

**COURSE OUTCOMES  
BIOL201  
HUMAN ANATOMY AND PHYSIOLOGY I  
2012**

**These are the department-approved outcomes for BIOL201. They are a guideline for the expected content of the course. They were developed in part from standard outcomes developed by HAPS, the Human Anatomy and Physiology Society and in part from the teaching experience of some of the Massasoit faculty.**

**We are distributing these outcomes to serve as a guideline for the many sections of Anatomy and Physiology I taught at Massasoit. We encourage everyone to review the outcomes and make sure that these outcomes are appropriately assessed in your classes. Our goal is to make the student experience in each class equally comprehensive and equally challenging.**

## Course Outcomes BIOL201

### General Outcomes

- Students should be able to use the general steps of the scientific method to form hypotheses, collect and evaluate data, and draw conclusions, in order to learn to distinguish between science and pseudoscience, and to evaluate scientific information in both professional journals and the popular press.
- Students should be able to relate the unifying themes of the relationship between structure and function and the maintenance of homeostasis to the structure and function of the human body, giving examples for all 11 systems.

### Specific Outcomes

#### Body Plan and Organization

1. Describe a person in anatomical position.
2. Describe how to use the terms right and left in anatomical reference.
3. Identify the following planes in which a body might be dissected: sagittal, frontal, transverse.
4. Describe the appearance of a body presented along various planes.
5. Describe the location of the following body cavities and identify the major organs found in each cavity: dorsal, cranial vertebral, ventral, thoracic, and abdominopelvic.
6. Describe the location of the four abdominopelvic quadrants and the nine abdominopelvic regions and list the major organs located in each.
7. List and define the following major directional terms used in anatomy: anterior, posterior, superior, inferior, lateral, medial, proximal, distal, deep and superficial.
8. Define the terms anatomy and physiology. Give specific examples to show the interrelationship between anatomy and physiology.
9. Describe, in order from simplest to most complex, the major levels of organization in the human organism.

#### Homeostasis

1. Define homeostasis.
2. List the components of a feedback loop and explain the function of each component.
3. Compare and contrast positive and negative feedback in terms of the relationship between stimulus and response.
4. Explain why negative feedback is the most commonly used mechanism to maintain homeostasis in the body.

#### Histology

1. Define the term histology.
2. List the four major tissue types.
3. Contrast the general features of the four major tissue types.
4. Classify the following tissue types based on distinguishing structural characteristics, location and functions:
  - a. simple and stratified squamous epithelia;

- b. simple and stratified cuboidal epithelia;
  - c. simple columnar epithelium;
  - d. ciliated pseudostratified columnar epithelium;
  - e. areolar;
  - f. dense irregular fibrous connective tissue;
  - g. dense regular fibrous connective tissue;
  - h. adipose tissue;
  - i. hyaline cartilage;
  - j. bone;
  - k. smooth, skeletal and cardiac muscle; and
  - l. neurons.
5. Be able to find and recognize the tissues using proper microscope technique.
  6. Describe the structure and function of mucous, serous, cutaneous & synovial membranes.
  7. Distinguish between exocrine and endocrine glands, structurally and functionally.
  8. Classify the different kinds of exocrine glands based on mechanisms of secretion (merocrine and holocrine).

### **Integumentary System**

1. Describe the general functions of the skin.
2. Describe the general functions of the subcutaneous layer (also known as the hypodermis or superficial fascia).
3. With respect to the epidermis:
  - a. identify and describe the tissue type making up the epidermis;
  - b. identify and describe the layers of the epidermis, indicating which are found in thin skin and which are found in thick skin;
  - c. correlate the structure of thick and thin skin with the locations in the body where each are found; and
  - d. describe the processes of growth and keratinization of the epidermis;
4. Identify and describe the dermis and its layers, including the tissue types making up each layer.
5. Identify and describe the subcutaneous tissue, including the tissue types making up subcutaneous tissue.
6. With respect to skin color:
  - a. describe the three pigments most responsible for producing the various skin colors.
  - b. name the layers of the skin that contain each of these pigments.
7. With respect to the epidermis:
  - a. describe the functions of the epidermis;
  - b. explain how each of the five layers, as well as each of the following cell types and substances, contributes to the functions of the epidermis: stem cells of stratum basale, keratinocytes, melanocytes, Langerhans' cells, Merkel cells and discs, keratin, and extracellular lipids; and
  - c. explain why the histology of the epidermis is well suited for its functions.

8. With respect to the dermis:
  - a. describe the overall functions of the dermis; and
  - b. describe the specific function of each dermal layer and relate that function to the skin's overall functions.
9. With respect to the subcutaneous layer:
  - a. describe the functions of the subcutaneous layer; and
  - b. describe the thermoregulatory role played by adipose tissue in the subcutaneous layer.
10. Identify each of the following structures, describe its location, anatomy and function:
  - a. apocrine and eccrine sweat glands, sebaceous glands, nails, hair, hair follicle arrector pili muscle; and
  - b. sensory receptors (Merkel cell, Meissner's & Pacinian corpuscles, hair follicle receptor, and temperature receptors).

### **Skeletal System**

1. Describe the major functions of the skeletal system.
2. List and describe the cellular and extracellular components of bone tissue.
3. Identify the internal structural components of compact bone and spongy bone.
4. Identify the types of cartilage tissues found in the skeletal system and explain the functions of each.
5. Explain the roles of dense regular and dense irregular connective tissue in the skeletal system.
6. Identify the structural components of a long bone, with emphasis on region of longitudinal growth
7. Explain the functions of those structural components in the context of a whole bone
8. Explain the roles osteogenic cells play in the formation of bone tissue
9. Compare and contrast intramembranous and endochondral (intra-cartilaginous) bone formation
10. Explain the hormonal regulation of skeleton growth
11. Explain the roles of calcitonin, parathyroid hormone and calcitriol (Vitamin D) in bone remodeling and blood calcium regulation.
12. Define the two major divisions of the skeletal system (axial and appendicular) and list the general bone structures contained within each
13. Identify the types of bones based on shape and composition (compact vs. spongy), and relate the shapes of bones to their functions.
14. Describe the development of the normal curvatures of the spine and identify common abnormalities; scoliosis, lordosis, kyphosis
15. Compare and contrast the adult male and female skeletons
16. Identify the individual bones and their location within the body.

### **Bone Identification**

#### **Identify the following on the skull:**

1. frontal bone

2. parietal bones
3. temporal bones
  - a. external auditory meatus
  - b. internal auditory meatus
  - c. zygomatic process
  - d. mastoid process
  - e. carotid canal
  - f. jugular foramen
4. occipital bone
  - a. mandibular fossa
  - b. jugular foramen
  - c. carotid canal
  - d. foramen magnum
  - e. occipital condyles
5. sphenoid bone
  - a. sella turcica
  - b. optic canal
6. ethmoid bone
  - a. crista galli
  - b. cribriform plate
  - c. perpendicular plate
7. mandible
  - a. mandibular condyle
  - b. coronoid process
  - c. angle
8. maxillae
  - a. palatine process
9. zygomatic bones
10. lacrimal bones
11. nasal bones
12. palatine bones
13. vomer
14. inferior nasal conchae

**Identify the following bone markings of the skull:**

15. sagittal suture
16. coronal suture
17. squamous suture
18. lambdoidal suture

**Identify the following vertebrae:**

19. atlas
20. axis
21. dens (odontoid process)
22. cervical vertebra
23. thoracic vertebra

- 24. lumbar vertebra
- 25. sacrum
- 26. coccyx

**Identify the following on a vertebra:**

- 27. body
- 28. vertebral arch
- 29. spinous process
- 30. transverse process

**Identify the following on the vertebral column:**

- 31. normal curvatures
  - a. cervical
  - b. thoracic
  - c. lumbar
  - d. sacral
- 32. intervertebral disc
- 33. vertebral foramen
- 34. intervertebral foramen
- 35. three curvature abnormalities: scoliosis, kyphosis, lordosis

**Identify the following bones and bone parts of the thorax:**

- 36. sternum
  - a. manubrium
  - b. body of the sternum
  - c. xiphoid process
- 37. rib
  - a. vertebrosteral ribs
  - b. vertebrocostal ribs
  - c. vertebral ribs
  - d. head of rib
  - e. neck of rib
  - f. shaft of rib
  - g. tubercle of rib

**Identify the following on the pectoral girdle**

- 38. clavicle
  - a. sternal end
  - b. acromial end
- 39. scapula
  - a. coracoid process
  - b. acromion process
  - c. glenoid cavity
  - d. spine
  - e. three borders

**Identify the following on the upper appendage:**

- 40. humerus
  - a. head of the humerus

- b. greater tubercle
  - c. lesser tubercle
  - d. deltoid tuberosity
  - e. trochlea
  - f. capitulum
  - g. coronoid fossa
  - h. olecranon fossa
41. ulna
- a. coronoid process
  - b. olecranon process
  - c. trochlear notch
  - d. styloid process
42. radius
- a. head of the radius
  - b. radial tuberosity
  - c. styloid process
43. carpals
44. metacarpals
45. phalanges

**Identify the following on the pelvic girdle:**

46. difference between male and female pelvis
47. coxal bone
48. ilium
- a. acetabulum
  - b. Iliac crest
  - c. anterior superior iliac spine
  - d. posterior superior iliac spine
  - e. obturator foramen
  - f. greater sciatic notch
  - g. lesser sciatic notch
49. ischium
- a. ischial tuberosity
  - b. ischial spine
50. pubis
- a. pubic symphysis
51. true vs false pelvis

**Identify the following on the lower appendage:**

52. femur
- a. head of femur
  - b. linea aspera
  - c. greater trochanter
  - d. lesser trochanter
  - e. lateral condyle
  - f. medial condyle

- g. lateral epicondyle
- h. medial epicondyle

**53. tibia**

- a. lateral condyle
- b. medial condyle
- c. tibial tuberosity
- d. medial malleolus

**54. fibula**

- a. lateral malleolus

**55. patella**

**56. tarsals**

**57. calcaneus**

**58. talus**

**59. metatarsals**

**60. phalanges**

### **Articulations**

1. With respect to classification of joints:
  - a. describe the functional classification, based on degree of movement allowed - synarthrotic, amphiarthrotic, and diarthrotic – and provide examples of each type;
  - b. describe the anatomical classification, based on structure - fibrous, cartilaginous, and synovial – and provide examples of each type; and
  - c. explain how the functional and anatomical classifications are related.
2. Identify the structural components of the synovial joint, including accessory structures like bursae, tendon sheaths, and ligaments.
3. For each of the six structural types of synovial joints:
  - a. describe the anatomical features of that structural type;
  - b. describe locations in the body where each structural type can be found; and
  - c. predict the kinds of movements that each structural type will allow.

### **Muscle System**

#### **Histology and Anatomy**

1. Describe the major functions of muscle tissue.
2. Describe the general function of the muscle system.
3. Compare and contrast the structural and functional characteristics of skeletal, cardiac and smooth muscle. Provide examples of the location of each in the body.
4. Describe the organization of muscle tissue from cell to whole muscle to groups of muscles.
5. Name the connective tissue layers that surround each cell, fascicle, muscle, and group of muscles and indicate the specific type of connective tissue that composes all of these layers.
6. Describe a skeletal muscle fiber including the transverse (T) tubules, sarcoplasmic reticulum, and myofibrils.
7. Explain the organization of a myofibril.

8. Name and describe the function of each of the contractile, regulatory, and structural protein components of a sarcomere.
9. Describe the anatomy of the neuromuscular junction.

## **Muscle System**

### **Physiology**

1. Explain the sliding filament theory of muscle contraction.
2. Describe the sequence of events involved in the contraction cycle of skeletal muscle.
3. Explain how a nervous system electrical signal arrives at the neuromuscular junction.
4. Describe, in order, the events that occur at the neuromuscular junction that elicit an action potential in the muscle fiber.
5. Explain what is meant by the expression "excitation-contraction coupling."
6. List the sources of energy stored in a typical muscle fiber.
7. Describe the mechanisms that muscle fibers use to obtain ATP for muscle contraction.
8. Explain the factors that contribute to muscle fatigue.
9. Summarize the events that occur during the recovery period of muscle contraction.
10. Interpret a myogram of a twitch contraction with respect to the duration of the latent, contraction and relaxation periods and describe the events that occur in each period
11. Define the terms tension and contraction, with respect to muscles
12. Define the term motor unit and explain its importance in muscle contraction.
13. Interpret a myogram or graph of tension vs. stimulus frequency and explain the physiological basis for the phenomena of, summation and tetanus.
14. Interpret a myogram or graph of tension vs. stimulus intensity and explain the physiological basis for the phenomenon of recruitment.
15. Demonstrate isotonic and isometric contraction.

## **Muscle System**

### **Muscle Identification**

**Identify the origin, insertion and action of the following major skeletal muscles:**

- |                           |                          |
|---------------------------|--------------------------|
| 1. frontalis              | 16. rectus abdominis     |
| 2. orbicularis oculi      | 17. external oblique     |
| 3. zygomaticus            | 18. internal oblique     |
| 4. orbicularis oris       | 19. transverse abdominis |
| 5. temporalis             | 20. latissimus dorsi     |
| 6. masseter               | 21. trapezius            |
| 7. platysma               | 22. deltoid              |
| 8. sternocleidomastoid    | 23. infraspinatus        |
| 9. occipitalis            | 24. supraspinatus        |
| 10. trapezius             | 25. subscapularis        |
| 11. pectoralis major      | 26. teres major          |
| 12. pectoralis minor      | 27. teres minor          |
| 13. serratus anterior     | 28. triceps brachii      |
| 14. external intercostals | 29. biceps brachii       |
| 15. internal intercostals | 30. brachialis           |

31. brachioradialis
32. pronator teres
33. flexor carpi radialis
34. palmaris longus
35. flexor carpi ulnaris
36. extensor carpi ulnaris
37. extensor digitorum
38. extensor carpi
39. radialis longus
40. extensor carpi
41. radialis brevis
42. iliopsoas
43. pectineus
44. gluteus medius
45. gluteus maximus

46. tensor fasciae latae
47. adductor longus
48. gracilis
49. sartorius
50. adductor magnus
51. biceps femoris
52. semitendinosus
53. semimembranosus
54. rectus femoris
55. vastus lateralis
56. vastus medialis
57. gastrocnemius
58. soleus
59. tibialis anterior

## **Nervous System**

### **Anatomy and Histology**

1. Describe the major functions of the nervous system
2. Describe the nervous system as a control system, identifying nervous system elements that are sensory receptors, the afferent pathway, control centers, the efferent pathway, and effector organs.
3. Differentiate between the somatic and autonomic divisions of the nervous system
4. List the parts of the nervous system that constitute the central nervous system (CNS) and those that constitute the peripheral nervous system (PNS)
5. With respect to the three structural types of neurons (unipolar, bipolar & multipolar):
  - a. identify each type of neuron;
  - b. identify soma (cell body), axon, and dendrites;
  - c. state which parts of each type of neuron receive information, which parts integrate information, and which parts conduct the output signal of the neuron;
  - d. describe the location of the cell bodies of each type of neuron within the nervous system; and
  - e. state a function of each type of neuron
6. Describe the structure and function of glial cells of the CNS and PNS.
7. Define the term nerve and differentiate between a nerve and a tract

## **Nervous System**

### **Physiology**

1. Explain how ion channels affect neuron selective permeability
2. Contrast the relative concentrations of sodium, potassium and chloride ions inside and outside of a cell.
3. Differentiate between a concentration gradient and an electrical potential.
4. Define electrochemical gradient

5. With respect to ion channels:
6. Differentiate between passive and active ion channels.
7. Explain how passive ion channels cause development of the resting membrane potential in neurons.
8. Differentiate between voltage-gated and chemically-gated ion channels.
9. Describe the voltage-gated ion channels that are essential for development of the action potential.
10. Discuss the sequence of events that must occur for an action potential to be generated
11. Describe the role of the sodium-potassium exchange pump in maintaining the resting membrane potential and making continued action potentials possible
12. Define threshold
13. Interpret a graph showing the voltage vs. time relationship of an action potential, and relate the terms depolarize, repolarize, and hyperpolarize to the events of an action potential.
14. With respect to the refractory periods
  - a. define absolute and relative refractory periods;
  - b. explain the physiological basis of the absolute and relative refractory periods; and
  - c. discuss the consequence of a neuron having an absolute refractory period.
15. With respect to impulse conduction:
  - a. describe how local circuit currents cause impulse conduction in an unmyelinated axon;
  - b. explain how axon diameter and myelination affect conduction velocity; and
  - c. describe saltatory conduction.
16. Identify the presynaptic and postsynaptic cells at a synapse.
17. List the structures that comprise a chemical synapse
18. Describe the synaptic (axon) terminal.
19. Restate the steps that lead from the action potential arriving in the synaptic terminal to the release of neurotransmitter from synaptic vesicles.
20. Discuss the relationship between a neurotransmitter and its receptor
21. Explain how the receptors for neurotransmitters are related to chemically-gated ion channels
22. Describe the events of synaptic transmission in proper chronological order
23. Define excitatory postsynaptic potential (EPSP) and inhibitory postsynaptic potential (IPSP) and interpret graphs showing the voltage vs. time relationship of an EPSP and an IPSP
24. Explain temporal and spatial summation of synaptic potentials
25. Explain how movement of sodium ions alone, or movement of both sodium and potassium ions, across the postsynaptic cell membrane can excite a neuron
26. Explain how movement of potassium or chloride ions across the postsynaptic cell membrane can inhibit a neuron
27. Compare and contrast synaptic potentials with action potentials
28. Explain how a single neurotransmitter may be excitatory at one synapse and inhibitory at another

## **Brain**

1. Correlate functions with each major area of the adult brain.
2. Describe the orientation of the brain relative to bones of the skull
3. Identify the five lobes of the cerebral cortex and describe how the motor and sensory functions of the cerebrum are distributed among the lobes
4. Discuss the concept of cerebral hemispheric specialization and the role of the corpus callosum in connecting the two halves of the cerebrum
5. Identify the meninges and describe their functional relationship to the brain and cranial bones
6. Describe the functions of cerebrospinal fluid, as well as the details of its production, its circulation within the central nervous system, and its ultimate reabsorption into the bloodstream
7. Describe the structural basis for, and the importance of the blood brain barrier

## **Cranial Nerves**

1. List the cranial nerves by name and number
2. Describe the specific functions of each of the cranial nerves and classify each as sensory, motor or mixed

## **Nervous System**

### **Sensory Receptors**

1. Describe exteroceptors, interoceptors and proprioceptors in terms of the general location of each in the body and the origin of the stimuli
2. Describe each of the following types of receptors, indicating what sensation it detects and giving an example of where it can be found in the body:
  - a. pain receptors (nociceptors), temperature receptors, mechanoreceptors (including proprioceptors and baroreceptors/pressoreceptors), chemoreceptors, and photoreceptors.

### **Reflexes**

1. Define the term reflex
2. Describe reflex responses in terms of the major structural and functional components of a reflex arc
3. Distinguish between each of the following pairs of reflexes: intrinsic (inborn) reflexes vs. learned reflexes, somatic vs. visceral reflexes, monosynaptic vs. polysynaptic reflexes, and ipsilateral vs. contralateral reflexes
4. Describe a stretch reflex and name all components of each reflex arc.

## **Nervous System**

### **Spinal Cord**

1. Describe the gross anatomy of the spinal cord and spinal nerves and specify their location relative to the anatomy of the skeletal system
2. Identify the anatomical features seen in a cross sectional view of the spinal cord

3. Contrast the relative position of gray matter and white matter in the spinal cord with the corresponding arrangement of gray and white matter in the brain
4. Identify the dorsal root ganglia, dorsal and ventral roots, and spinal nerves
5. Discuss how the structures root, nerve, ramus, plexus, tract and ganglion relate to one another
6. List the four spinal nerve plexuses and give examples of nerves that emerge from each
7. Distinguish between ascending and descending tracts in the spinal cord

## **Nervous System**

### **Autonomic Nervous System**

1. Describe the two divisions of the autonomic nervous system and the general physiological roles of each
2. Contrast the anatomy of the parasympathetic and sympathetic systems, including central nervous system outflow locations, ganglia locations, pre- and post-ganglionic neuron relative lengths, and ganglionic and effector neurotransmitters
3. Describe examples of specific effectors dually innervated by the two branches of the autonomic nervous system and explain how each branch influences function in a given effector
4. Describe examples of effectors innervated by only the sympathetic branch or the parasympathetic branch of the nervous system and explain how that branch by itself influences function in a given effector
5. Differentiate between cholinergic and adrenergic nerve fibers and discuss the physiological interactions of transmitters released by these neurons with specific cholinergic and adrenergic receptor subtypes
6. Describe major parasympathetic and/or sympathetic physiological effects on target organs.
7. Distinguish between the effectors of the somatic and autonomic nervous systems
8. Name the neurotransmitters released at synapses with effector organs in the somatic and autonomic motor pathways and classify each effector response as excitatory or inhibitory

### **Special Senses**

#### **Eye**

1. Identify the accessory eye structures, the tunics, the optical components and the neural components of the eye.
2. Describe the functions of the accessory structures of the eye.
3. Describe the structure of the retina and the cells that compose it.
4. Compare and contrast the function of rods and cones in vision.

### **Special Senses**

#### **Ear**

1. Identify the hearing structures of the outer, middle and inner ear.
2. Describe how the various structures of the outer, middle and inner ear function in hearing.

3. Describe the sound conduction pathway from the auricle to the fluids of the inner ear and the path of nerve impulses from the spiral organ to various parts of the brain
4. Describe the role of the auditory tube in drainage and equalization of pressure in the middle ear.

**In Addition**

- Apply the basic principles of biology to the function of cells and cell membranes in the human body in order to be able to predict the nature of processes involving membrane transport, receptors, surface area, and energy, thus learning from understanding rather than memory.
- Describe the results of homeostatic imbalance of the same important variables in order to relate changes to the underlying causes of disease.
- Present and interpret data from charts and graphs in order to develop skills in using charts and graphs to convey information, to be able to read and understand professional journals and to understand data used in the workplace and presented at meetings and conferences.
- Communicate accurately and clearly both in writing and orally in order to educate patients (for students entering allied health fields) and communicate with professional colleagues.