching online:

- Lead the students through the nervous system by screen sharing your own iPad/tablet or desktop with the 3D4Medical Complete Anatomy app installed, filling out the tables, and labeling the models as you go
- Proceed as per the directions above

Detailed Lesson Content & Teaching Notes

Introduction to the Lesson

Include a First Nations land acknowledgement and ask students to reflect on what respect for animals means to them. Provide an introduction to the apps and models that will be used in class. Provide an overview of how to access AiSPI's Nervous System workbook if teaching remotely.

Introduction to the Topic

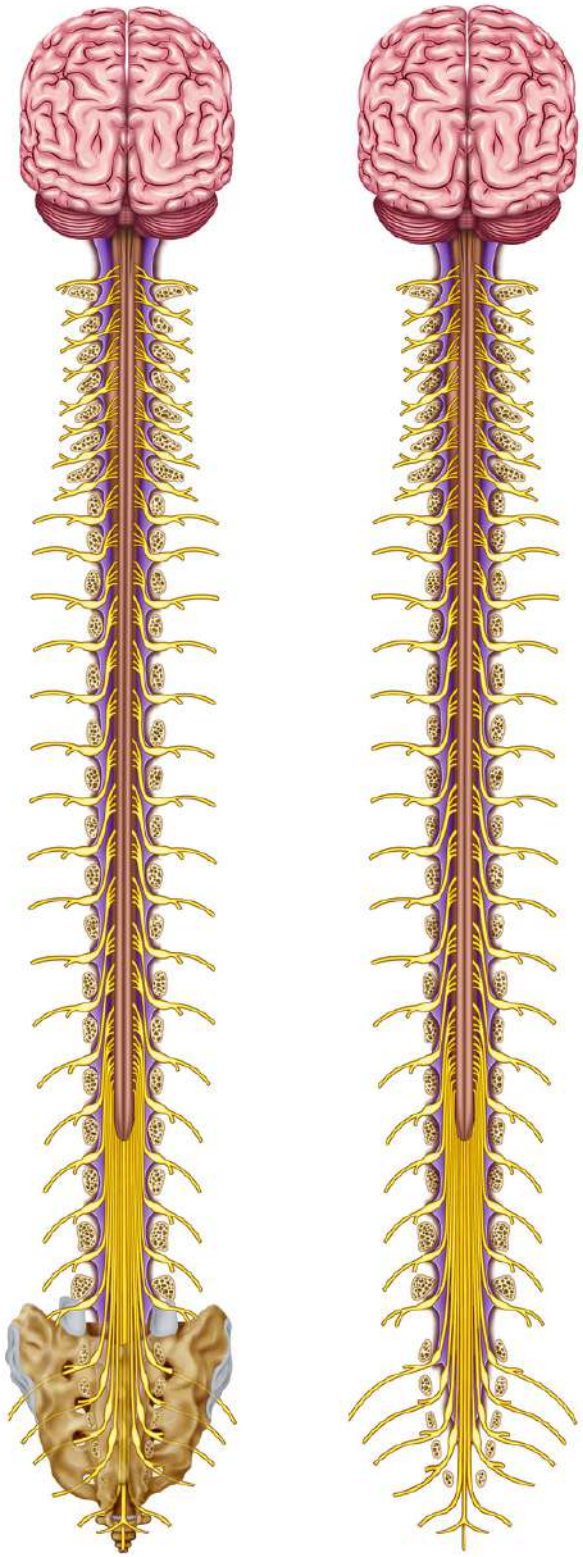
Students will use **3DAnatomica** and **3D4Medical Complete Anatomy** app to explore the nervous system at large. We recommend covering the function of the nervous system, identifying the major components of the system, and discussing the vocabulary you would like the students to learn early in the lesson.

THE NERVOUS SYSTEM AT-A-GLANCE

Function	The nervous system is involved in receiving information about the environment around us (sensation) and generating responses to that information (motor responses). The nervous system can be divided into regions that are responsible for sensation (sensory functions) and for the response (motor functions).
Component	Brain, spinal cord, nerves, neurons.
Important vocabulary	Brain, frontal lobe, temporal lobe, occipital lobe, parietal lobe, cerebral cortex, cerebellum, motor cortex, hippocampus, basal ganglia, thalamus, amygdala, ventricles, dura, cerebrospinal fluid, brainstem , pons, midbrain, medulla, spinal cord, dorsal horn, ventral horn, reflex, nerve fibre, nerve bundle, parasympathetic, sympathetic, autonomic, central nervous system, peripheral nervous system, neuron, axon, dendrites, schwann cell, myelin, node of ranvier, action potential, synapse, neurotransmitter.

Components in Detail:

Central nervous system



- The central nervous system consists of the brain and spinal cord.
- The brain plays a central role in the control of most bodily functions, including awareness, movements, sensations, thoughts, speech, and memory.
- Some reflex movements can occur via spinal cord pathways without the participation of brain structures.
- The spinal cord is connected to a section of the brain called the brainstem and runs through the spinal canal.
- Cranial nerves exit the brainstem.
- Nerve roots exit the spinal cord to both sides of the body.
- The spinal cord carries signals (messages) back and forth between the brain and the peripheral nerves.
- Cerebrospinal fluid surrounds the brain and the spinal cord and also circulates within the cavities (called ventricles) of the central nervous system.
- The leptomeninges surround the brain and the spinal cord.
- The cerebrospinal fluid circulates between 2 meningeal layers called the pia matter and the arachnoid(or pia-arachnoid membranes).
- The outer, thicker layer serves the role of a protective shield and is called the dura matter.
- The basic unit of the central nervous system is the neuron (nerve cell).
- Billions of neurons allow the different parts of the body to communicate with each other via the brain and the spinal cord.
- A fatty material called myelin coats nerve cells to insulate them and to allow nerves to communicate quickly.

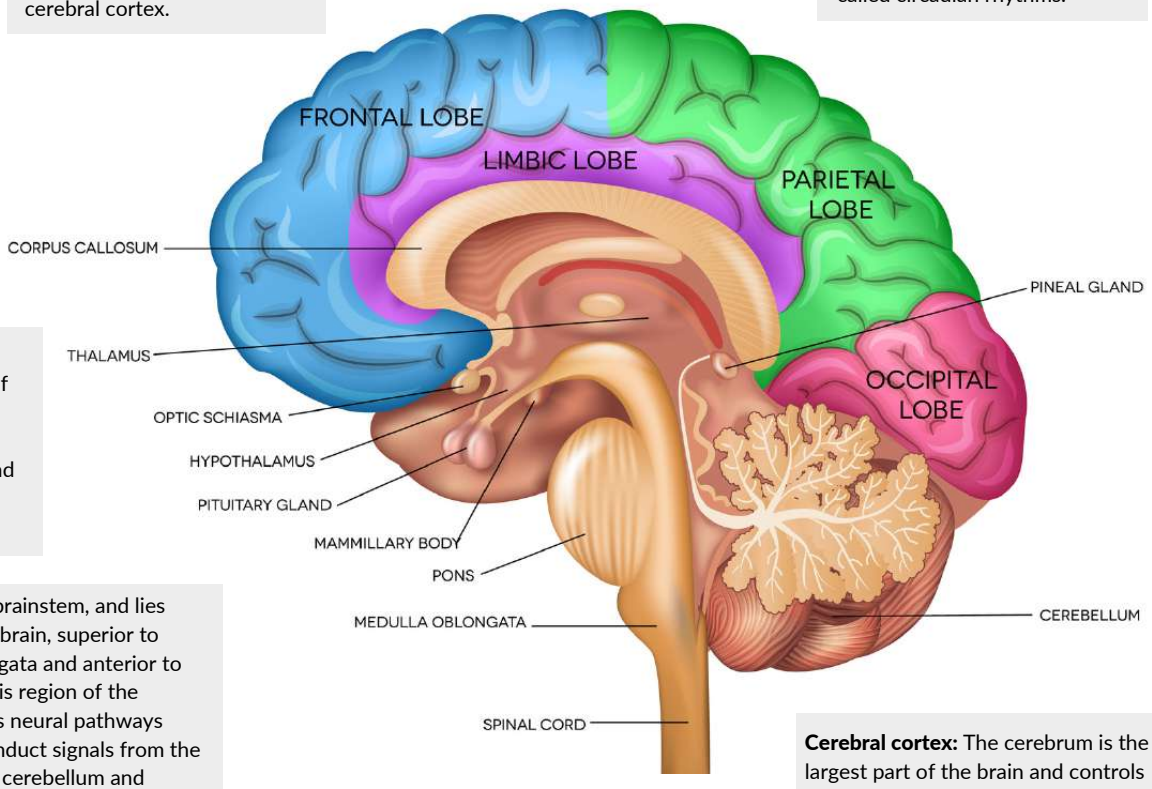
Components in Detail:
Brain Anatomy

Corpus callosum: a large, C-shaped nerve fiber bundle found beneath the cerebral cortex. It stretches across the midline of the brain, connecting the left and right cerebral hemispheres. It makes up the largest collection of white matter tissue found in the brain.

Thalamus: a small structure within the brain located just above the brain stem between the cerebral cortex and the midbrain and has extensive nerve connections to both. The main function of the thalamus is to relay motor and sensory signals to the cerebral cortex.

Pineal gland: a small, pea-shaped gland in the brain. Its function isn't fully understood. Researchers do know that it produces and regulates some hormones, including melatonin. Melatonin is best known for the role it plays in regulating sleep patterns. Sleep patterns are also called circadian rhythms.

Hypothalamus: a small region of the brain. It's located at the base of the brain, near the pituitary gland. While it's very small, the hypothalamus plays a crucial role in many important functions, including: releasing hormones. regulating body temperature.



Pituitary gland: a pea-sized body attached to the base of the brain, the pituitary is important in controlling growth and development and the functioning of the other endocrine glands.

Pons: part of the brainstem, and lies inferior to the midbrain, superior to the medulla oblongata and anterior to the cerebellum.This region of the brainstem includes neural pathways and tracts that conduct signals from the brain down to the cerebellum and medulla, and tracts that carry sensory signals up into the thalamus.

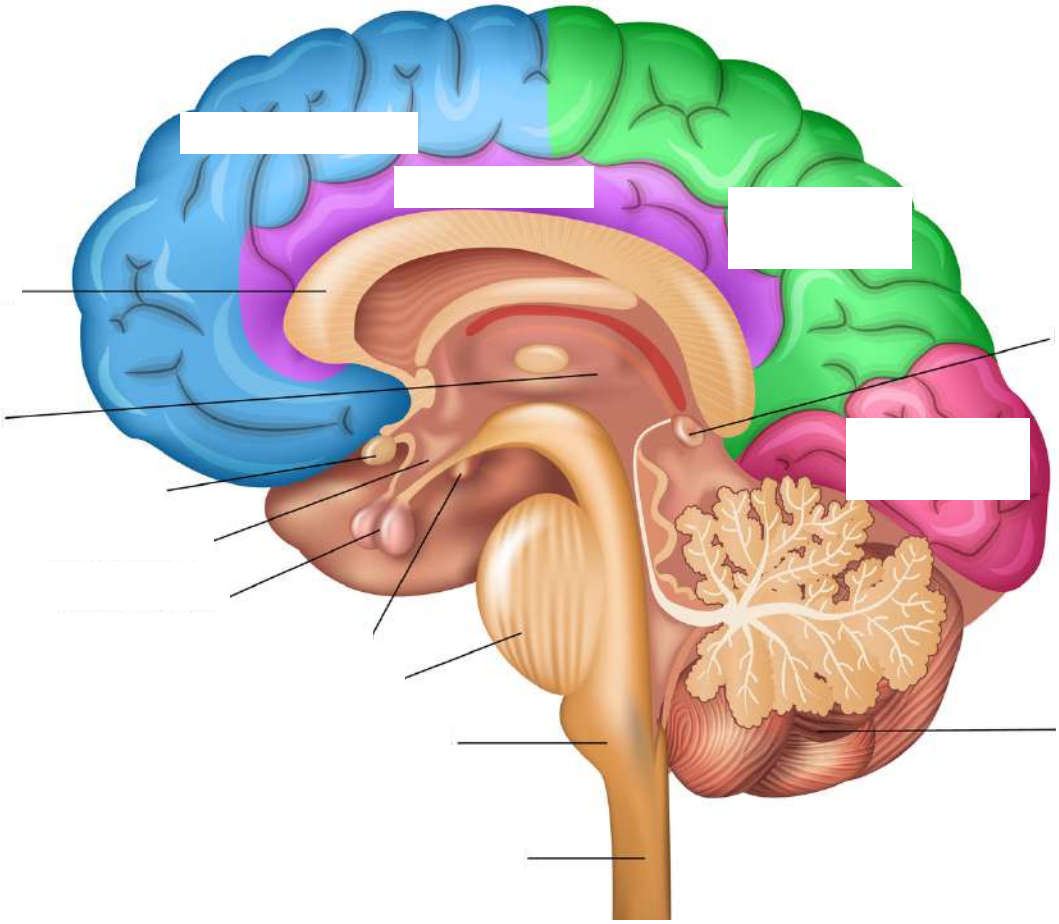
Cerebellum: receives information from the sensory systems, the spinal cord, and other parts of the brain and then regulates motor movements. The cerebellum coordinates voluntary movements such as posture, balance, coordination, and speech, resulting in smooth and balanced muscular activity.

Cerebral cortex: The cerebrum is the largest part of the brain and controls voluntary actions, speech, senses, thought, and memory. It is divided in to the frontal lobe, temporal lobe (not pictured), limbic lobe, parietal lobe and occipital lobe.

Medulla oblongata: a long stem-like structure which makes up part of the brainstem. It is anterior and partially inferior to the cerebellum. It is a cone-shaped neuronal mass responsible for autonomic (involuntary) functions ranging from vomiting to sneezing.

Spinal cord: a long, thin, tubular structure made up of nervous tissue, which extends from the medulla oblongata in the brainstem to the lumbar region of the vertebral column. It encloses the central canal of the spinal cord, which contains cerebrospinal fluid.

Human Brain Anatomy (student activity)

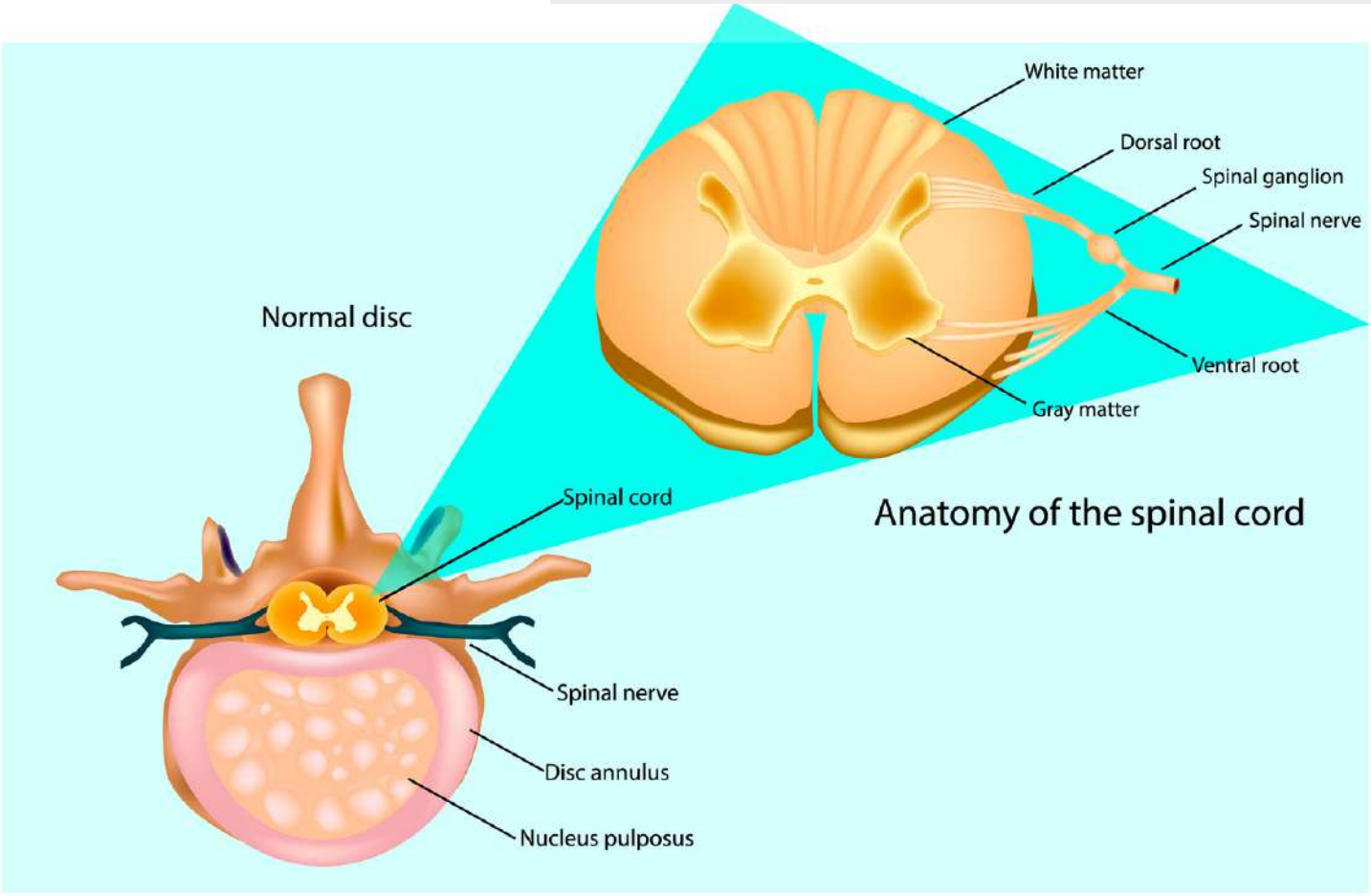


Components in Detail:

Spinal Cord Anatomy

White matter is the tissue through which messages pass between different areas of grey matter within the central nervous system. The white matter is white because of the fatty substance (myelin) that surrounds the nerve fibres (axons).

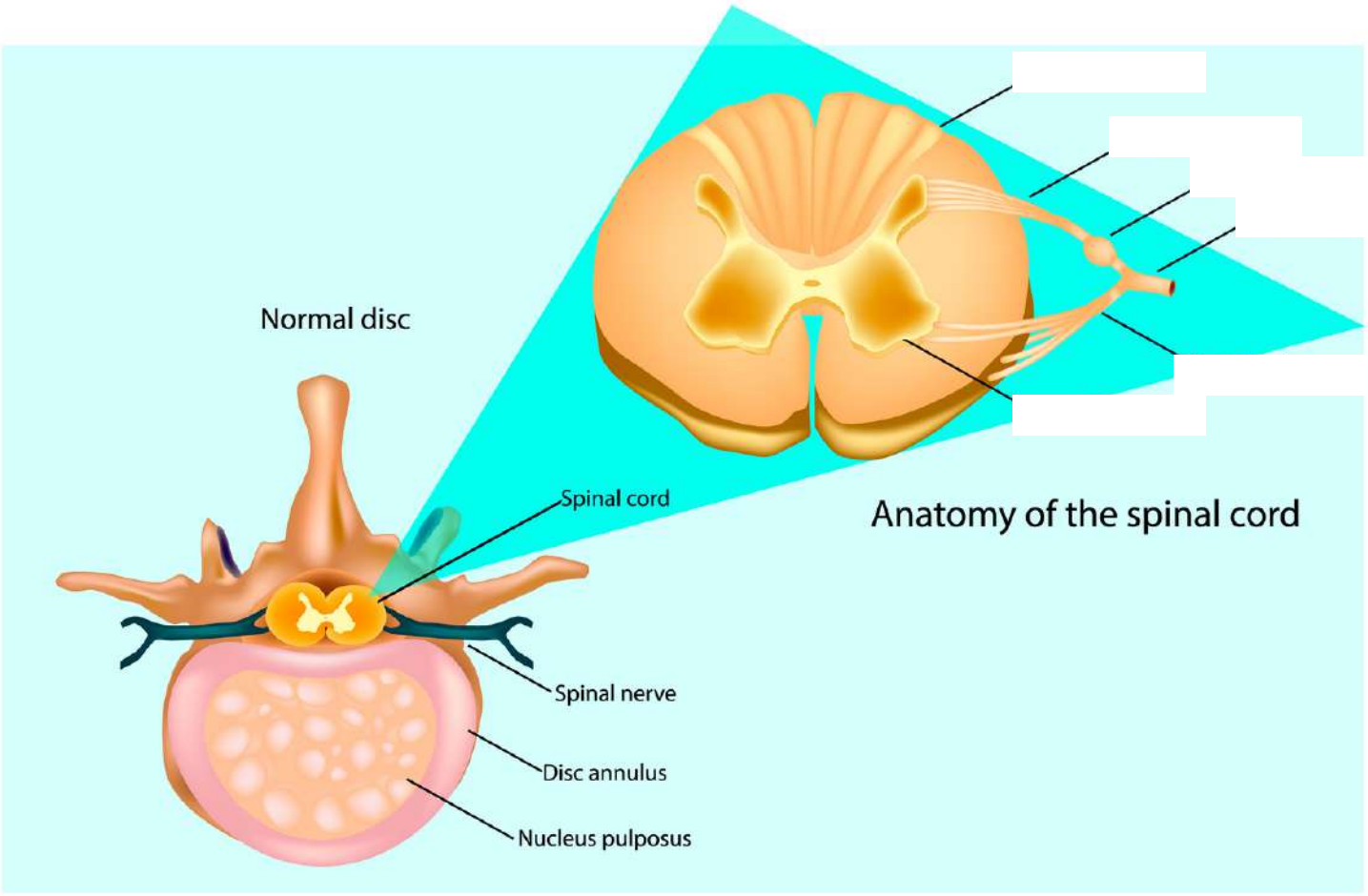
The **dorsal root** of spinal nerve (or posterior root of spinal nerve) is one of two "roots" which emerge from the spinal cord. It emerges directly from the spinal cord, and travels to the **dorsal root (spinal) ganglion**. The dorsal root transmits sensory information, forming the afferent sensory root of a spinal nerve.



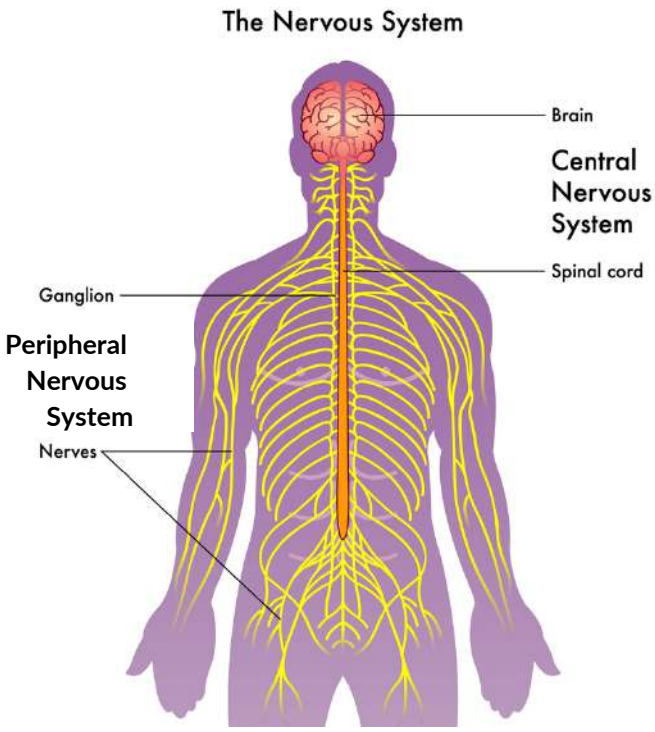
The ventral root of the spinal nerve contains outgoing, efferent (meaning to "bear away from") fibres that carry information destined to control motor or glandular function. The cell bodies of these motor neurons are located in the ventral horns of the spinal cord's central grey region.

Grey matter (or gray matter) is a major component of the central nervous system, consisting of neuronal cell bodies, neuropil (dendrites and unmyelinated axons), glial cells (astrocytes and oligodendrocytes), synapses, and capillaries.

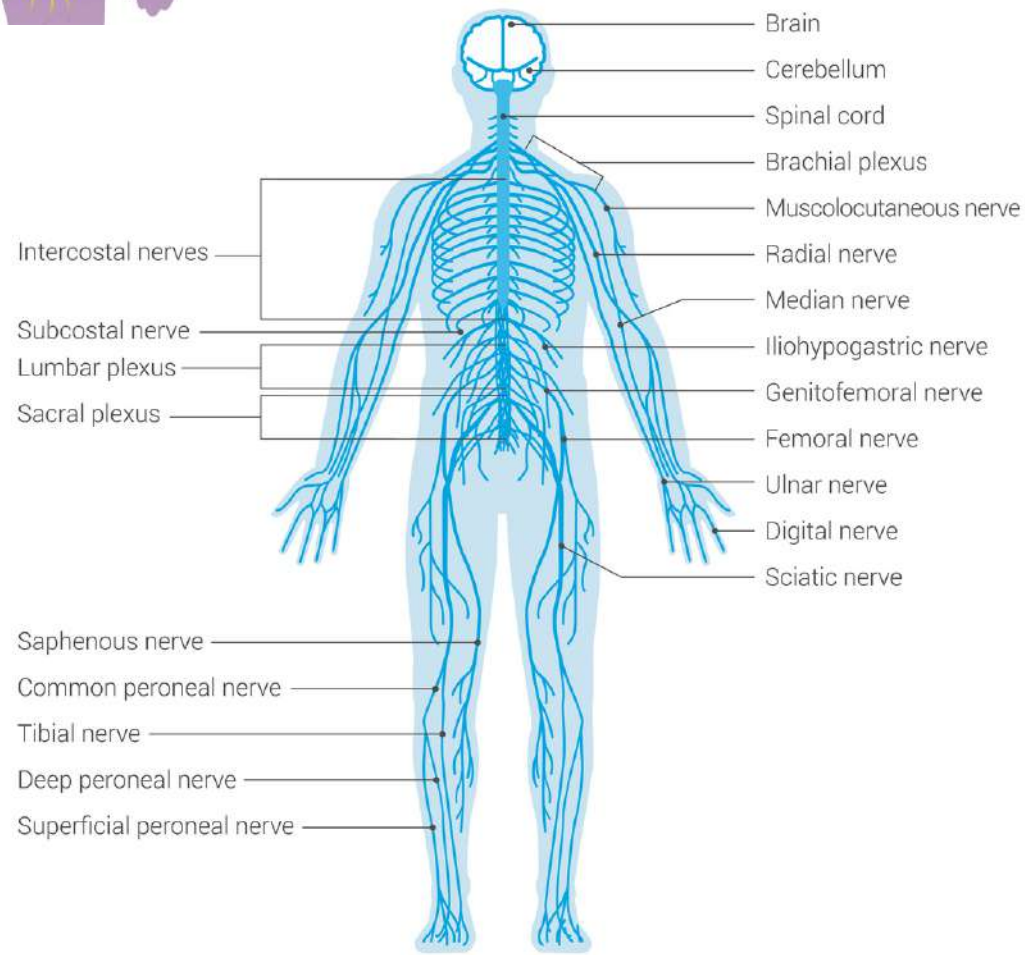
Spinal Cord Anatomy (student activity)



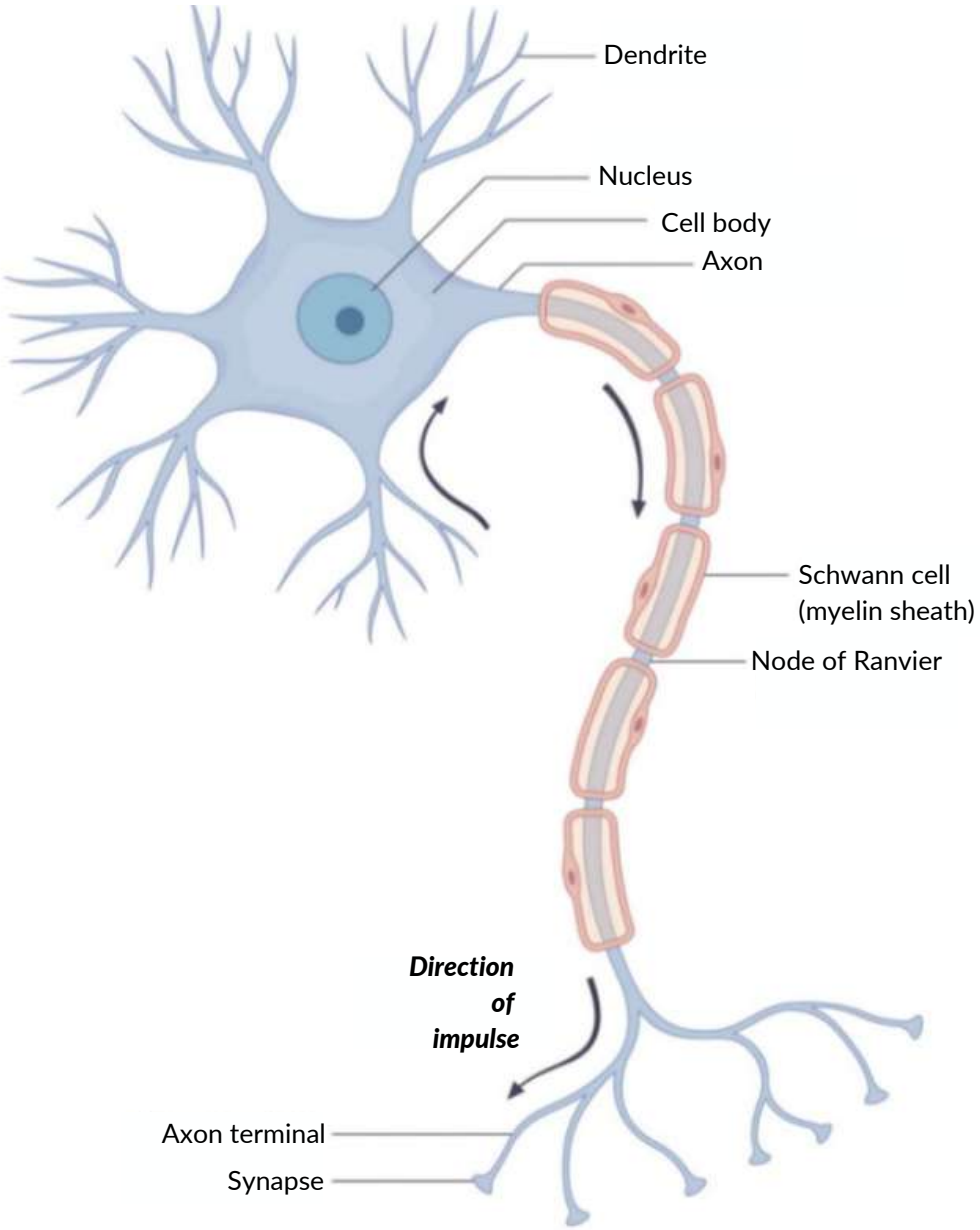
Components in Detail:
Peripheral nervous system



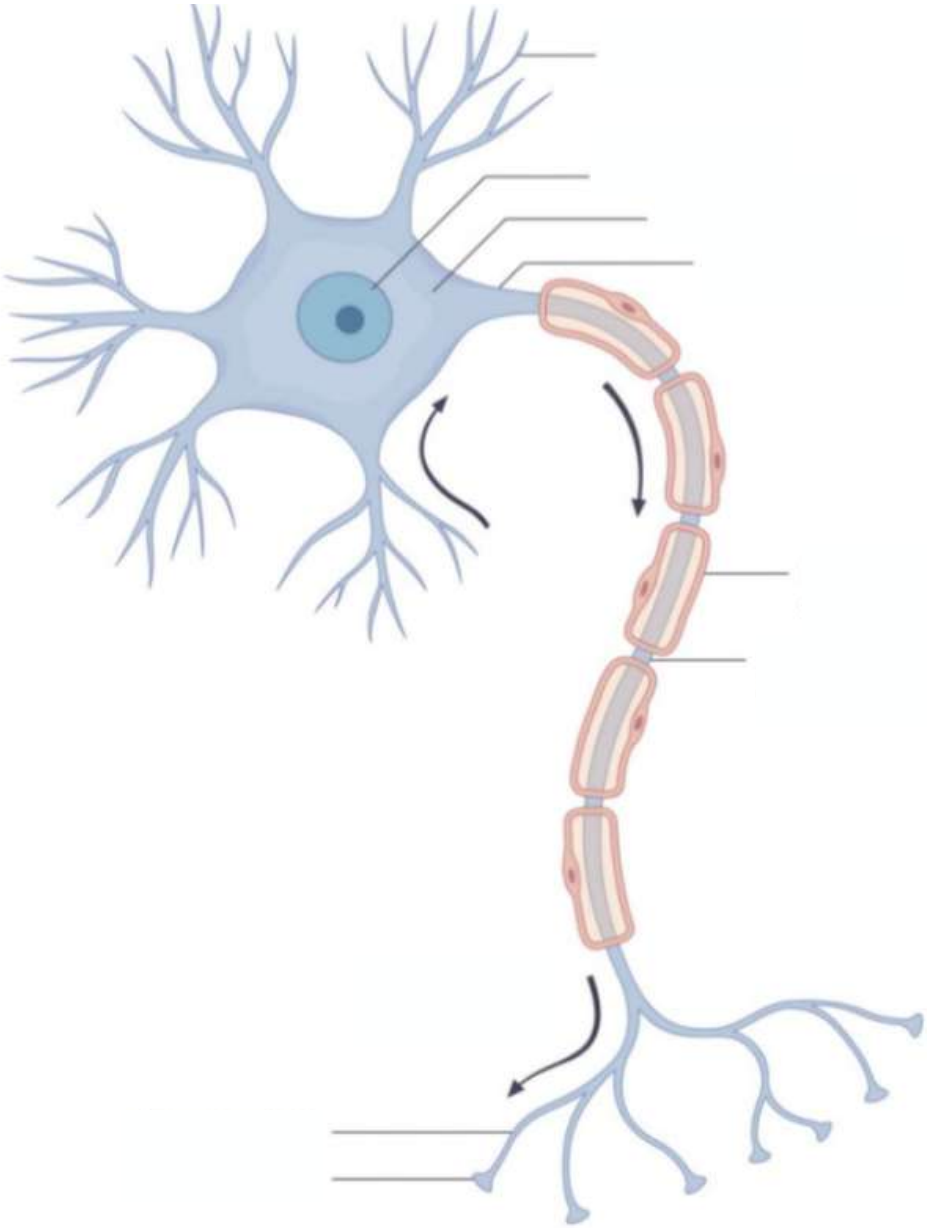
The **peripheral nervous system** refers to parts of the nervous system outside the brain and spinal cord. It includes the **cranial nerves**, **spinal nerves** and their roots and branches, **peripheral nerves**, and **neuromuscular junctions**. In the peripheral nervous system, bundles of nerve fibres or axons conduct information to and from the central nervous system.



Components in Detail:
Neuron Anatomy

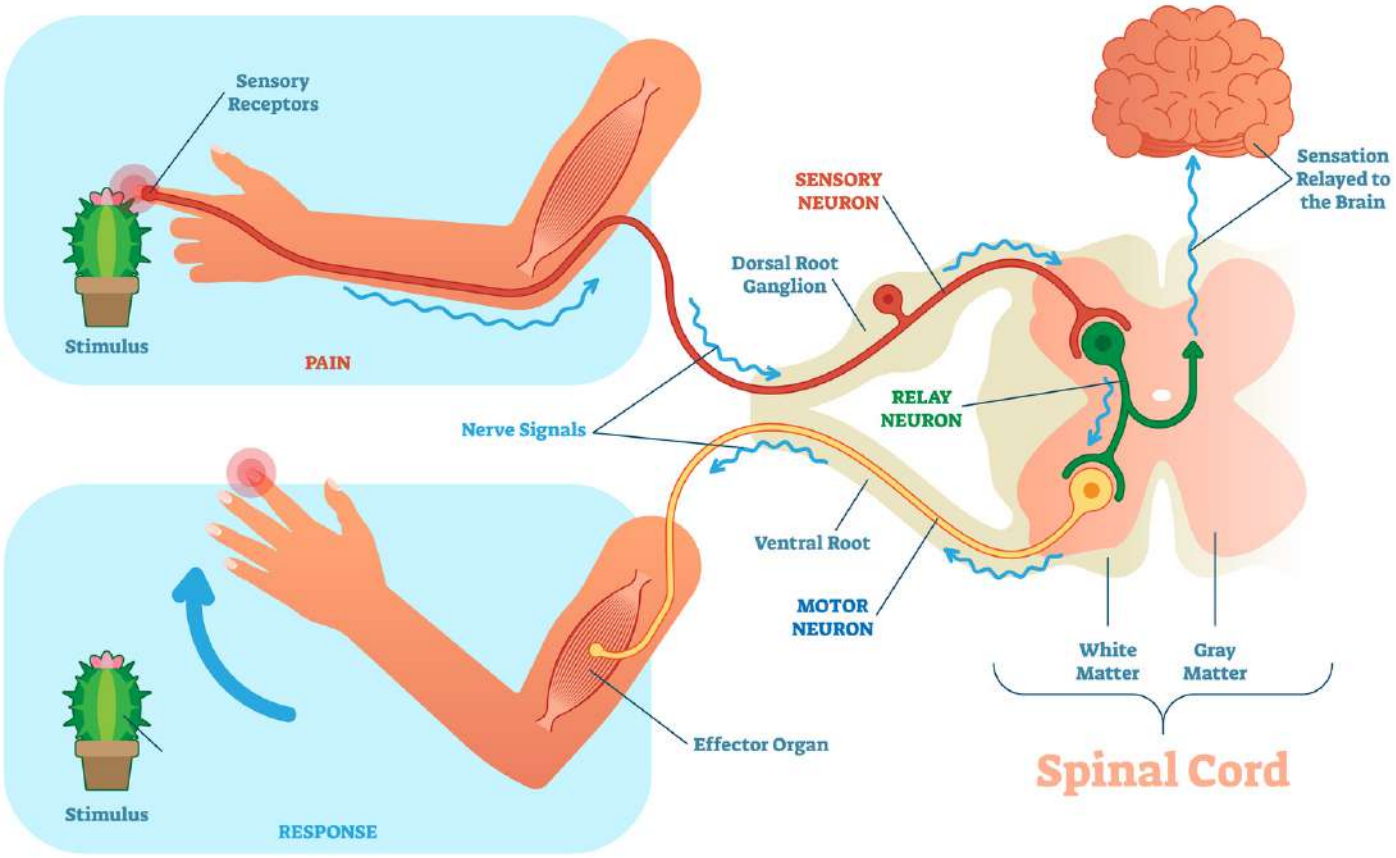


Neuron anatomy activity (student activity)



Components in Detail:

Reflex Arc



5 Parts of a Reflex Arc

First Part of a Reflex Arc: Sensor

Reflexes start in structures called **sensors**. These structures detect one kind of **energy** such as touch, stretch, heat, light, smell, and vibration. Some sensors are **neurons**, and they fire nerve impulses when stimulated. Other sensors are not neurons but can signal nearby sensory neurons when they detect their specific **stimuli**. All information about the world inside and outside your body has to be changed into **nerve impulses** before that information can be used by the circuits of your nervous system. When you tap your knee, you stretch the tendon that connects your quadriceps muscle to your tibia, the largest bone in your lower leg. Stretching the tendon stretches the muscle, and stretch sensors in the muscle detect this change. The stretch sensors are not neurons. They are special muscle cells that stimulate the sensory nerves to fire impulses.

Second Part of a Reflex Arc: Sensory Neuron

Each reflex has a **sensory neuron**. The sensor may be the nerve endings of the sensory neuron, or the sensor is another kind of cell that signals the sensory neuron. The sensory neuron begins a nerve impulse that travels to the **spinal cord** or the **brain**. Sensory neurons take messages to the spinal cord or brain from sensors in the eyes, ears, muscles, skin, and other body parts. The sensory neuron in the knee jerk reflex sends its messages to the spinal cord.

Third Part of a Reflex Arc: **Control Center**

In the spinal cord, the sensory neuron splits into at least three branches. Each branch forms a **synapse** with one of three different kinds of cells. In the case of the knee jerk reflex, one branch connects to a cell called an **interneuron**. The interneuron sends a message up the spinal cord to let the **cerebral cortex** know what is happening. Another branch goes to the **motor neuron** for the quadriceps muscle on the front of the thigh. The third branch goes to another interneuron that makes a connection to the motor neuron going to the biceps femoris muscle on the back of the thigh. Neurons in the brain and spinal cord control **reflexes** by receiving information and deciding if the stimulus is strong enough to command a **response**. Sometimes the neurons in the brain and spinal cord combine information from different sources. That is why you can sometimes hold back a reflex like a cough or keep your eyes open when the eye doctor asks you to, even though an instrument is close to your eye. Information from the cortex tells the controlling neuron in the reflex arc not to respond. The cerebral cortex is an important control centre. Messages come from your eyes, ears, skin, and muscles. These messages travel along sensory neurons to get to the **cortex**. The cortex processes all these messages in networks of interneurons that decide how to respond. In making these decisions, the cortex also uses information from memory. The cerebral cortex is not involved, however, in completing a simple reflex like the knee jerk reflex.

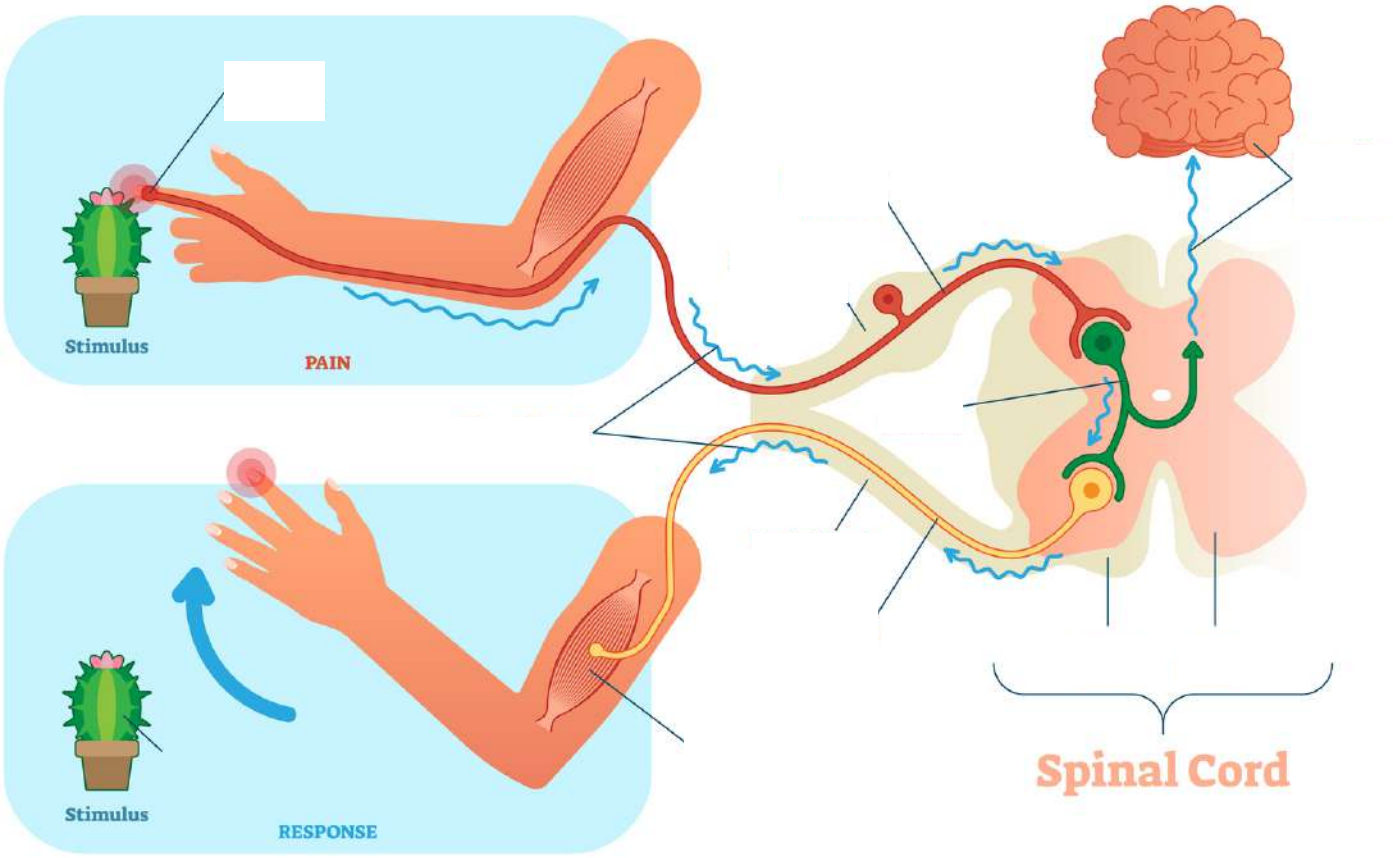
Fourth Part of a Reflex Arc: **Motor Neuron**

The fourth part of the knee jerk reflex arc is called the **output phase**. Three things happen at once during the output phase. The nerve impulse to the motor neuron travels out to the quadriceps. The nerve impulse is carried along an interneuron a short distance to the motor neuron for the biceps femoris muscle on the back of your leg. A message traveling along interneurons starts its long trip to the cerebral cortex.

Fifth Part of a Reflex Arc: **Muscle**

A message from a motor neuron tells your muscles to **contract**. In the knee jerk reflex, the muscle contracts when the nerve impulse reaches your quadriceps muscle. This muscle contraction should move your leg forward. But your leg won't move forward if the opposing biceps femoris muscle is also contracted. An interneuron tells the biceps motor neuron not to send nerve impulses to keep the biceps muscle relaxed. As the quadriceps muscle contracts, the biceps relaxes, and your leg moves forward. All these events occur before the message about what is happening arrives in your cortex. **Reflex arcs** need an interneuron to turn off one reflex to make room for another. An interneuron that turns off, or inhibits, a reflex is called an **inhibitory interneuron**. In the vomiting reflex, inhibitory interneurons keep you from breathing at the wrong time. Other inhibitory interneurons keep your hand from squeezing a hot grill, as muscles on the back of your hand contract to pull the hand away. Reflexes protect your body. Inhibitory interneurons help reflexes work the right way every time.

Reflex Arc (student activity)



5 Parts of a Reflex Arc

1. _____
2. _____
3. _____
4. _____
5. _____

Components in Detail:

Autonomic nervous system

The **autonomic** nervous system regulates certain body processes, such as blood pressure and the rate of breathing. This system works **automatically** (autonomously), without a person's conscious effort. Disorders of the autonomic nervous system can affect any body part or process. Autonomic disorders may be reversible or progressive.

Anatomy of the autonomic nervous system

The autonomic nervous system is the part of the nervous system that supplies the internal organs, including the blood vessels, stomach, intestine, liver, kidneys, bladder, genitals, lungs, pupils, heart, and sweat, salivary, and digestive glands.The autonomic nervous system has two main divisions:

- **Sympathetic**
- **Parasympathetic**

After the autonomic nervous system receives information about the body and external environment, it responds by stimulating body processes, usually through the sympathetic division, or inhibiting them, usually through the parasympathetic division. An autonomic nerve pathway involves two nerve cells. One cell is located in the brain stem or spinal cord. It is connected by nerve fibres to the other cell, which is located in a cluster of nerve cells (called an **autonomic ganglion**). Nerve fibres from these ganglia connect with internal organs. Most of the ganglia for the sympathetic division are located just outside the spinal cord on both sides of it. The ganglia for the parasympathetic division are located near or in the organs they connect with.

Function of the autonomic nervous system

The autonomic nervous system controls **internal body processes** such as the following:

- Blood pressure
- Heart and breathing rates
- Body temperature
- Digestion
- Metabolism (thus affecting body weight)
- The balance of water and electrolytes (such as sodium and calcium)
- The production of body fluids (saliva, sweat, and tears)
- Urination
- Defecation
- Sexual response

Many organs are controlled primarily by either the sympathetic or the parasympathetic division. Sometimes the two divisions have opposite effects on the same organ. For example, the sympathetic division increases blood pressure, and the parasympathetic division decreases it. Overall, the two divisions work together to ensure that the body responds appropriately to different situations.

Components in Detail:

Autonomic nervous system

Generally, the sympathetic division does the following:

- **Prepares the body for stressful or emergency situation**s—fight or flight

Thus, the sympathetic division increases heart rate and the force of heart contractions and widens (dilates) the airways to make breathing easier. It causes the body to release stored energy. Muscular strength is increased. This division also causes palms to sweat, pupils to dilate, and hair to stand on end. It slows body processes that are less important in emergencies, such as digestion and urination.

The parasympathetic division does the following:

- **Controls body process during ordinary situations.**

Generally, the parasympathetic division conserves and restores. It slows the heart rate and decreases blood pressure. It stimulates the digestive tract to process food and eliminate wastes. Energy from the processed food is used to restore and build tissues.

Both the sympathetic and parasympathetic divisions are involved in sexual activity, as are the parts of the nervous system that control voluntary actions and transmit sensation from the skin (somatic nervous system).

Two chemical messengers (neurotransmitters) are used to communicate within the autonomic nervous system:

- **Acetylcholine**
- **Norepinephrine**

Nerve fibres that secrete acetylcholine are called **cholinergic fiberes**. Fibres that secrete secrete norepinephrine are called **adrenergic fibres**. Generally, acetylcholine has parasympathetic (inhibiting) effects and norepinephrine has sympathetic (stimulating) effects. However, acetylcholine has some sympathetic effects. For example, it sometimes stimulates sweating or makes the hair stand on end.

How Does the Nervous System Work Together With Other Organ Systems?

Skeletal System

- Bones provide calcium that is essential for the proper functioning of the nervous system.
- The skull protects the brain from injury.
- The vertebrae protect the spinal cord from injury.
- Sensory receptors in joints between bones send signals about body position to the brain.
- The brain regulates the position of bones by controlling muscles

Cardiovascular System

- Endothelial cells maintain the blood-brain barrier.
- Baroreceptors send information to the brain about blood pressure.
- Cerebrospinal fluid drains into the venous blood supply.
- The brain regulates heart rate and blood pressure.

Muscular System

- Receptors in muscles provide the brain with information about body position and movement.
- The brain controls the contraction of skeletal muscle.
- The nervous system regulates the speed at which food moves through the digestive tract.

Endocrine System

- Hormones provide feedback to the brain to affect neural processing.
- Reproductive hormones affect the development of the nervous system.
- The hypothalamus controls the pituitary gland and other endocrine glands.

Respiratory System

- The brain monitors respiratory volume and blood gas levels.
- The brain regulates respiratory rate.

Digestive System

- Digestive processes provide the building blocks for some neurotransmitters.
- The autonomic nervous system controls the tone of the digestive tract.
- The brain controls drinking and feeding behavior.
- The brain controls muscles for eating and elimination.
- The digestive system sends sensory information to the brain.

Integumentary System

- Receptors in skin send sensory information to the brain.
- The autonomic nervous system regulates peripheral blood flow and sweat glands.
- Nerves control muscles connected to hair follicles.

How Does the Nervous System Help Maintain Homeostasis?

Of all the body systems, the nervous system is the major control system of **homeostasis**. It provides monitoring, response, and regulation of all systems in the human body and other organisms. It functions from the tiny level of individual cells to affecting the whole body at once. **Receptors** inside and outside the body are constantly monitoring conditions and watching for changes. When a body system leaves a set point and falls outside its normal range, signals are sent through the nervous system which trigger responses to bring the system back into the normal range of functioning. This is the process of homeostasis. These complicated and intricate processes have evolved over millions of years. For example, **thermoreceptors** and **mechanoreceptors** in the skin sense changes in temperature and pressure, respectively. Then, signals sent from them to the brain make it possible to detect situations that could cause injury or death. In addition, nerves make muscles contract which moves the bones of the skeleton, making it possible to evade predators and/or fight. This ability to perceive the environment and reacting to it is critical to maintaining homeostasis in the body.

Vision

The nervous system is intricately involved in visual perception which also helps maintain homeostasis. In humans, there is a thin layer of nervous tissue called the **retina** covering the rear of the inside of the eye. This tissue is populated with millions of **photoreceptor cell**s, **ganglion cells**, and **bipolar cells**. The cells detect light and transmit electrical information to the brain via the optic nerve which results in a visual picture. Pupil dilation is also controlled by the nervous system, optimizing the amount of light entering the eye for best vision. Vision allows animals to see and escape danger and find food and mates.

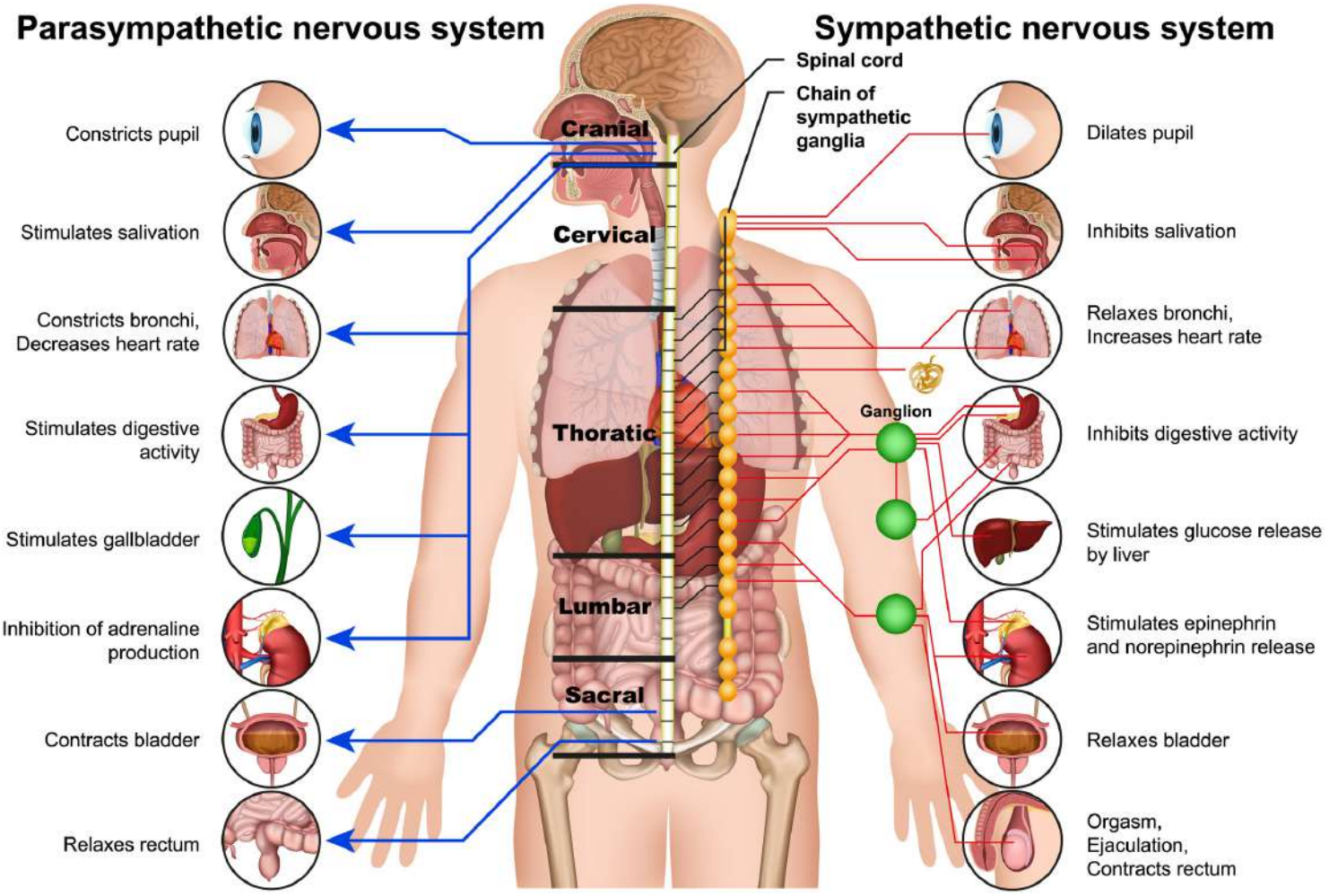
Core Temperature

The nervous system is also responsible for **regulating the core temperature** of the body. When conditions are too warm and body temperature rises, the blood vessels dilate causing heat loss to the environment. Nerves trigger sweat glands to release fluid that evaporates and cools the skin. Conversely, a drop in core temperature makes blood vessels constrict to conserve heat. The nervous system also triggers muscles to shiver to generate heat and warm the body.

The Autonomic Nervous System

The autonomic nervous system is comprised on the **sympathetic** and **parasympathetic** nervous systems which both have critical homeostatic functions. The sympathetic system innervates the heart and increases heart rate and the force of its contractions. It also controls the constriction of blood vessels and dilation of bronchioles in the lungs. The parasympathetic system has the opposite effects on the heart and lungs but is has no effect on blood vessels.

How Does the Nervous System Help Maintain Homeostasis?

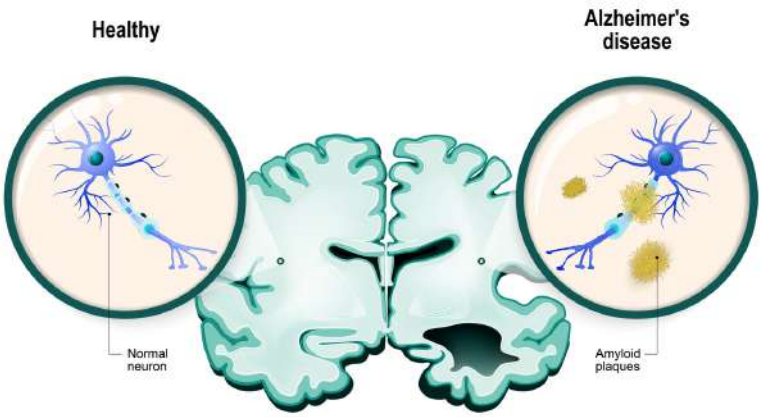


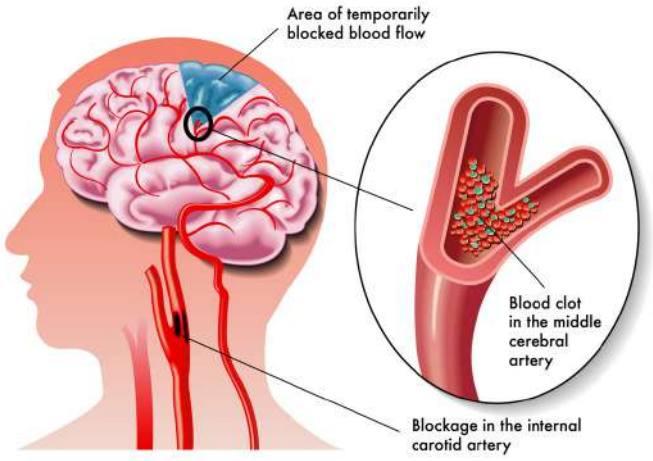
Common Neurological Diseases

The **brain**, **spinal cord**, and **nerves** make up the nervous system. Together they control all the workings of the body. When something goes wrong with a part of your nervous system, you can have trouble moving, speaking, swallowing, breathing, or learning. You can also have problems with your memory, senses, or mood.

There are more than 600 neurologic diseases. Major types include:

- Diseases caused by faulty genes, such as Huntington's disease and muscular dystrophy
- Problems with the way the nervous system develops, such as spina bifida
- Degenerative diseases, where nerve cells are damaged or die, such as Parkinson's disease and Alzheimer's disease
- Diseases of the blood vessels that supply the brain, such as stroke
- Injuries to the spinal cord and brain
- Seizure disorders, such as epilepsy
- Cancer, such as brain tumours
- Infections, such as meningitis





Closing Check-In and Discussion

During the check closing in:

Recap with the students how nerve impulses travel along the nervous system system. Go over ways the nervous system interacts with other body systems, as well as how it helps maintain homeostasis. Ask the following questions:

- **How might virtual dissections and models compare with using real specimens?**
- **Were you able to successfully learn the structure and function of individual parts of the respiratory system?**

Closing - Discussion on Ethics

The knowledge to create these accurate virtual models of the nervous system had to initially come from real humans and or animals. However, now that we have such a plentiful resources for accurate models of these structures, as well as the ability to perform dissections virtually, do you think we need to continue using animals? Why or Why not?

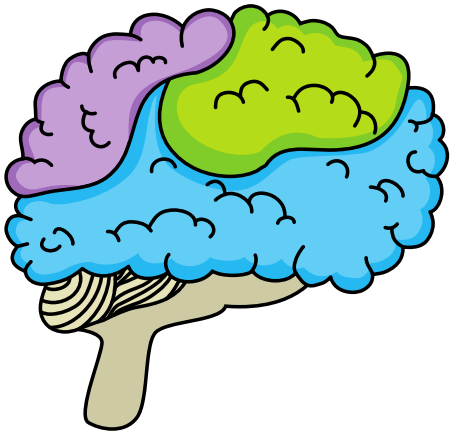
Think

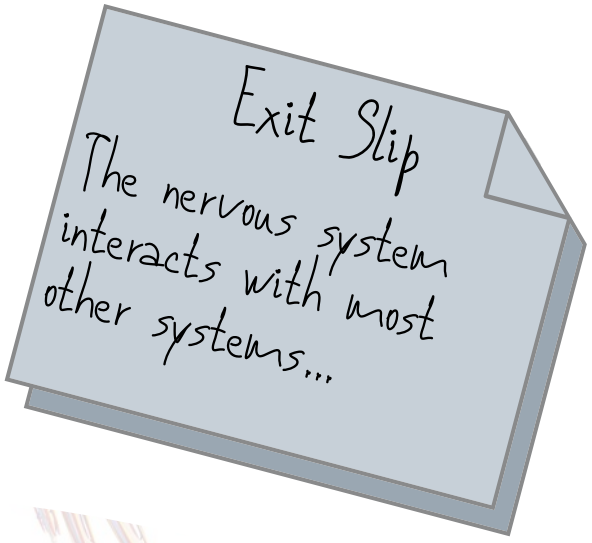
Ask the students to think about where they stand on the subject of animal dissections and the use of animals in science. They don't need to answer right away, rather, this is to get them to start forming their own ethical opinions.

Formative Assessment

The formative assessment can be in the form of an exit slip. This involves asking each student at the end of the class to answer 2-3 questions on a sheet of paper and hand it in, with their names on it, to ensure understanding of the main concepts covered. Examples of questions to include:

- **What is one way the nervous system maintains homeostasis within the body?**
- **What is one way the nervous system interacts with other body systems?**
- **What are the main structures nerve impulses travel along through within the nervous system?**





Thank you for choosing these materials to support your class adventures!

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