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| **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. |
| **Vocabulary** | Axial skeleton  Appendicular skeleton  Skeletal system  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  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  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  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  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  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  analyze man-made and natural phenomena.  a. Analyze a system using the principles of boundaries,  subsystems, inputs, outputs, feedback, or thesystem’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 change  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.   1. Identify questions, concepts, and testable hypotheses that guide scientific investigations. 2. Design and safely conduct methodical scientific investigations, including experiments with controls. 3. Use statistics to summarize, describe, analyze, and interpret results. 4. Formulate and revise scientific investigations and models using logic and evidence. 5. Use a variety of tools and technologies to improve investigations and communications. 6. Recognize and analyze alternative explanations and models using scientific criteria. 7. 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.   1. Identify new problems or a current design in need of improvement. 2. Generate alternative design solutions. 3. Select the design that best meets established criteria. 4. Use models and simulations as prototypes in the design planning process. 5. Implement the proposed design solution. 6. Evaluate the solution to a design problem and the consequences of that solution. 7. 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.   1. Describe how hypotheses and past and present knowledge guide and influence scientific investigations. 2. 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.   1. Provide an example that shows how science advances with the introduction of new technologies and how solving technological problems often impacts new scientific knowledge. 2. 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.   1. 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.   1. Describe the ethical traditions in science including peer review, truthful reporting, and making results public. 2. 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. 3. Give examples that show how societal, cultural, and personal beliefs and ways of viewing the world can bias scientists. 4. 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.   1. 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. 2. Describe the role of DNA sequences in determining the degree of kinship among organisms and the identification of species. 3. Analyze the relatedness among organisms using structural and molecular evidence. 4. 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.   1. Explain why ecosystems can be reasonably stable over hundreds or thousands of years, even though populations may fluctuate. 2. 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  Students describe the interactions between and among species, populations, and environments that lead to natural selection and evolution.   1. 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. 2. 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. 3. Explain why some organisms may have characteristics that have no apparent survival or reproduction advantage. 4. 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:   + Essentials of Human Anatomy and Physiology, 9th edition by Elaine N. Marieb   + Anatomy and Physiology Coloring Workbook: A Complete Study Guide by Elaine N. Marieb   + Essentials of Human Anatomy and Physiology Laboratory Manual by Elaine N. Marieb * Videos:   + National Geographic: Inside the Living Body   + National Geographic: The Incredible Human Machine * Other Resources   Lab Supplies |