

1. What is the difference between genotype and phenotype? Give examples.

- The genotype of an organism refers to its complete set of inherited genes, which determines its unique genetic makeup. The genotype includes not only the genes that are expressed, but also those that are silent or inactive. For example, a person's genotype may include genes for blue eyes, even if they have brown eyes due to the expression of a different dominant gene.
- The phenotype, on the other hand, refers to the physical and behavioral characteristics that are expressed as a result of the interaction between an organism's genotype and the environment. The phenotype is the observable result of gene expression and can be influenced by environmental factors such as diet, temperature, and exposure to toxins. For example, a person's phenotype may include the color of their eyes, height, and the shape of their nose, which are all influenced by both genetic and environmental factors.

4. Describe the relationship between chromosomes, DNA, and genes.

- Chromosomes, DNA, and genes are all related components of an organism's genetic material.
- DNA (deoxyribonucleic acid) is a molecule that carries the genetic instructions for the development and function of all living organisms. DNA is made up of long chains of nucleotides, which are the building blocks of the molecule.
- Genes are sequences of DNA that provide the instructions for making a specific protein. Proteins are the building blocks of cells and are responsible for

performing many of the functions that keep an organism alive and healthy. Each gene contains the instructions for making a single protein.

- Chromosomes are structures that are made up of DNA and proteins. In most human cells, the DNA is packaged into 46 chromosomes (23 pairs). Each chromosome contains many genes, and the complete set of chromosomes in a cell is referred to as its genome. The genome is the entire genetic material of an organism and contains all of its genes.

5. What are glial cells? Why are they important? What are the functions of glial cells?

- Glial cells, also known as neuroglia or simply glia, are non-neuronal cells in the central nervous system (CNS) that provide support and protection to the neurons. There are several types of glial cells, including astrocytes, oligodendrocytes, and microglia.

Glial cells are important because they play several crucial roles in the functioning of the CNS. Some of the functions of glial cells include:

1. Supporting and protecting neurons: Glial cells help to maintain the physical structure of the brain and spinal cord by holding neurons in place, providing insulation, and helping to repair damage.
2. Regulating the chemical environment: Glial cells help to regulate the chemical environment of the brain by removing excess neurotransmitters, controlling the levels of ions and nutrients, and maintaining the correct pH.

6. Why is neural transmission described as electrochemical communication? Explain.

- Neural transmission, or the transmission of signals in the nervous system, is often described as electrochemical communication because it involves both electrical and chemical signaling mechanisms.

Electrical signaling in the nervous system is accomplished through the movement of ions, such as sodium and potassium, across the cell membrane. This movement of ions creates a change in voltage, or an action potential, which can travel along the axon of a neuron and trigger the release of neurotransmitters.

Chemical signaling in the nervous system occurs when neurotransmitters, which are chemicals produced by neurons, bind to receptors on the post-synaptic neuron and alter its electrical potential. This can either excite or inhibit the post-synaptic neuron, depending on the type of neurotransmitter and receptor involved.

Thus, the combination of electrical and chemical signaling in the nervous system allows for rapid and precise communication between neurons. The electrical component of neural transmission allows for the rapid propagation of signals along the axon, while the chemical component allows for the precise control of the post-synaptic neuron.

8. What are the two branches of the somatic nervous system? Describe two disadvantages of the fight or flight response in our modern world.

The two branches of the somatic nervous system are the sensory (afferent) division and the motor (efferent) division.

The sensory division is responsible for transmitting sensory information, such as touch, temperature, and pain, from the periphery to the central nervous system (CNS). The neurons in the sensory division have their cell bodies in the dorsal root ganglia and their axons in the spinal nerves.

The motor division is responsible for controlling the voluntary movements of the skeletal muscles. The neurons in the motor division have their cell bodies in the spinal cord and their axons in the peripheral nerves.

The fight or flight response is a physiological response to perceived threats that prepares the body for action. However, in our modern world, this response can have some disadvantages:

1. Chronic stress: In modern society, many people face chronic stress, which means that their bodies are in a constant state of fight or flight. This can lead to health problems such as high blood pressure, heart disease, and depression.
2. Inability to relax: The fight or flight response is designed to be a temporary response to a threat, but in modern society, many people are unable to switch off this response. This can lead to chronic tension and muscle pain, as well as difficulties with sleeping and relaxing.

9. What is the corpus callosum? What is its function? Explain.

- The corpus callosum is a large bundle of nerve fibers that connects the two hemispheres of the brain and allows them to communicate with each other. It is the largest white matter structure in the human brain and is located in the center of the brain, above the brainstem. The corpus callosum is responsible for

integrating and coordinating information between the two hemispheres of the brain. The information travels between the hemispheres through the corpus callosum, allowing the two hemispheres to work together. This integration is essential for complex cognitive processes such as perception, language, memory, and motor control.

- Each hemisphere of the brain has specialized functions, and the corpus callosum allows for the transfer of information between these specialized areas. For example, the left hemisphere is often associated with language and logic, while the right hemisphere is often associated with creativity and spatial abilities. The corpus callosum allows the two hemispheres to work together to produce a more complete and integrated response to sensory input.

10. Describe two brain areas with roles essential for language functioning.

- Two key brain areas essential for language functioning are the Broca's area and Wernicke's area.
- The Broca's area, located in the frontal lobe of the left hemisphere in most people, is involved in language production and speech motor control. It is responsible for generating the grammatically correct sentences and generating the movements required for speech. People with damage to this area often experience difficulty producing speech and are referred to as having Broca's aphasia.
- Wernicke's area, located in the temporal lobe of the left hemisphere in most people, is responsible for language comprehension and the production of

meaningful words. This area is responsible for the ability to understand spoken and written language, as well as the ability to generate meaningful words. People with damage to this area often have difficulty understanding spoken language and are referred to as having Wernicke's aphasia.

16. What are two neurotransmitters involved in regulating mood and sleep? How do they work? Why are they important?

- Two neurotransmitters involved in regulating mood and sleep are serotonin and dopamine.
- Serotonin is a neurotransmitter that plays a key role in regulating mood, appetite, and sleep. It acts as a mood stabilizer by regulating the activity of other neurotransmitters in the brain. When there is a deficiency of serotonin, it can lead to depression, anxiety, and insomnia. To help regulate mood and improve sleep, selective serotonin reuptake inhibitors (SSRIs) are often prescribed, which work by increasing the availability of serotonin in the brain.
- Dopamine is another neurotransmitter that plays a role in regulating mood and motivation. It acts as a reward system by releasing a burst of dopamine in response to pleasurable experiences, such as eating, sex, or drugs. A deficiency of dopamine can lead to depression, lack of motivation, and decreased pleasure in life. Antidepressants, such as selective serotonin and norepinephrine reuptake inhibitors (SNRIs), work by increasing the availability of dopamine and other neurotransmitters in the brain to help regulate mood.

- These neurotransmitters are important because they help regulate mood, sleep, and motivation, which are all essential components of overall health and well-being. Understanding how they work and how they can be regulated through medication or lifestyle changes can help improve mental health and quality of life.

22. Watch the video “The Neuron” below and then answer the following questions: What are SSRIs and how do they work? What is the myelin sheath and why is it so important? What is meant by the term “brain plasticity”?

- Selective Serotonin Reuptake Inhibitors (SSRIs) are a type of antidepressant medication used to treat depression, anxiety, and other mental health conditions. They work by increasing the levels of the neurotransmitter serotonin in the brain. Serotonin is a neurotransmitter that regulates mood, appetite, and sleep, among other functions. When there is a deficiency of serotonin, it can lead to depression, anxiety, and other mental health conditions. SSRIs work by blocking the reuptake, or absorption, of serotonin by nerve cells in the brain, which leads to an increase in the levels of serotonin available to bind to other nerve cells and regulate mood.

The myelin sheath is a fatty coating that covers and protects nerve fibers, allowing electrical signals to be transmitted more efficiently along the nerves.

This sheath is important because it helps to maintain the health and function of nerve fibers, and contributes to the speed and accuracy of nerve signal transmission.

Brain plasticity refers to the brain's ability to change and adapt, both structurally and functionally, in response to experience and learning. This plasticity is the underlying mechanism for how the brain can learn, store new memories, and recover from injury. It occurs through the formation of new connections between nerve cells, and changes in the strength of these connections, in response to new experiences and learning. Brain plasticity is important because it allows the brain to adapt and change over time, which is essential for learning, memory, and recovery from injury.

23. Watch the video “The Synapse” below and then answer the following questions:

What is the relationship between biology and psychology? What do you think might occur if the transmission of neurotransmitters across the synapse is blocked? What if it is facilitated?

- Biology and psychology are closely related fields of study that often intersect and inform one another. Biology provides a foundation for understanding the physiological processes and mechanisms that underlie human behavior, while psychology is concerned with the study of behavior and mental processes.

The transmission of neurotransmitters across the synapse is a biological process that is essential for regulating behavior and mental processes. Neurotransmitters are chemical messengers that transmit signals between nerve cells, or neurons, in the brain. When the transmission of neurotransmitters across the synapse is blocked, it can lead to a decrease in communication between neurons and a

disruption of normal brain function. This can result in various mental and physical symptoms, such as depression, anxiety, and cognitive problems.

On the other hand, if the transmission of neurotransmitters across the synapse is facilitated, it can result in an increase in communication between neurons and an enhancement of normal brain function. This can have positive effects on mood, cognition, and overall mental and physical health. For example, certain medications, such as antidepressants and stimulants, work by either blocking or facilitating the transmission of neurotransmitters to help regulate mood and behavior.