Science
Honors: Human Anatomy and Physiology
Unit 8: The Nervous System

Essential Understandings	▪ The nervous system maintains body homeostasis with electrical signals; provides for sensation, higher mental functioning, and emotional response; and activates muscles and glands. ▪ There are two divisions of the nervous system: the central nervous system and the peripheral nervous system. ▪ Neurons have a general structure that can be classified based on their structure and function. ▪ A series of events lead to the generation of a nerve impulse and its conduction from one neuron to another. ▪ Major regions of the brain can to diagramed and labeled. ▪ The brain has protective structures. ▪ Reflexes pass through the spinal cord. ▪ Cranial and spinal nerves are part of the peripheral nervous system. ▪ The effects of the sympathetic and parasympathetic nervous system differ. ▪ Several factors can have harmful effects on brain development. ▪ There are five types of sensory receptors.
Essential Questions	▪ How do the roles of the central nervous system and peripheral nervous system differ? ▪ What is the general structure on a neuron and what are the names of the important anatomical regions? ▪ How is an action potential initiated and how is a nerve impulse generated? ▪ What are the major regions of the brain and what are their functions? ▪ What are the protective structures of the brain? ▪ How do reflexes differ from normal nervous system response? ▪ What are the functions of the major spinal and cranial nerves? ▪ How do the sympathetic and peripheral nervous system differ in their effect on organs in the body? ▪ What factors impact brain development? ▪ How do the sensory organs differ in structure and function?
Essential Knowledge	▪ The CNS is made of the brain and spinal cord while the PNS is made of the spinal and cranial nerves. ▪ Neurons conduct impulses while neuroglia cells help to support the neurons. ▪ The parts of a neuron are the axon, cell body, dendrites, myelin sheath, and nodes of Ranvier. ▪ There are three types of neuron: sensory neurons, interneurons, and motor neurons. ▪ An action potential is an “all-or-none response”. ▪ The generation of a nerve impulse involves a change in charge across the cell membrane that must then be reversed.

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	▪ There are four major regions of the brain – the cerebrum, the cerebellum, the brain stem, and the diencephalon region and each region has a different role to play in the body. ▪ The meninges and the blood brain barrier help to protect the brain. ▪ Neurons are connected by synapses that allow for passage of an impulse. ▪ The spinal nerves and the cranial nerves send nerves to different locations in the body. ▪ The sympathetic nervous system generates a "fight or flight" response while the parasympathetic nervous system generates a "rest and digest" response. ▪ A lack of oxygen can lead to the death of neurons and exposure to drugs, alcohol, and radiation can be damaging to fetal tissue. ▪ The senses rely on pain receptors, thermoreceptors, mechanoreceptors, chemoreceptors, and photoreceptors to help us perceive the world around us.
Vocabulary	Central nervous system (CNS) Peripheral nervous system (PNS) Sensory or afferent division Somatic sensory fibers Visceral sensory fibers or visceral afferents Motor or efferent division Somatic nervous system or voluntary nervous system Autonomic nervous system (ANS) or involuntary nervous system Sympathetic Parasympathetic Supporting cells or neuroglia Glia Astrocytes Microglia Ependymal cells Oligodendrocytes – myelin sheath Schwann cells Satellite cells Neurons or nerve cells Cell body Nissl substance Neurofibrils Processes or fibers Dendrites Axons Axon hillock Collateral branch Axon terminals

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	Neurotransmitters Synaptic cleft Synapse Myelin Myelin sheaths Neurilemma Nodes of Ranvier Multiple sclerosis (MS) Nuclei Ganglia Tracts Nerves White matter Gray matter Sensory or afferent neurons Receptors Cutaneous sense organs Proprioceptors Motor or efferent neurons Interneurons or association neurons Multipolar neuron Bipolar neuron Unipolar neuron Nerve impulses Irritability Conductivity Polarized Depolarized Graded potential Action potential or nerve impulse All-or-nothing response Repolarization Salutatory conduction Impulse Electrochemical event Reflexes Reflex arcs Somatic reflexes Autonomic reflexes Neural tube Ventricles Cerebral hemispheres Cerebrum Gyri (gyrus = singular) Sulci (sulcus = singular)

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	Fissures Lobes Cerebral cortex Primary somatic sensory area Parietal lobe Central sulcus Sensory homunculus Occipital lobe Temporal lobe Primary motor area Frontal lobe Corticospinal or pyramidal tract Motor homunculus Broca's area Speech area Gray matter Cerebral white matter Corpus callosum Basal nuclei or basal ganglia Huntington's disease or Huntington's chorea Parkinson's disease Diencephalons or interbrain Thalamus Hypothalamus Limbic system Pituitary gland Mammillary bodies Epithalamus Pineal body Choroid plexus Brain stem Midbrain Cerebral aqueduct Cerebral peduncles Corpora quadrigemina Pons Medulla oblongata Fouth ventricle Reticular formation Reticular activating system (RAS) Cerebellum Ataxia Meninges Dura mater Falx cerebri

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	Tentorium cerebelli Arachnoid mater Subarachnoid space Pia mater Arachnoid villi Meningitis Encephalitis Cerebrospinal fluid (CSF) Hydrocephalus Blood-Brain Barrier Concussion Contusion Intracranial hemorrhage Cerebral edema Cerebrovascular accidents (CVAs) Hemiplegia Aphasias Transient ischemic attack (TIA) Spinal cord Cauda equina Dorsal or posterior horns Ventral or anterior horns Central canal Dorsal root Dorsal root ganglion Ventral root Spinal nerves Flaccid paralysis Dorsal, lateral, and ventral columns Spastic paralysis Peripheral nervous system (PNS) Nerve Endoneurium Perineurium Fascicles Epineurium Mixed nerves Sensory or afferent nerves Motor or efferent nerves Cranial nerves I. Olfactory II. Optic III. Oculomotor IV. Trochlear V. Trigeminal

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	VI. Abducens VII. Facial VIII. Vestibulocochlear IX. Glossopharyngeal X. Vagus XI. Accessory XII. Hypoglossal Spinal nerves Dorsal and ventral rami Plexuses Cervical Phrenic Brachial Lumbar Femoral Sacral Sciatic Autonomic nervous system (ANS) Involuntary nervous system Preganglionic axon Postganglionic axon Sympathetic division Parasympathetic division Sympathetic division Parasympathetic division Cerebral palsy Anencephaly Spina bifida Orthostatic hypotension Arteriosclerosis Senility sensory receptor pain receptor thermoreceptor mechanoreceptor chemoreceptor photoreceptor The Senses The Eye cornea aqueous humor iris vitreous humor pupil lens

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	retina rod cone fovea optic nerve The Ear auditory canal tympanum hammer anvil stirrup oval window semicircular canal cochlea cochlear nerve eustachian tube Taste and Smell taste bud olfactory bulb
Essential Skills	▪ Recognize the differences between parts of the Central and Peripheral Nervous Systems. ▪ Diagram and label a model of a neuron. ▪ Describe an action potential and nerve impulse. ▪ Name and describe the major sections of the brain. ▪ Label a diagram of the spinal and cranial nerves. ▪ Label of a diagram of an ear and eye.
Related Maine Learning Results	<u>Science</u> A. Unifying Themes A1.Systems Students apply an understanding of systems to explain and analyze man-made and natural phenomena. a. Analyze a system using the principles of boundaries, subsystems, inputs, outputs, feedback, or the system's relation to other systems and design solutions to a system problem. b. Explain and provide examples that illustrate how it may not always be possible to predict the impact of changing some part of a man-made or natural system. A3.Constancy and Change Students identify and analyze examples of constancy and chang that result from varying types and rates of change in physical, biological, and technological systems with and without counterbalances. B. The Skills and Traits of Scientific Inquiry and Technological Design B1.Skills and Traits of Scientific Inquiry

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	Students methodically plan, conduct, analyze data from, and communicate results of in-depth scientific investigations, including experiments guided by a testable hypothesis. a. Identify questions, concepts, and testable hypotheses that guide scientific investigations. b. Design and safely conduct methodical scientific investigations, including experiments with controls. c. Use statistics to summarize, describe, analyze, and interpret results. d. Formulate and revise scientific investigations and models using logic and evidence. e. Use a variety of tools and technologies to improve investigations and communications. f. Recognize and analyze alternative explanations and models using scientific criteria. g. Communicate and defend scientific ideas. B2.Skills and Traits of Technological Design Students use a systematic process, tools and techniques, and a variety of materials to design and produce a solution or product that meets new needs or improves existing designs. a. Identify new problems or a current design in need of improvement. b. Generate alternative design solutions. c. Select the design that best meets established criteria. d. Use models and simulations as prototypes in the design planning process. e. Implement the proposed design solution. f. Evaluate the solution to a design problem and the consequences of that solution. g. Present the problem, design process, and solution to a design problem including models, diagrams, and demonstrations. C. The Scientific and Technological Enterprise C1.Understandings of Inquiry Students describe key aspects of scientific investigations: that they are guided by scientific principles and knowledge, that they are performed to test ideas, and that they are communicated and defended publicly. a. Describe how hypotheses and past and present knowledge guide and influence scientific investigations. b. Describe how scientists defend their evidence and explanations using logical argument and verifiable results. C2.Understanings About Science and Technology

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	Students explain how the relationship between scientific inquiry and technological design influences the advancement of ideas, products, and systems. a. Provide an example that shows how science advances with the introduction of new technologies and how solving technological problems often impacts new scientific knowledge. b. Provide examples of how creativity, imagination, and a good knowledge base are required to advance scientific ideas and technological design. C3.Science, Technology, and Society Students describe the role of science and technology in creating and solving contemporary issues and challenges. b. Explain how ethical, societal, political, economic, and cultural factors influence personal health, safety, and the quality of the environment. c. Explain how ethical, societal, political, economic, religious, and cultural factors influence the development and use of science and technology. C4.History and Nature of Science Students describe the human dimensions and traditions of science, the nature of scientific knowledge, and historical episodes in science that impacted science and society. a. Describe the ethical traditions in science including peer review, truthful reporting, and making results public. b. Select and describe one of the major episodes in the history of science including how the scientific knowledge changed over time and any important effects on science and society. c. Give examples that show how societal, cultural, and personal beliefs and ways of viewing the world can bias scientists. d. Provide examples of criteria that distinguish scientific explanations from pseudoscientific ones. D. The Physical Setting D2.Earth Students describe and analyze the biological, physical, energy, and human influences that shape and alter Earth Systems. c. Describe and analyze the effects of biological and geophysical influences on the origin and changing nature of Earth Systems. d. Describe and analyze the effects of human influences on Earth Systems. D3.Matter and Energy

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	Students describe the structure, behavior, and interactions of matter at the atomic level and the relationship between matter and energy. h. Describe radioactive decay and half-life. E. The Living Environment E1.Biodiversity Students describe and analyze the evidence for relatedness among and within diverse populations of organisms and the importance of biodiversity. a. Explain how the variation in structure and behavior of a population of organisms may influence the likelihood that some members of the species will have adaptations that allow them to survive in a changing environment. b. Describe the role of DNA sequences in determining the degree of kinship among organisms and the identification of species. c. Analyze the relatedness among organisms using structural and molecular evidence. d. Analyze the effects of changes in biodiversity and predict possible consequences. E2.Ecosystems Students describe and analyze the interactions, cycles, and factors that affect short-term and long-term ecosystem stability and change. a. Explain why ecosystems can be reasonably stable over hundreds or thousands of years, even though populations may fluctuate. b. Describe dynamic equilibrium in ecosystems and factors that can, in the long run, lead to change in the normal pattern of cyclic fluctuations and apply that knowledge to actual situations. E3.Cells Students describe structure and function of cells at the intracellular and molecular level including differentiation to form systems, interactions between cells and their environment, and the impact of cellular processes and changes on individuals. a. Describe the similarities and differences in the basic functions of cell membranes and of the specialized parts within cells that allow them to transport materials, capture and release energy, build proteins, dispose of waste, communicate, and move. b. Describe the relationship among DNA, protein molecules, and amino acids in carrying out the work of cells and how this

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	is similar among all organisms. c. Describe the interactions that lead to cell growth and division (mitosis) and allow new cells to carry the same information as the original cell (meiosis). d. Describe ways in which cells can malfunction and put an organism at risk. e. Describe the role of regulation and the processes that maintain an internal environment amidst changes in the external environment. f. Describe the process of metabolism that allows a few key biomolecules to provide cells with necessary materials to perform their functions. g. Describe how cells differentiate to form specialized systems for carrying out life functions. E4.Heredity and Reproduction Students examine the role of DNA in transferring traits from generation to generation, in differentiating cells, and in evolving new species. c. Explain how the instructions in DNA that lead to cell differentiation result in varied cell functions in the organism and DNA. d. Describe the possible causes and effects of gene mutations. E5.Evolution Students describe the interactions between and among species, populations, and environments that lead to natural selection and evolution. a. Describe the premise of biological evolution, citing evidence from the fossil record and evidence based on the observation of similarities within the diversity of existing organisms. b. Describe the origins of life and how the concept of natural selection provides a mechanism for evolution that can be advantageous or disadvantageous to the next generation. c. Explain why some organisms may have characteristics that have no apparent survival or reproduction advantage. d. Relate structural and behavioral adaptations of an organism to its survival in the environment.
Sample Lessons and Activities	▪ View human brain models ▪ Do a sheep brain dissection ▪ Do a cow eye dissection ▪ Make a model neuron with pipe cleaners ▪ Model an action potential

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	▪ Reflex and Response Lab ▪ Taste lab using *Gymnema sylvestre* ▪ Test the effect of alcohol on *C. elegans* ▪ View nervous tissue during a rat and fetal pig dissection. ▪ Read articles related to disorders caused by homeostatic imbalance in the nervous system. ▪ Have the school Substance Abuse Counselor meet with the class to discuss the effects of drugs and alcohol on the nervous system
Sample Classroom Assessment Methods	▪ Quiz ▪ Chapter Test ▪ Worksheets ▪ Labs
Sample Resources	▪ Publications: o Essentials of Human Anatomy and Physiology, 9th edition by Elaine N. Marieb o Anatomy and Physiology Coloring Workbook: A Complete Study Guide by Elaine N. Marieb o Essentials of Human Anatomy and Physiology Laboratory Manual by Elaine N. Marieb ▪ Videos: o National Geographic: Inside the Living Body o National Geographic: The Incredible Human Machine ▪ Other Resources Lab Supplies