OUR LADY OF FATIMA UNIVERSITY

# COURSE UNIT

## BACHELOR OF SCIENCE IN COMPUTER SCIENCE:
## HUMAN BIOLOGY

| COURSE MODULE | COURSE UNIT | WEEK |
|---|---|---|
| 2 | 8 | 9 |
| Nervous System and the General Sensory System | | |

## CHECK LIST

- ✓ Read course and unit objectives
- ✓ Read study guide prior to class attendance
- ✓ Read required learning resources; refer to unit terminologies for jargons
- ✓ Proactively participate in classroom discussions
- ✓ Participate in weekly discussion board (Canvas)
- ✓ Answer and submit course unit tasks

## UNIT EXPECTED OUTCOMES (UEOs)

At the end of this unit, the students are expected to:

*Cognitive:*

1. Identify the parts and function of the brain and the spinal cord
2. Describe the processes that allow for the gathering of visual and auditory information

*Affective:*

1. Listen attentively during class discussions
2. Challenge ideas and opinions raised by the classmates and instructors with tact and respect.
3. Appreciate how the coordination of the nervous system and the senses results in the proper movement and response of the human body

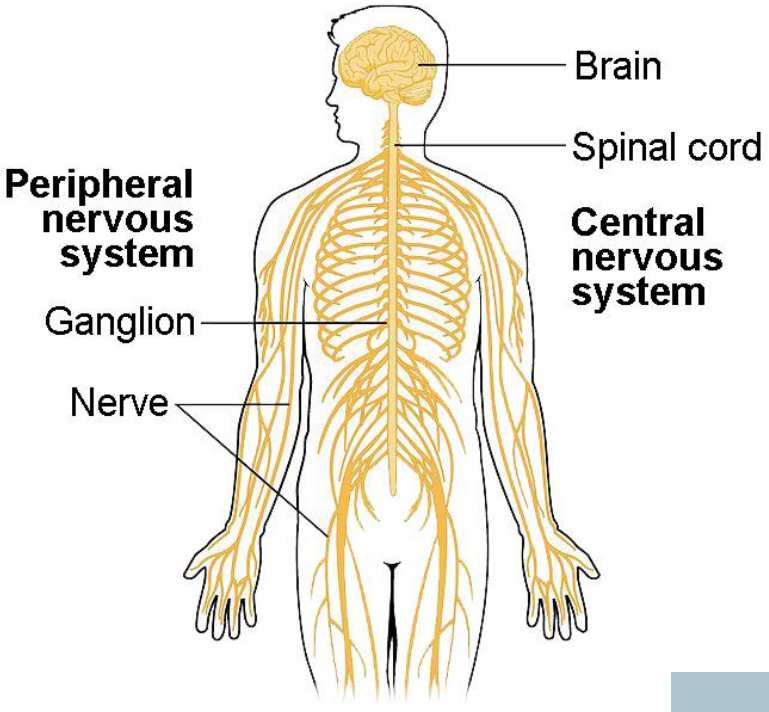
*Psychomotor:*

1. Participate actively during online and face-to-face discussions

## REQUIRED READINGS

Goodenough, J. and McGuire, B. A. 2011. Human Biology. Majority of the modules are based on the book Biology of Humans (4th Edition): Concepts, Application, and Issues (pp. 129-143, 151-172). San Francisco, CA: Pearson

## STUDY GUIDE

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Several parts protect the brain and the spinal cord. These include the bony cases that protect the skull and vertebral column, membranes called the meninges, and a fluid cushion called the cerebrospinal fluid.

The meninges refer to the three layers of protective connective tissue that surrounds the

**Organization of the Nervous System**

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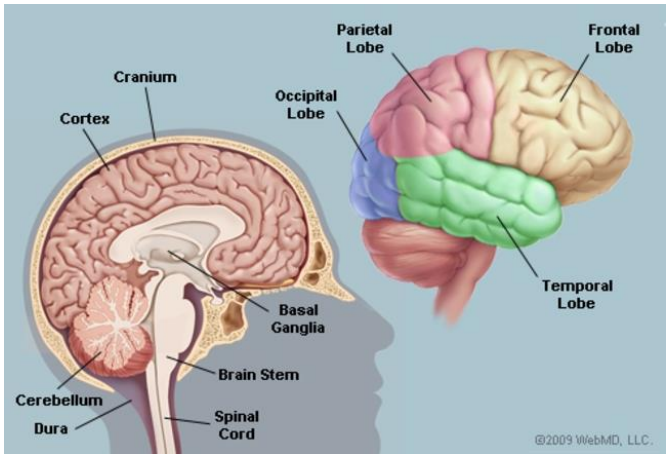
The nervous system can be categorized into the central nervous system and the peripheral nervous system. The central nervous system (CNS) includes the brain and spinal cord while the rest of nervous tissue outside the CNS is categorized under the peripheral nervous system. The peripheral nervous system can be further subdivided into the somatic nervous system and autonomic nervous system.

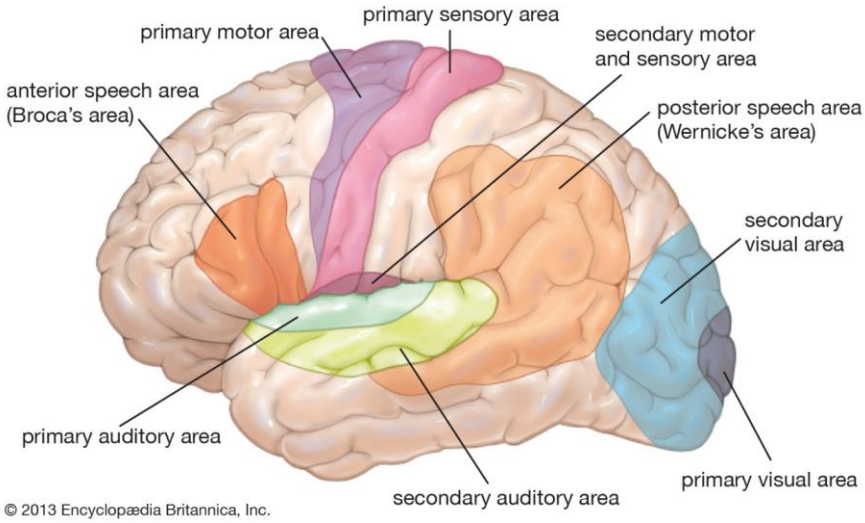
**Central Nervous System**



brain and spinal cord. Inflammation of the connective tissue due to bacteria or viruses result in a condition called meningitis

Between the layers of the meninges, we can find the fluid cushion called the cerebrospinal fluid. This fluid serves as a shock absorber for the brain, supports the brain, and nourishes the brain while removing waste materials. To prevent entry of damaging substances, the blood–brain barrier exists as a filter that allows only certain substances to enter the cerebrospinal fluid from the blood.

The brain serves as the body's central command center. This organ coordinates and regulates the body's other organ systems. The brain is divided into several parts. The cerebrum, which occupies the largest part of the brain, is the thinking, conscious part of the brain. The cerebrum consists of two hemispheres and each hemisphere receives sensory impulses from the opposite side of the body. The hemisphere also directs the movements of the opposite side of the body.




The outer layer of the cerebrum is comprised of gray matter called the cerebral cortex, and this layer is divided into three types of functional areas, which are the sensory, motor and association. Underlying the cerebral cortex is a layer of white matter, which is made up of myelinated nerve tracts that allow communication between various regions of the brain.

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**Sensory areas** of the cerebral cortex are responsible for the awareness of the situation. **Motor areas** of the brain are responsible for coordinating the movement of different parts of the body. **Association areas** is required for the coordination of the sensory and motor areas for the analysis of sensory impulses and creating appropriate action.

The thalamus relays all sensory experience except smell, and it plays a part in coordinating motor activity, stimulation of the cerebral cortex, and retention of memory.

Meanwhile, the hypothalamus is essential in maintaining a stable environment within the body. In its aim tor regulate the body conditions, this part regulates blood pressure, heart rate, breathing rate, digestion, body temperature and other important physiological processes. It also coordinates the activities of both the nervous and endocrine systems by leveraging its connections with the pituitary gland. Aside from conducting these functions, it also serves as the center of emotion as part of the limbic system.

Cerebellum is responsible for the coordination of sensory and motor functions by integrating information from the motor cortex and sensory pathways to create smooth movements.

The medulla oblongata controls the breathing rate, heart rate, and blood pressure. Sensory messages to higher brain centers and motor messages leaving the brain also travel through the

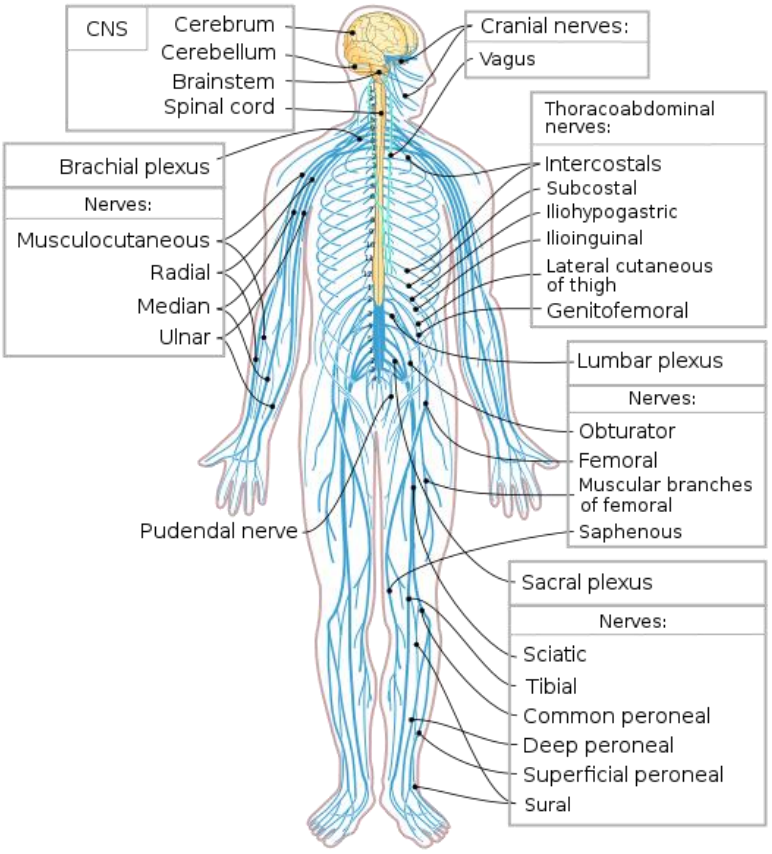
medulla oblongata. Meanwhile, the pons connects lower portions of the CNS with higher brain structures. It connects the spinal cord and cerebellum to the cerebrum, thalamus, and hypothalamus.

The limbic system is largely responsible for emotions and it is comprised of multiple components which include the hypothalamus and hippocampus. The hippocampus converts short-term memory to long-term memory.

The reticular activating system is comprised of a complex network of neurons. This system filters sensory input and helps maintain the cerebral cortex alert.

The spinal cord is a cable of nerve tissue. The spinal cord originates from the medulla and it extends to approximately the bottom of the rib cage. This part serves to conduct impulses and commands between the brain and the body. It also serves as a reflex center, coordinating and commanding movements even before the stimulus reaches the brain.

**Peripheral Nervous System**

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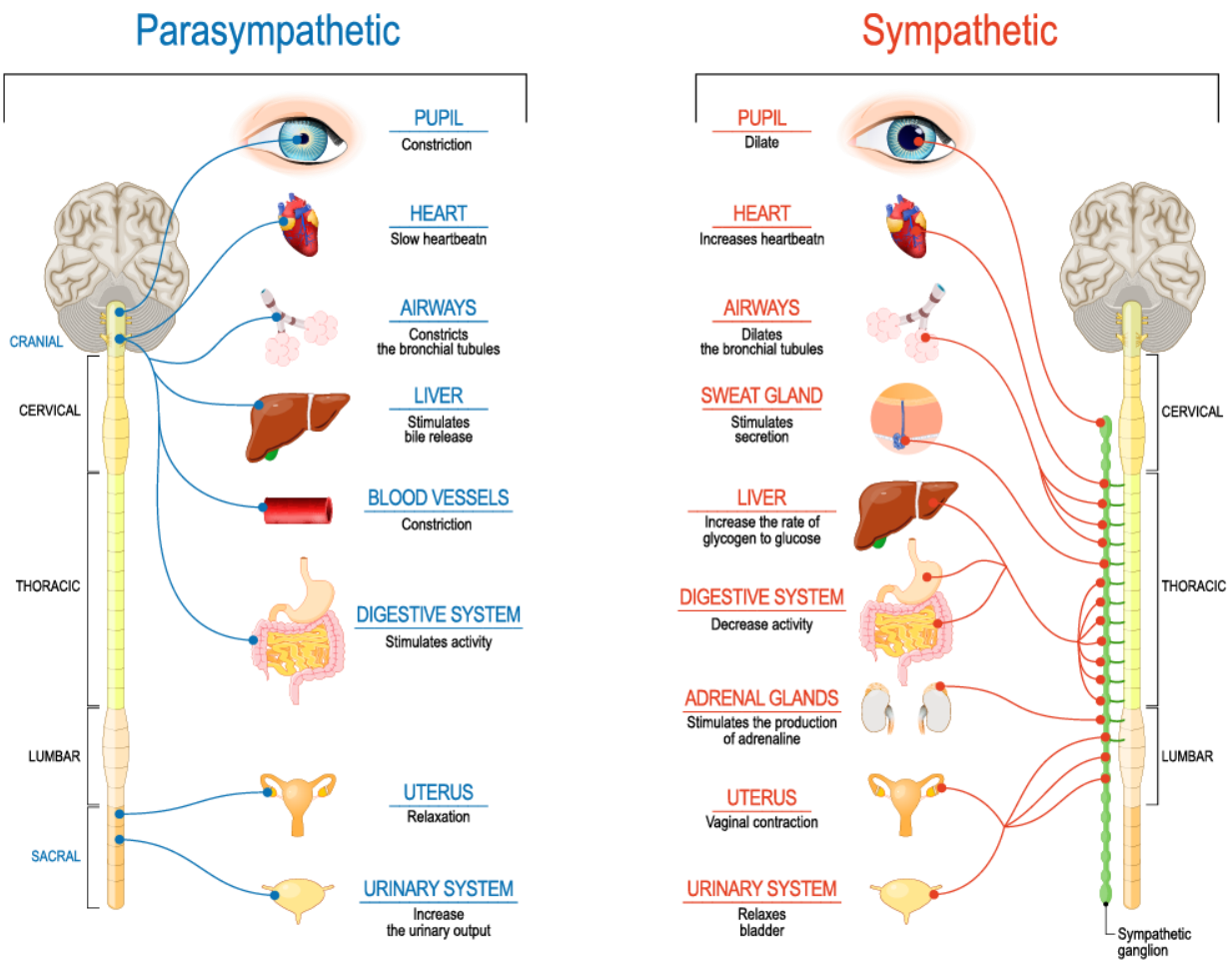
The majority of the Peripheral Nervous System is made up of two types of nerves, which are identified as spinal nerves and cranial nerves. Spinal nerves originate from the spinal cord and serves a specific region of the body. Meanwhile, cranial nerves originate from the brain. These nerves the structures of the head and certain body parts such as the heart and diaphragm.

The PNS is divided into the two following parts, which are the somatic and autonomic nervous systems. The somatic nervous system is responsible for the conscious motions of the individual, which include governing conscious sensations and voluntary movements. Meanwhile, the autonomic nervous system, controls our unconscious, involuntary internal activities.

Meanwhile, the autonomic nervous system is divided into the sympathetic and parasympathetic nervous systems. These components have distinctly antagonistic actions. For example, the sympathetic nervous system prepares the body to deal with stressful or emergency situations while the parasympathetic nervous system modifies body functioning during rest to conserve energy.

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**General Sensory System**

**Sensory Receptors**

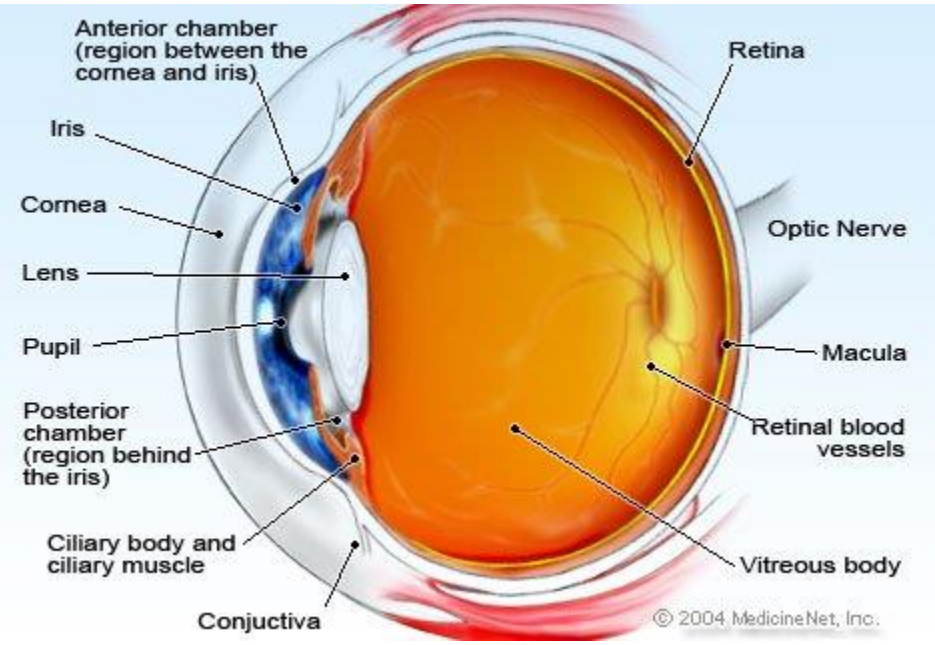
Sensory receptors are stimulated by the changes in the internal and the external environment. Once changes in the environment is detected, receptors generate electrochemical messages. These messages are then converted to nerve impulses transmitted to the brain.

**Classes of Receptors**

There are five types of sensory receptors, identified as mechanoreceptors, thermoreceptors, photoreceptors, chemoreceptors and pain receptors. Mechanoreceptors detect changes in the environment related touch, pressure, hearing, equilibrium, blood pressure, and body position, while thermoreceptors identify changes in temperature. Photoreceptors detect light while chemoreceptors track chemical levels within the body. Chemoreceptors also detect chemicals that elicit specific smells and tastes. Pain receptors respond to strong stimuli that cause physical or chemical damage to tissues.

The location of the sensory receptors differ significantly based on their respective functions. Receptors located near the body surface respond to environmental changes. Other sensory receptors are located inside the body and monitor internal conditions.

**Vision**

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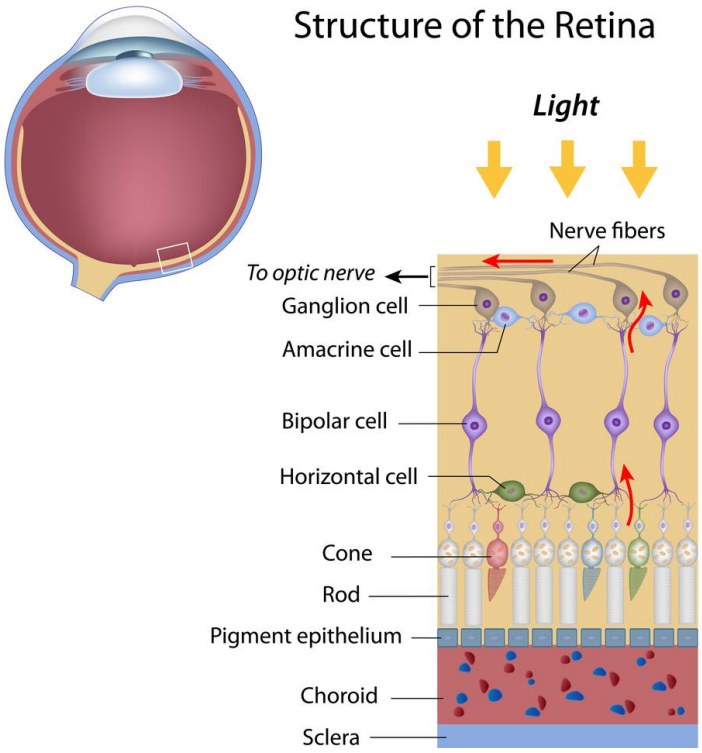
The wall of the eye is comprised of three layers. The outermost layer features the sclera and the cornea. The middle layer are comprised of the choroid, ciliary body, and iris make up the middle layer. The innermost layer contains the retina, the structure that features contains the photoreceptors (rods and cones).

The cornea and the lens work together to focus images on the retina by changing the shape of the lens to focus the image on the retina.

The rods or cones (photoreceptors) contain pigment cells that absorb light. Once the light hits the pigments, chemical changes are observed in the pigments. The resulting change in pigment causes changes in the permeability of the membrane of the photoreceptor, which results in the generation of a neural message. This neural message is carried by the optic nerve to the brain.

Color vision depends on the cones. The three types of cones are named for the color of light they absorb best—green, red, or blue. The combination of these three cones allow us to see colors.

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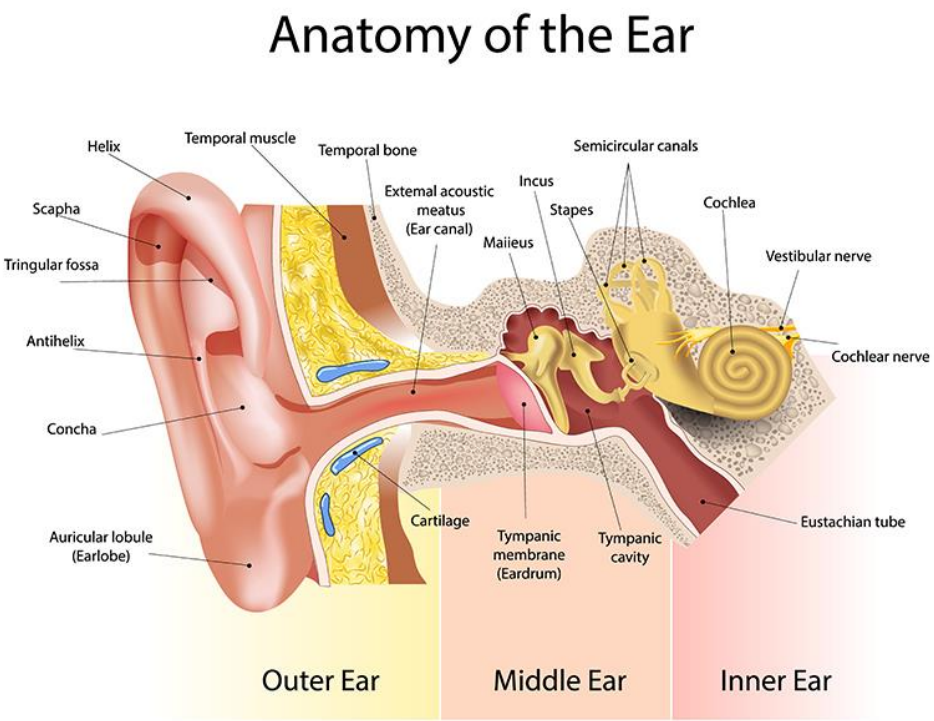
**Hearing**

The ear, the organ responsible for hearing, is divided into three regions, namely the outer ear, the middle ear, and the inner ear. The outer ear functions as a receiver. This region includes the pinna and the external auditory canal. Meanwhile, the middle ear serves as an amplifier and this region is comprised of the tympanic membrane (eardrum), three small bones (malleus, incus, and stapes), and the auditory tube. Last but not the least, the inner ear is a transmitter and consists of the cochlea and vestibular apparatus.

Hearing is the sensing of sound waves, mechanical waves that are caused by vibration. Sound enters the outer ear and and the energy carried by the mechanical waves vibrates the eardrum. These vibrations then move the malleus. The movement of the malleus then moves the incus and the stapes. The stapes conveys these vibrations to the inner ear by means of the oval window. Pressure on either side of the eardrum is regulated by the auditory tube.

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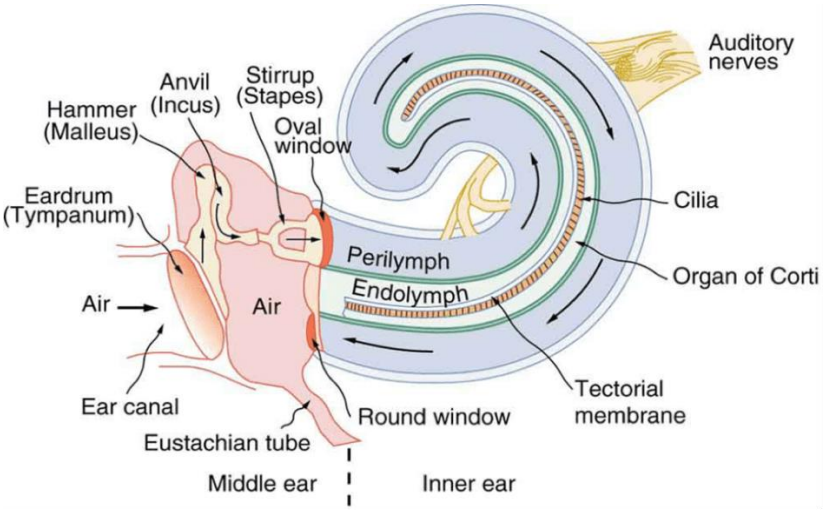
The inner ear is comprised of cochlea and vestibular apparatus. The cochlea is a coiled tube enclosed in bone, and it is divided into three longitudinal tubes.

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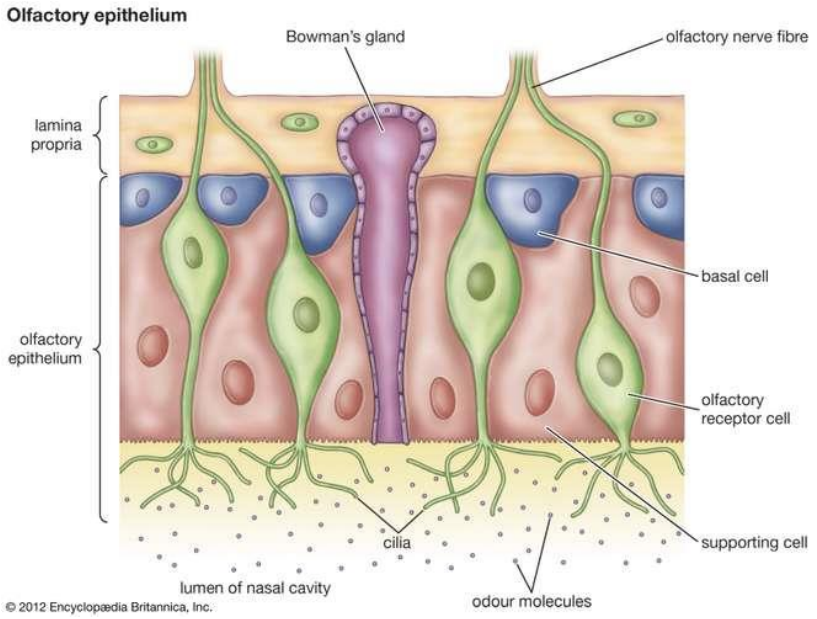
The middle tube contains the spiral organ (of Corti). This organ is lined with hair cells that are responsible for hearing, and these sensory hair cells extend from the basilar membrane which forms the floor of the spiral organ. The cochlea contains fluid that moves once vibrations reach the oval window of the cochlea. Movement of the fluid causes the basilar membrane to vibrate and it will also result in pushing hair cells into the overlying tectorial membrane. Once the hair cells are bent, this process will initiate nerve impulses.

**Balance and the Vestibular Apparatus of the Inner Ear**

- Balance is controlled by the vestibular apparatus, which consists of the semicircular canals and the vestibule.
    - The semicircular canals monitor sudden movements of the head.
    - The vestibule is made of two components, the saccule and the utricle, which tell the brain the position of the head with respect to gravity.

**Smell and Taste**

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Olfactory receptors are the receptors situated in the nasal cavity and these receptors are lined with cilia and coated with mucus. Odorous molecules dissolve in the mucus and bind to the receptors' hairs. Once the molecules bind to the receptors, this will result in stimulation of the receptors. Information is passed to the olfactory bulbs found in the brain and then to the limbic system and the cerebral cortex.
Meanwhile, the taste buds are chemoreceptors responsible for our sense of taste. They are located on the tongue, inside the cheeks, on the roof of the mouth, and in the throat, and these chemoreceptors can sense the five primary tastes of sweet, salty, sour, bitter, and umami.

## TERMINOLOGIES

**Ganglia** – a swollen structure that features a number of cell bodies that are typically linked by synapses
**Reflex Arc** – a neural pathway that controls a reflex and a usually does not pass through the brain but rather through the spinal cord
**Reticular Activating System** – a piece of the brain above the spinal cord that serves as the gatekeeper of information between the sensory system and the conscious mind
**Sensory Receptors** – Dendrites of neurons that detect and receive sensory stimuli
**Stimuli** – an event that results in a functional reaction in an organ or tissue
**Sensory Adaptation** – reduction in sensitivity after repeated exposure to a specific stimulus

## FURTHER READINGS

Kerr, S and Georgia Institute of Technology. (23 November 2016). Biology 1520: Animal Sensory Systems. http://bio1520.biology.gatech.edu/chemical-and-electrical-signals/sensory-systems-i/

## UNIT TASKS

Study Questions

- Two individuals figured in a car accident and both received spinal cord injuries of similar degree of severity. However, the patients differed in terms of location of the injuries. The first patient, named John, had the injury at the lower back while the second patient, named Rick, had his injury at the neck area. Which of the two patients will likely be in more critical condition? Why?
- Tina can read without any assistance from corrective eyewear but she requires glasses when she has to drive. What is her visual problem? What kind of eyewear does she have to wear?

# REFERENCES

Goodenough, J. and McGuire, B. A. 2011. Human Biology. Majority of the modules are based on the book Biology of Humans (4th Edition): Concepts, Application, and Issues (pp. 129-143, 151-172). San Francisco, CA: Pearson

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