Human Anatomy

PEHR 1089 Reading 5

When studying anatomy for the first time, you may encounter descriptive terms that are unfamiliar. Use of the correct anatomical terms for position, location and direction is essential when describing a particular movement, exercise or activity to fitness professional.

Most anatomical terms have their roots in Latin or Greek languages and are usually quite descriptive. (See table 2.1)
There are five major human body systems pertinent to physical activity: the cardiovascular system, the respiratory system, the nervous system, the skeletal system.

Anatomical, Directional and Regional Terms

Anterior (ventral)	Toward the front
Posterior (dorsal)	Toward the back
Superior	Toward the head
Inferior	Away from the head
Medial	Toward the midline of the body
Lateral	Away from the midline of the body
Proximal	Toward the attached end of the limb, origin, of the structure, or the midline of the body
Distal	Away from the attached end of the limb, origin of the structure, or midline of the body
Superficial	External; located close to or on the body surface
Deep	Internal; located further beneath the body surface than the superficial structures
Cervical	Regional term referring to the neck
Thoracic	Regional term referring to the portion of the body between the neck and the abdomen; also known as the chest (thorax)
Lumbar	Regional term referring to the portion of the back

	between the abdomen and the pelvis
Plantar	The sole or bottom of the foot
Dorsal	The top surface of the foot and hands
Palmar	The anterior or ventral surface of the hands
Sagittal Plane	A longitudinal (imaginary) line that divides the body or any of its parts into right and left sections
Frontal Plane	A longitudinal (imaginary) section that divides the body into anterior and posterior parts; lies at a right angle to the sagittal plane
Transverse Plane	Also known as the horizontal plane; an imaginary line that divides the body or any of its parts into superior and inferior sections

Cardiovascular System

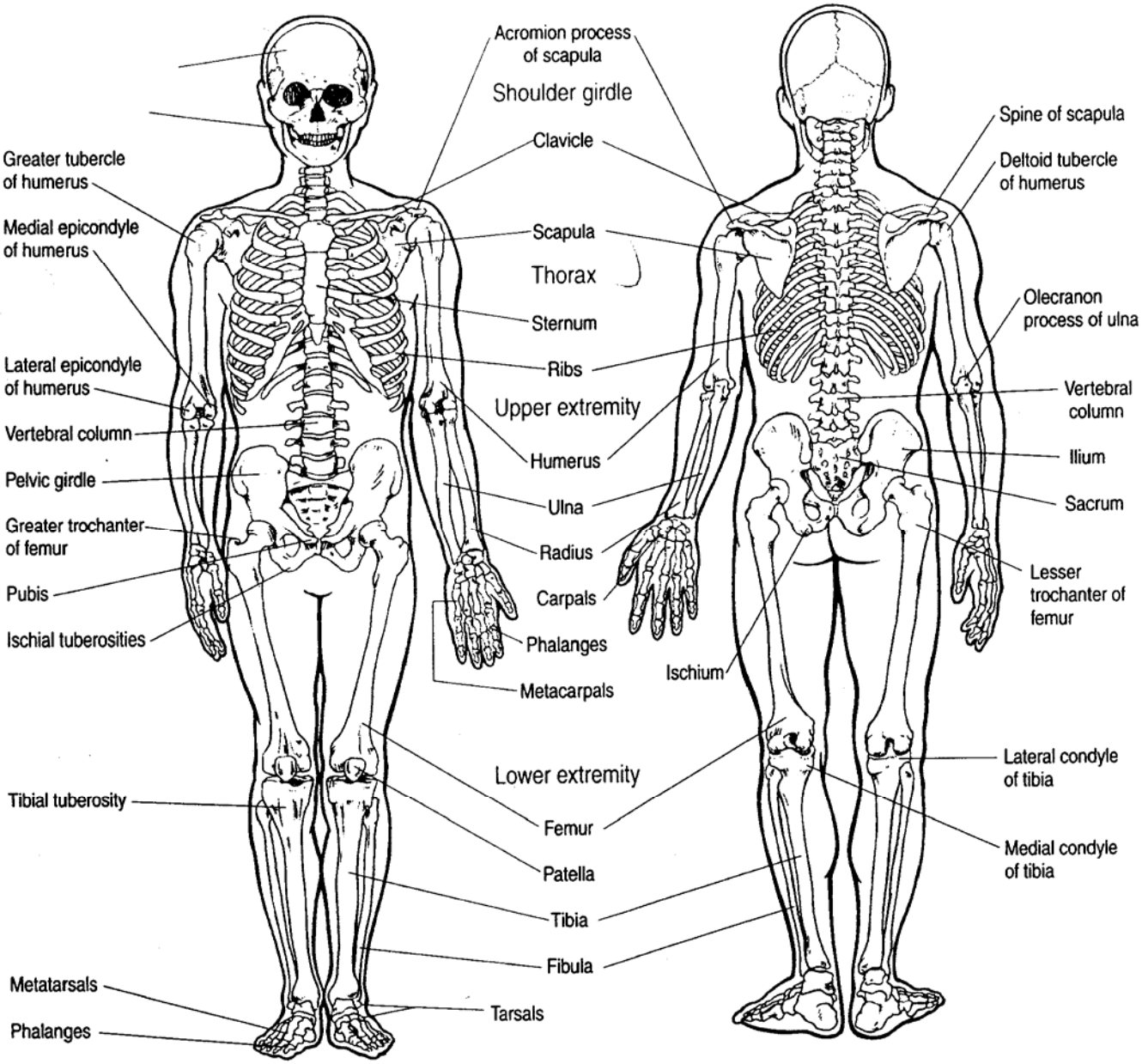
Oxygen is required for energy production and, thus, sustains cellular activity (cellular metabolism) in the human body. A by-product of this activity is carbon dioxide. Since nigh levels of carbon dioxide in the cells produce acidic conditions that are poisonous to cells, excess carbon dioxide must be eliminated rapidly. The cardiovascular and respiratory systems are primarily responsible for this function. The cardiovascular system is comprised of blood, the blood vessels and the heart. The cardiovascular system distributes oxygen and nutrients to the cells, carries carbon dioxide and metabolic wastes from the cells, protects against disease, help regulates body temperature and prevents serious blood loss after injury through the formation of clots.

Blood is the only fluid tissue in the body and is composed of two parts: formed elements, which include different types of living blood cells (white blood cells, red blood cells, and platelets) and plasma, the nonliving liquid portion of blood. Plasma is about 92 percent water and 8 percent dissolved solutes. There are more than 100 different types of dissolved solutes in plasma; the most abundant of these are plasma proteins. In adults, blood accounts for about 8 percent of body weight; and average-sized healthy woman has about 4 to 5 liters, while an average-sized healthy man has about 5 to 6 titers of blood.

There are two different types of blood vessels; **arteries,** which carry blood away from the heart; and veins, which transport blood toward the heart. Arteries are stronger and thicker than veins, and their muscular walls help propel blood. Unlike arteries, veins contain valves to prevent the blood from flowing backward. The largest arteries are those nearest the heart; as blood flows further away from the heart, the arteries branch into smaller vessels called arterioles that deliver the blood into the even smaller **capillaries.** These are microscopic blood vessels that branch to form an extensive network throughout the distal tissues. It is in the capillary beds that the critical exchange of nutrients and metabolic waste products takes place. Depleted of its oxygen and nutrients on the way from the heart to the periphery, capillary blood now begins its journey back to the heart via small vessels called

Skeletal System

The human skeletal system consists of 206 bones (figure 2.6) that can divide into two sections: the axial skeleton, the 80 bones that comprise the head, neck and trunk; and the appendicular skeleton, the 126 bones that form the extremities. The bones that form the skeleton combine to provide live basic yet important functions. First, the skeletal system provides protection for many of the vital organs, such as the heart, brain and spinal cord. Second, the skeleton provides support for the soft



tissues so that erect posture and, the form of the body can be maintained. Third, the bones provide a framework of levers to which the muscles are attached. When particular muscles contract, long bones typically act as levers to produce movement. Fourth, the red marrow of bone is responsible for the production for certain blood cells, namely red blood cells and platelets. Fifth, bones serve as storage areas for calcium, phosphorus, potassium, sodium and other minerals. Due to their high mineral content, bones remain intact for many years after death. Fat also is stored within the middle section of long bones in the medullary cavity.

Bones many also be classified according to their shape: long, short, flat or irregular. Long bones are those in which the length exceeds the width and the thickness. Most of the bones in the lower and upper extremities are long bones, including the femur, tibia, fibula and metatarsals in the lower limbs, and the humerus, radius, ulna and metacarpals in the upper extremity. Each long bone has a shaft called a **diaphysis** and two ends known as epiphyses, that are usually wider than the shaft. The disphysis of a long bone is surrounded by a connective tissue sheath called the periosteum. The periosteum has two layers: an outer layer that serves as an attachment site for muscles and tendons, and an inner layer that, when disrupted by fracture, signals the release of osteoblasts (bone forming cells) to repair the fracture.

Short **bones** have no long axis but are approximately equal in length and width. They are found in the

hands (carpals) and the feet (tarsals). **Flat bones are partially** described by their name; they are thin, but usually bent or curved rather than flat. Examples include the bones of the skull, the ribs, the sternum and the scapulae (shoulder blades). **Irregular bones are** bones that do not fall into the other three

The anatomical system most directly affected by exercise is the muscular system. While bones and joints provide the framework for the body, it is the contraction (and relaxation) of specific muscles that enable us to move. There are three different types of muscle tissue: skeletal, cardiac and visceral. Skeletal muscle tissue is attached to bones by tendons, and is typically named according to the location. Skeletal muscle is voluntary muscle; that is, it can be made to contract by conscious effort. Cardiac muscle tissue forms the walls of the heart and is involuntary in nature. The third type of muscle is visceral (smooth) muscle, is found in the walls of internal organs like the stomach and intestines and in the blood vessels. The contraction of visceral muscle also is involuntary and, thus, is not under conscious control. While all three types of muscle have vital functions, the structure and skeletal muscles warrant further discussion. Both ends of a skeletal muscle are attached to bone via tendons (a cord of connective tissue). In some cases, skeletal muscles are attached to bone by **aponeurosis,** a broad, flat type of tendon. The wide, flat insertion of rectus abdominis is an excellent example of an aponeurosis.

While there are more than 600 muscles within the human body, only the major muscles will be discussed. Muscles are named according to:

1. Location: posterior tibialis, rectus abdominis
2. Shape: deltoid, trapezius, rhomboid
3. Action: extensor, flexor abductor, adductor
4. Number of divisions: biceps brachii, quadriceps femoris, triceps brachii
5. Bony attachments: coracobrachialis, iliocostalis
6. Size relationship: pectoralis major, pectoralis minor

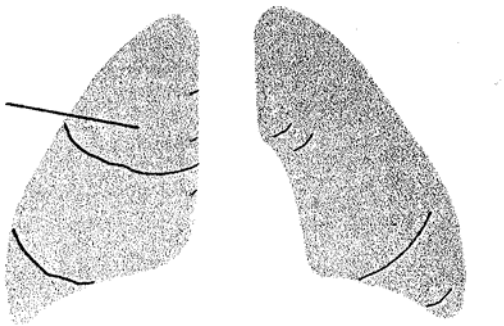
Muscle tissue had the ability to receive and respond to input from the nervous system that may cause the muscle to contract (shorten and thicken) or relax. Muscle tissue also had elasticity so that, with proper techniques, muscles may be safely stretched. From a functional standpoint, it is important to understand that the most muscles of the trunk and extremities are arranged in opposing pairs. That is, when one muscle is contracting to achieve a desired movement (the agonist), its opposite muscle (the antagonist) is being stretched. For example, when the abdominal muscles are contracted during a bent-knee sit-up, the erector spinae muscles are being stretched. At most joints, several muscles help (combine) to perform the same anatomical function; these muscles are functionally known as synergists. For example, the synergistic contraction of the gastrocnemius, soleus and six other muscles of the leg produce plantarilexion at the ankle joint.

Muscle contraction results in motion, the maintenance of posture and heat production. Locomotion (walking, running) is the result of the complex, combined functioning of the bones, joints and muscles. Muscle contraction also enables the maintenance of posture in stationary positions, such as sitting and standing. Through regular contraction, muscles produce heat, which plays an important

Respiratory System

The respiratory system supplies oxygen, eliminates carbon dioxide, and helps regulate the acid-base balance (pH) of the body. The respiratory system is comprised of the lungs and a series of passageways leading to and from them (mouth, throat, trachea, bronchi). Respiration is the overall exchange of gases (oxygen, carbon dioxide, nitrogen) between the atmosphere, the blood and the cells. There are three general phases of respiration: external, internal and cellular. External respiration is the exchange of oxygen and carbon dioxide between the atmosphere and the blood within the large capillaries in the lungs. Internal respiration involves the exchange of those gases between the blood and the cells of the body. Cellular respiration involves the utilization of oxygen and the production of carbon dioxide by the metabolic activity within cells. When the body is at rest, air enters the respiratory. system via the nostrils of the nose, and is warmed as it passes through a series of nasal cavities lined by the mucous membrane. This membrane is covered with cilia (small hairs) that filter out small particles (Figure 2.4). From the nasal cavity, inspired air next enters the pharynx (throat), which lies just posterior to the nasal and oral (mouth) cavities. The pharynx serves as a passageway. for air and food, and also provides a resonating chamber for speech sounds. During vigorous physical activity, mouth breathing tends to predominate~ and air taken in via the mouth is not filtered to the same extent as air taken in through the nostrils.

The larynx (the organ of voice) is the enlarged upper (proximal) end of the trachea (windpipe). The larynx conducts air to and from the lungs via the pharynx. An easy landmark for locating the larynx is the thyroid cartilage, or Adam's apple. The trachea is a tubular airway approximately 12 centimeters long (about 4.5 inches) kept open by a series of C-shaped cartilage's that function in a manner similar to the wire rings in the hose of a vacuum cleaner. The trachea extends from the larynx to approximately the level of the fifth thoracic vertebra, where it divides into the right and left primary bronchi. After the trachea divides into the right and left primary bronchi, each primary bronchus then enters a lung and divides into smaller secondary bronchi, one for each lobe of the lung (five in total). The secondary bronchi branch into many tertiary bronchi, and these branch several times further, eventually forming tiny terminal **bronchioles.** The terminal bronchioles have microscopic branches called respiratory bronchioles that, in turn, subdivide into several alveolar ducts (plural alveoli). The actual exchange of respiratory gases, such as oxygen and carbon dioxide, between the lungs and the blood occurs at this anatomic level. The lungs contain an estimated 300 million alveoli that provide an extremely large surface area (approximately 70 square meters or 230 square feet) for exchange of gases. The continuous branching of the trachea resembles a tree trunk and its branches and is commonly referred to as the bronchial tree.



The final components of the respiratory system are the lungs- paired, cone-shaped organs lying in the thoracic cavity. The right lung has three lobes; the left lung has only two.
The diaphragm, the muscles that form the floor of the thoracic cavity, contracts during inspiration and relaxes to allow expiration. The lungs are separated by a space known as the mediastinum which contains, most notably, the heart, the esophagus (the tube that connect the throat with the stomach) and a portion of the trachea.