Science
Honors Human Anatomy and Physiology
Unit 4: The Skeletal System

Essential Understandings	▪ The skeletal system provides an internal framework for the body. ▪ The skeletal system protects the body by enclosure. ▪ The skeletal system anchors skeletal muscles so that muscle contractions can cause movement. ▪ The skeletal system is divided into two main subdivisions ▪ There are three major categories of joints. ▪ Bone and joint problems can develop during life.
Essential Questions	▪ What bones make up both the axial and appendicular skeleton? ▪ What are the four main classifications of bones? ▪ What are the major anatomical areas of a long body? ▪ What is the microscopic anatomy of the bone? ▪ What is the process of bone formation in the fetus and how does bone remodeling occur throughout life? ▪ What are the various types of factures that occur in bones? ▪ What are the bones of the skull and face? ▪ How does the skull of a newborn differ from the skull of an adult? ▪ How do cervical, thoracic, and lumbar vertebrae differ from one another? ▪ How do abnormal spinal curvatures (scoliosis, lordosis, and kyphosis) differ from one another? ▪ What are the bones of the shoulder and pelvic girdles and their attached limbs? ▪ How does the female pelvis differ from the male pelvis? ▪ How does the structure of a joint affect its function? ▪ What are bone and joint problems that can affect the skeletal system?
Essential Knowledge	▪ The axial skeleton is made up of the skull, vertebrae, ribs and sternum. ▪ The appendicular skeleton is made up of the shoulder girdle, pelvis, and appendages. ▪ Bone is classified as long, short, flat, and irregular bones. ▪ Bone begins as hyaline cartilage in embryos and much of the cartilage ossifies and changes as humans grow. ▪ There are six major categories of bone fractures. ▪ Broken bones heal in a predictable pattern. ▪ Name the bones of body. ▪ The form of the male and female pelvis affects their function. ▪ Joints allow bones to move (or not move) in different ways. ▪ Bones and joints can break down and become diseased over time.
	Axial skeleton Appendicular skeleton Skeletal system

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Vocabulary	Compact bone Spongy bone Long bones Short bones Flat bones Irregular bones Diaphysis Periosteum Perforating or Sharpey's fibers Epiphyses Articular cartilage Epiphyseal line Epiphyseal plate Yellow marrow or medullary cavity Red marrow Bone markings Projections or processes Depressions or cavities Tuberosity Crest Trochanter Line Tubercle Epicondyle Spine Process Head Facet Condyle Ramus Meatus Sinus Fossa Groove Fissure Foramen Osteocytes Lacunae Lamellae Central (Haversian) canals Osteon or Haversian system Canaliculi Perforating (Volkmann's) canals Ossification

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	Osteoblasts Appositional growth Osteoclasts Hypercalcemia Bone remodeling Rickets Fractures Closed or simple Open or compound Reduction Closed reduction Open reductions Hematoma Fibrocartilage callus Bony callus Comminuted Compression Depressed Impacted Spiral Greenstick Skull Cranium Facial bones Frontal bone Parietal bones Sagittal suture Coronal suture Temporal bones Squamous sutures External acoustic meatus Styloid process Zygomatic process Mastoid process Jugular foramen Internal acoustic meatus Cartoid canal Occipial Bone Lambdoid suture Foramen magnuem Occipital condyles Sphenoid bone Sella turcica or Turk's saddle Optic canal

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	Sphenoid sinuses Ethmoid bone Crista galli Cribriform plates Superio nasal conchae Middle nasal conchae Facial bones Maxillae Maxillary bones Alveolar margin Palatine processes Sinuses Paranasal sinuses or maxillary sinuses Palatine bones Zygomatic bones Lacrimal bones Nasal bones Vomer bone Inferior nasal conchae Mandible Alveolar margin Hyoid bone Fetal skull fontanels Vertebral column or spine Vertebrae Intervertebral discs Herniated discs Primary curvatures S-curve C-curve Secondary curvatures Scoliosis Kyphosis Lordosis Congenital Body or centrum Vertebral arch Vertebral foramen Transverse processes Spinous process Superior and inferior articular processes Cervical vertebrae Atlas

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	Axis Dens Thoracic vertebrae Lumbar vertebrae Sacrum Coccyx Bony thorax Thoracic cage Sternum Manubrium Body Xiphoid process Jugular notch Sternal angle Xiphisternal joint Sternal puncture Ribs True ribs False ribs Floating ribs Shoulder girdle or pectoral girdle Clavicle or collarbone Scapulae or shoulder blades Acromion Coracoic process Acromioclavicular joint Suprascapular notch Glenoid cavity Sternoclavicular joint Upper Arm Humerus Deltoid Tuberosity Radial groove Trochlea Capitulum Coronoid fossa Olecranon fossa Medial and lateral epicondyles Radius Radioulnar joints Interosseous membrane Radial Tuberosity Ulna Coronoid process

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	Olecranon process Trochlear notch Carpal bones Carpus Metacarpals Phalanges Pelvic girdle Coxal bones or ossa coxae or hip bones Ilium Sacroiliac joint Iliac crest Ischium Ischial tuberosity Ischial spine Greater sciatic notch Pubis or pubic bone Obturator foramen Pubic symphysis Acetabulum False pelvis True pelvis Outlet Inlet Femur or thigh bone Greater and lesser trochanters Intertrochanteric line Intertrochanteric crest Gluteal Tuberosity Lateral and medial condyles Intercondylar fossa Patellar surface Tibia or shin bone Interosseous membrane Medial and lateral condyles Intercondylar eminence Tibial Tuberosity Medial malleolus Fibula Lateral malleolus Tarsus Tarsal bones Calcaneus Talus Metatarsals

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	Phalanges Joints or articulations Synarthroses Amphiarthroses Diarthroses Fibrous joints Syndesmoses Cartilaginous joints Synovial joints Articular cartilage Fibrous articular capsule Joint cavity Reinforcing ligaments Bursae tendon sheath Dislocation Reduction Plane joint Hinge joint Pivot joint Condyloid joint Saddle joints Ball-and-socket joint Bursitis Sprain Arthritis Osteoarthritis (OA) Bone spurs Crepitus Rheumatoid arthritis (RA) Pannus Ankylosis Gouty arthritis or gout Osteoporosis
Essential Skills	▪ Name all of the bones of the axial and appendicular skeletal systems. ▪ Label a diagram of a long bone. ▪ Draw the microscopic anatomy of compact bone. ▪ Identify joint types throughout the body. ▪ Relate bone development to bone disease that can occur later in life.
Related Maine Learning Results	Science A. Unifying Themes A1.Systems Students apply an understanding of systems to explain and

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	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 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.

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	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 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.

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	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 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.

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	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 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

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	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	▪ Microscope Lab using Compact Bone ▪ Examine cow and sheep bones ▪ Compare skull models of human and other primates ▪ Examine articulated and disarticulated skeletons ▪ Play Simon Says game to learn bone names ▪ Watch a joint replacement or ACL replacement surgery on-line ▪ View bones during a rat and fetal pig dissection ▪ Read articles related to disorders caused by homeostatic imbalance in the skeletal 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