Course Learning Outcomes for Unit III

Upon completion of this unit, students should be able to:

7. Categorize the cells, tissues, and organs located within the body cavities and membranes.

8. Examine the structure and function of the organs located within the skeletal, muscular, integumentary, cardiovascular, lymphatic and immune, nervous, sensory, endocrine, gastrointestinal, urinary, reproductive, and respiratory systems.

9. Identify the common signs, symptoms, and illnesses associated with the structure and functions of the skeletal, muscular, integumentary, cardiovascular, lymphatic and immune, nervous, sensory, endocrine, gastrointestinal, urinary, and reproductive and respiratory systems.

Reading Assignment

Chapter 6: 
The Skeletal System: The Framework

Chapter 7: 
The Muscular System: Movement for the Journey

Unit Lesson

The Musculoskeletal System

Have you ever seen a beautiful house that you admired and wanted to live in? Perhaps as you gaze at the house you can imagine the huge walk-in closets, spacious kitchen, and open floor plan. Perhaps you envision your children running around in the backyard as you watch them from the sunroom at the back of the house. As you gaze at the external beauty of the house, you are probably not giving much thought to the beams and framework that hold it all together. The human body can be thought of as a house. If the human body is the house, the skeletal system is the wood framework. The bones of the skeletal system help to provide the body with shape and strength just as the frame of a house provides shape, strength, and support.

Functions of the Muscular System

If you had to describe the function of muscles, what would you say? It is likely that you would focus on the limb movements needed for everyday activities such as walking, running, bending, and twisting. What many people do not think about is that there are other very important skeletal muscle functions that we use on a daily basis. For example, muscles are necessary for breathing, talking, and even sneezing. Another important ability of muscles is the ability to allow us to communicate through facial expression. There are more than 20 muscles in the face that allow us to perform very specific movements in our face. The muscles surrounding the eyes can contract more than 100,000 times per day (Colbert, Ankney, & Lee, 2013). These expressions give us the ability to express emotions such as joy, laughter, and sadness. Think about it. Without the ability to express emotions through facial expressions, each of us would be a blank canvas.

Types of Muscle

Humans have three types of muscles: Smooth, cardiac, and skeletal. The word muscle is derived from the Latin word *mus*, which means mouse, because the movement of muscles has the appearance of mice running under the skin (Colbert et al., 2013). All muscle, regardless of type, has the ability to contract—or to
The contractile cells of muscles can also elongate and are called muscle fibers. Each of these fibers is about the same diameter as a human hair.

**The Functional Unit of the Muscle**

The typical muscle is surrounded by connective tissue. Inside of the muscle are bundles of muscle fibers surrounded by perimysium. These bundles are called fascicles. Each individual muscle fiber is encased in a connective tissue that is known as endomysium and is filled with cylinders known as myofibrils. The myofibril consists of protein threads that are organized into contractile units known as sarcomeres. Each sarcomere is separated by a dark line known as the *Z* line, which is what gives muscles their striated appearance (Colbert et al., 2013).

**Skeletal Muscle**

Skeletal muscles are cylindrical and striated. Skeletal muscles are innervated—meaning that they receive stimulation to contract by way of motor neurons that are found in nerves. Skeletal muscles attach to bones and are voluntary muscles, meaning that they are under conscious control. Skeletal muscles are separated from other muscles and held into place by layers of fibrous connective tissue that is known as fascia (Moini, 2013). Skeletal muscles serve several functions in the human body. Skeletal muscles provide support for the body. The contractions of skeletal muscles serve as an opposing force of gravity, which allows us to remain upright as we walk. Skeletal muscles also make bones and other body parts move.

Skeletal muscle helps maintain a constant body temperature. As muscles contract, energy is broken down in order to produce heat that is then distributed around the body. This is why your temperature rises when you are exercising and why you shiver when you are cold. The pressure of skeletal muscle contraction also keeps blood moving through the blood vessels and lymphatic vessels throughout the body. Skeletal muscle also serves as a layer of protection for bones and vital organs.

**Smooth Muscle**

Smooth muscle is located in the walls of hollow internal organs and blood vessels. Smooth muscle contractions are involuntary and are not striated. The movement of smooth muscle allows materials to move through organs and blood vessels. Smooth muscle fibers are narrow in appearance and have tapered, cylindrical cells that have a single nucleus. Smooth muscles are slower in regards to contraction as compared to skeletal muscle, but they have the ability to sustain prolonged contractions without becoming fatigued (Longenbaker, 2013).

There are two types of smooth muscle: multiunit and visceral. Multiunit smooth muscle contracts only when stimulated by certain nerve impulses or hormones. Visceral smooth muscle is made up of sheets of cells and is found in the walls of hollow organs such as the intestines, stomach, and bladder (Moini, 2013). Visceral smooth muscle fibers can stimulate other muscles. For example, during peristalsis, a wavelike motion allows food to move from the stomach into the intestines.

**Cardiac Muscle**

Cardiac muscle forms the internal structure of the heart. Cardiac muscle is made up of striated cells that connect and allow for contraction in order to pump blood out of the chambers of the heart. Cardiac muscle is involuntary and allows the heart to work constantly in order to supply blood and oxygen to the other parts of the body. Cardiac muscle fibers are connected by intercalated discs that allow one fiber to contract and then the adjacent fiber to contract. This creates a domino or wave effect that allows the blood to be squeezed out of the heart and into the body (Colbert et al., 2013). Cardiac muscle is unique in that it does not regenerate after severe damage. For example, if a coronary artery is blocked by plaque, the blood supply to the heart muscle is cut off and this can create irreparable damage to portions of the heart.

**The Energy Source for Muscles**

In order to survive and function, muscles require fuel in the form of nutrients and oxygen. The body has the ability to break down glycogen, a carbohydrate that is stored in the muscle, into glucose. Energy is then
released during cellular respiration, and energy is released from the glucose and converted into adenosine triphosphate (ATP), which is a source of power for the muscle (Colbert et al., 2013).

Functions of the Skeletal System

The skeletal system consists of bone tissue, cartilage, blood, connective tissue, and nervous tissue (Moini, 2013). The skeletal system helps to provide support and allows us to move, but—unbeknownst to many of us—the skeletal system does so much more. The skeletal system also provides assistance with movement, performs mineral homeostasis, produces red blood cells, and stores triglycerides (Tortora & Derrickson, 2012). The adult human body consists of 206 major bones, which are classified by their individual shapes. These shapes are as follows:

Types of Bones

- **Flat bones**: generally thin and resemble plates (e.g., skull, ribs, scapulae)
- **Irregular bones**: have complex shapes; often connected to other bones (e.g., facial bones, bones that make up the vertebrae)
- **Sesamoid (round) bones**: small, flat, and shaped like sesame seeds (e.g., hand bones)
- **Short bones**: small and often cube-shaped (e.g., wrist and ankle bones)
- **Long bones**: have long shafts with expanded ends (e.g., femur)

The largest bone in the human body is the pelvis, composed of six bones joined together. The longest bone is the femur, making up almost a quarter of the body’s total height. The smallest bone is the stirrup in the ear, which is hardly larger than a grain of rice.

Bone Composition, Formation, and Structure

Bone cells are known as osteocytes. Osteocytes occupy small chambers (lacunae) that create a complex matrix around central (Haversian) canals in bones. Cellular processes allow osteocytes to communicate with other cells throughout the body. Bone tissue is made up of collagen and inorganic salts such as calcium phosphate. The bones hardness depends on the crystallization of inorganic mineral salts and a bone’s flexibility depends on its collagen fibers (Tortora & Derrickson, 2012).

At the microscopic level, there are four major types of cells present in bone tissues. Osteocytes, as previously mentioned, are one of those types. Osteocytes are mature bone cells and are the main cells in bone tissue. These cells help maintain daily metabolism and exchange nutrients and wastes with blood. Another type of cell in bone tissue is the osteogenic cell, also known as the osteoprogenitor cell. Osteogenic cells are unspecialized stem cells and are able to undergo cell division. Osteogenic cells divide, creating osteoblasts that are known for their bone-building capacity. Finally, osteoclasts are large cells that are created through the fusion of monocytes. These cells release enzymes and acids that can digest the protein and mineral composition of bone. This process is known as resorption. Resorption is a normal part of the development, growth maintenance, and repair of bones.

Bone Remodeling

Our bones are constantly remodeling in response to the physical demands placed on the body. Bones form before birth and continue to renew thereafter. Bone remodeling refers to the ongoing replacement of old bone tissue by new bone tissue. Bone remodeling involves resorption and bone deposition. Bone resorption results in the destruction of the extracellular matrix and bone deposition results in the formation of bone extracellular matrix. There is a delicate balance that exists between these processes. For example, abnormal acceleration of this process of remodeling can lead to a condition known as Paget’s disease. In Paget’s disease, newly formed bones—particularly those of the pelvis, limbs, and skull—become hard, brittle, and prone to easy fracture.
Fractures

A fracture is simply a break in any bone. Fractures are generally classified into the following types:

- **Partial**: an incomplete break across the bone
- **Complete**: a break across a bone in which the bone is broken into two or more pieces
- **Closed** (simple): the fractured bone does not break through the skin
- **Open** (compound): the broken ends of the bone protrude through the skin

Most minor fractures heal within six to eight weeks as the body’s internal processes correct the defect in the bone. Broken bones are often associated with casts, but not every broken bone requires a cast. Broken ribs, collarbones, and toes are typically treated without the use of a cast. A broken toe is typically buddy taped: wrapped up in tape/bandaging with the healthy toe next to it. Broken collarbones are usually treated with a fabric sling that immobilizes the shoulder. Pelvic fractures and broken ribs often need no treatment at all except for pain medication and limited activity.

Fractures and Aging

Bones that have been weakened by osteoporosis are extremely susceptible to fracture. In patients with osteoporosis, something as simple as tripping and falling to the ground can cause a hip fracture that is significant enough to require surgical correction. Some patients with osteoporosis may develop compression (crushing) fractures in their vertebrae following an incident considered so trivial that they are not even aware that any trauma has occurred.

The body has over 600 muscles, and they come in various sizes and shapes to allow them to perform different functions. Muscles make up almost half of the weight of the entire body (Colbert et al., 2013). Some of the biggest and strongest muscles are in the back near the spine, helping to maintain upright posture and providing the power to lift and push things. A lifetime of abuse to the back muscles can result in serious and painful problems, sometimes triggered by a task as simple as picking up a pencil—the “straw that broke the camel’s back.” Careful attention to lifting and moving—especially as we approach middle age when back injury becomes more prevalent—can help prevent debilitating injury.

References


Learning Activities (Non-Graded)

For a review of the Key Terms of the unit, click here to access the interactive Unit III Flashcards in PowerPoint form. (Click here to access a PDF version.)

Non-graded Learning Activities are provided to aid students in their course of study. You do not have to submit them. If you have questions, contact your instructor for further guidance and information.