

BIOLOGY 11

Human Anatomy and Physiology (4 credits and 7 hours)

Fall 2020 /Winter 2021

SYLLABUS AND ONLINE COURSE INFORMATION

COURSE CO-COORDINATORS FOR BIOLOGY 11 & 12

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Required textbook:

Textbook for Biology 11 and Biology 12.

Students will be using openstax ebook for this course. For assigned readings please access Openstax @ <https://openstax.org/details/books/anatomy-and-physiology>

BIOLOGY 11: HUMAN ANATOMY AND PHYSIOLOGY

PROGRAM GOALS FOR STUDENT OUTCOMES

Allied Health Programs

1. Demonstrate knowledge of basic concepts in anatomy and physiology.
2. Apply knowledge to distinguish normal from homeostatic imbalances.
3. Demonstrate basic computer skills and competence utilizing the internet for solving problems.
4. Solve a biomedical problem through analysis and interpretation of tabulated and graphical data.
5. Demonstrate understanding of the scientific literature related to allied health fields through presentation of findings in written form and to an audience.

COURSE GOALS

Course goals for Bio 11

1. Apply the scientific method when thinking and learning about human anatomy and physiology.
2. Recognize and explain the principle of homeostasis and the use of feedback loops to control the physiology of the body systems.
3. Demonstrate an understanding of basic chemical and biochemical concepts inherent to the function of the human body.
4. Develop the anatomical/physiological vocabulary essential to success in this course.
5. Understand the fundamentals of the cell and its components, and cell specializations in various body systems.
6. Understand the relationship between cells, tissues and organs.
7. Recognize and explain the interrelationships within and between anatomical and physiological aspects of the integumentary, skeletal, muscular, nervous, and endocrine systems, and of the interrelations between these systems as they maintain homeostasis.

Statement to the Students

Course Prerequisites:

Placement at the English 12 and Math 09 levels on the CUNY assessment tests.

Course Description:

Biology 11 is the first semester of a one-year course in Human Anatomy and Physiology. Both Biology 11 and Biology 12 are designed to provide students with a thorough understanding of the basic principles inherent in the study of human anatomy and physiology, and is intended for students majoring in the allied-health professions, e.g. nursing, pre-physical therapy, pre-physicians assistant, etc. The emphasis of this course will be concerned with understanding the structural and functional relationships of the major organ systems of the human body. A special effort will be made to understand the concept of homeostasis and how the individual organ systems of the body interact with each other in the maintenance of the normal functioning of the entire organism.

Biology 11 combines both lecture and laboratory experiences over a twelve week period.

There will be a writing assignment(s) during the semester relating to an aspect of human anatomy and physiology. Details will be provided by your instructor.

Plagiarism as a violation of academic integrity is the intentional use of another's intellectual creation(s) without attribution. Determination and penalty—ranging from grade reduction to course failure—is at the sole discretion of the faculty member. If a faculty member suspects that a student has committed a violation of CUNY or KCC's Academic Integrity Policy, he/she shall notify the student of the facts and circumstances of the suspected violation whenever possible. It is then at his/her discretion to seek an academic or disciplinary sanction.

Required Materials

Textbook for Biology 11

Students will be using openstax ebook needed for this course.

Reading Assignments

To obtain the maximum advantage from the required readings, you should complete the readings **before** beginning weekly activities. The lecture syllabus lists the reading assignments that will prepare you for the lectures and laboratory exercises for that particular week and refers to reading assignments in your textbook. The benefits that you will derive by completing the readings for lecture **prior** to the week for which they are assigned are as follows:

1. You will find that it is easier to understand the lecture and laboratory material because you already have some background regarding the topics that are to be covered.
2. The reading assignments for lecture are directly related to the topics that will be covered. If you are already familiar with these topics, you will find that you will be able to take fewer and better notes and pay more attention to what the lecturer is saying.
3. Prior reading of the assignments can help you to pinpoint areas in which may be giving you some difficulty. You then can pay very special attention to what the lecturer is saying when discussing these same topics.

Grade Determination:

1. **Laboratory:** The laboratory portion of Biology 11 represents 50% of the course grade. The grade for laboratory will be based on your quiz grades, the writing assignments, and other factors that will be explained to you by your laboratory instructor.
2. **Lecture:** There will be several unit exams that will be administered during the semester **determined by the individual instructor**. The final examination will account for 20% of your grade.

3. **Summary of the grading procedures:**

Laboratory activities	=	50%
Lecture activities	=	30%
Final examination	=	<u>20%</u>
Total	=	100%

Lecture Syllabus (*openstax ebook*)

Week

- 1. An Introduction to Human body:** Overview of Anatomy and Physiology. Structural levels of organization. Homeostasis. Anatomical terminology. Medical imaging **Chapter 1.**
- 2. The Chemical level of organization:** Chemistry: Elements and atoms. Chemical bonds. Chemical reactions. **Chapter 2.**
- 3. The Chemical level of organization:** Inorganic and organic compounds. **Chapter 2.**
- 4. The Cellular level of organization:** Cell membrane. Cytoplasm and cellular organelles. The nucleus and DNA replication. Protein synthesis. Cell growth and Division. Cellular differentiation **Chapters 3.**
- 5. The Tissue level of organization:** Types of tissues. Epithelial, connective, nervous & muscle and tissues. Tissue injury and aging. **Chapter 4.**
- 6. The Integumentary System:** Layers of skin. Accessory structures of skin. Functions of the integumentary system. Diseases, Disorders and Injuries of Integumentary system **Chapter 5.**
- 7. Bones Tissue and Skeletal system:** Functions of skeletal system. Bone Classification. Bone structure. Bone formation and development. Fracture. Exercise, nutrition, hormones and bone tissue. Calcium homeostasis. **Chapter 6.**
- 8. Joints:** Classification. Fibrous, cartilaginous and synovial joints. Types of body movements. Anatomy of selected joints. **Chapter 9.**
Muscle tissue: Overview of muscle tissue. **Chapter 10.**
- 9. Muscle tissue:** Skeletal muscle. Muscle fiber and contraction and relaxation. Nervous system control of muscle tension. Types of muscle fibers. Exercise and muscle performance. Cardiac muscle. Smooth muscle. Development and regeneration of muscle tissue. **Chapter 10.**
- 10. The Nervous system and Nervous tissue:** Basic structure and function of nervous system. Nervous tissue. The Action potential. Communication between neurons. **Chapter 12.**
- 11. Anatomy of Nervous System.** The Embryological perspective. The Central Nervous system. Circulation and the Central nervous system. The peripheral nervous system. **Chapters 13.**
- 12. The Autonomic Nervous System.** Divisions of Autonomic Nervous system. Autonomic reflexes and homeostasis. Central control. Drugs that affect autonomic system. **Chapter 15.**

Laboratory Syllabus

Week

1. **Scientific method and metric system.**

The language of anatomy: Anatomical position, surface anatomy, body planes and sections, body cavities.

2. **Organ system overview:** Rat dissection. Identification of the major organ using the dissected rat and the torso models.

Matter and Energy. Elements, atomic structure, chemical bonds, pH.

Chemistry: Chemical reactions, synthesis of iron sulfate.

3. **Properties of water.**

Introduction to macromolecules: structures and synthesis. **Macromolecules:** study and chemical detection.

4. **The microscope.**

The Cell. Transport mechanisms and cell permeability: **Passive processes** (diffusion-osmosis and filtration), **Active processes**

5. **The cell:** Anatomy of the composite cell. Differences and similarities in cell structure. Cell division.

Epithelial tissue. Classification of covering and lining membranes.

6. **Connective Tissue.**

Introduction to the integumentary system and the skin. Basic structure of the skin and accessory organs of the skin. Cutaneous glands.

7. **Introduction to the study of the skeletal system.** Study of the appendicular and axial skeleton. The fetal skeleton.

8. **Articulations and body movements.** Study of the three major types of articulations, joint disorders and types of body movement.

9. **Gross and microscopic study of the three muscle types.** Identification of selected muscle groups using the human torso model. **Physiology of skeletal muscle. Muscle Physiology Simulations.**

10 **Histology of nervous tissue. Gross neuroanatomy: Sheep brain dissection.** Study of the preserved human brain and models of the human brain.

11 **Gross anatomy, histology and physiology of the spinal cord.** Study of the anatomical aspects of the Autonomic Nervous System. **Reflex physiology Reflex Simulations.**

12 **Senses: Vision:** Gross anatomy of the eye Dissection of the cow eye. Visual acuity and color blindness tests. Microscopic examination of the retina.

Audition: Hearing and equilibrium. Gross anatomy of the human ear (using models of the human ear). Auditory acuity and equilibrium tests. Microscopic anatomy of the Organ of Corti. Selected experiments dealing with the gustatory and olfactory senses.

LEARNING OBJECTIVES

Human Body: Orientation and Homeostasis

1. List and briefly describe the following branches of the science of biology and their origins: anatomy, gross anatomy, comparative anatomy, cytology, histology, physiology, and biochemistry.
2. Name and define 10 characteristics (qualities) of life.
3. Describe the levels of organization of matter in the universe with at least 2 specific examples for each level.
4. Define the following anatomical terms: (a) anterior, (b) posterior, (c) superior, (d) inferior, (e) dorsal, (f) ventral, (g) medial, (h) lateral, (i) proximal (j) distal, (k) superficial, (l) deep.
5. Explain how the body or an organ is cut in each of the following planes: longitudinal, sagittal, mid-sagittal, frontal (coronal), transverse (cross-sectional).
6. Describe the quadrants of the human abdomen and the organs underlying each quadrant.
7. List all the cavities within the dorsal cavity of the human body and all the organs in those cavities.
8. List all the cavities within the ventral cavity of the human body and all the organs in those cavities.
9. Define the location of the following serous membranes: parietal and visceral membranes
10. Name all the organ systems of the human body and state their main functions.
11. Complete the exercises to review principles of the metric system.
12. Define the following terms: homeostasis, negative feedback and positive feedback.
13. Explain how homeostasis is maintained by negative feedback mechanisms using 3 different examples from the human body.
14. Describe two examples of positive feedback from the human body.

Essential Basic chemical Concepts

1. Define and give examples of the following terms using one sentence each: matter (substance), element, atom, compound, molecule, and mixture.
2. In a short paragraph, describe the differences between kinetic and potential energy.
3. Define the following terms using one sentence each and explain how they interact to form an atom: proton, neutron, and electron.
4. In a short paragraph, explain the difference between atomic number and atomic mass, and explain how they are calculated.
5. In a paragraph, describe the relationship between the rule of eights and the number of bonds an atom makes.
6. In a short paragraph, define ions, and describe the relationship between cations and anions, and

how hydrogen bonding contributes to their formation in solution. Give an example of a biologically important ion.

7. In a paragraph, differentiate between the following types of chemical bonds: (a) ionic, (b) covalent, (c) polar covalent and (d) hydrogen. Give an example of each.
8. Describe in a paragraph how each of the following properties of water is important for human life: solvency, cohesion, adhesion, thermal stability, and chemical reactivity.
9. Describe in a paragraph the three major types of mixtures: suspensions, colloidal dispersions, and true solutions and give examples of each in the body.
10. Calculate the molecular weight of a molecule when given its formula.
11. Calculate the amount of solute and solvent required to make solutions with concentrations presented as a) weight of solute per unit volume, and b) percent solutions.
12. Define in a paragraph the term mole, and explain how this metric unit relates to the molar concentration of a solution.
13. Calculate the molecular weight of a molecule when given its formula.
14. In a paragraph, define pH, and differentiate between acids and bases.
15. In a paragraph, define the term buffer and explain how a buffer works using bicarbonate buffer as your example.
16. Use simple equations to illustrate, and provide an example of, the following types of reactions: a. decomposition, b. synthesis and c. reversible.
17. In a paragraph, explain the effects of the following on the rate of a chemical reaction: concentration of reactants, temperature, pH, catalysts.

Essential Basic Biochemical Concepts

1. In a paragraph, contrast the monomers and polymers for proteins, carbohydrates, lipids, and nucleic acids. Describe the general structures and biological functions of each type of macromolecule.
2. In a paragraph, illustrate and give an example of the role of a dehydration synthesis reaction and a hydrolysis reaction in forming and breaking down polymers.
3. In a paragraph, describe the four levels of protein structure.
4. In a paragraph, describe the role of enzymes and how they affect the rate of chemical reactions.
5. In a paragraph, describe the important role of ATP synthesis and decomposition in cellular functions.

Cytology: Description, cell cycle and transport across the plasma membrane

1. State the Modern Cell Theory and discuss its development.
2. Describe cell shapes from their descriptive terms.

3. Discuss factors that limit cell size.
4. Explain how advances in microscopy have led to a better understanding of cell structure.
5. Draw a typical animal cell, and label its components.
6. Describe the structural components of the plasma membrane, and state their functions.
7. Distinguish between integral and peripheral proteins, and state their functions.
8. Describe the components and functions of the cytoskeleton.
9. Describe the composition and functions of the glycocalyx.
10. Describe the structure and functions of microvilli, cilia, and flagella.
11. Distinguish between membranous and non-membranous organelles, provide examples of each.
12. Describe the structure and functions of the following organelles: nucleus, smooth endoplasmic reticulum, rough endoplasmic reticulum, ribosomes, Golgi complex, mitochondria, centrioles, peroxisomes, lysosomes.
13. Contrast the differences between organelles and inclusions, provide some examples of inclusions.
14. Define the following terms: cytoplasm, cytosol, extra cellular fluid.
15. Describe G1, S and G2 of the typical “cell cycle”.
16. Describe the following stages of mitosis: prophase, metaphase, anaphase, telophase, and the process of cytokinesis.
17. Define diffusion
18. Define osmosis. Explain why osmosis is considered a specific type of diffusion.
19. Define the words, isotonic, hypertonic, and hypotonic,
20. Define filtration
21. Define facilitated diffusion. Define active transport. Explain the difference between symport and antiport membrane carriers.
22. Define bulk transport, endocytosis, and exocytosis.
23. Define the following terms: (a) phagocytosis and (b) pinocytosis. Explain the steps involved in (a) phagocytosis and (b) pinocytosis

Tissues

1. List the 4 basic tissue types and state their basic functions in the human body.
2. Name the derivatives of the 3 embryonic tissues
3. Define: squamous, cuboidal, columnar, simple, stratified and keratinized with respect to epithelial tissue.
4. Describe the following 3 types of cellular junctions and a tissue that utilizes them: tight junctions, desmosomes, and gap junctions.

5. List common characteristics shared by all types of epithelial tissues,
6. State the 3 fundamental characteristics of connective tissue.
7. Describe and illustrate the structural arrangement of a generalized connective tissue including the terms: ground substance, fibers, matrix, and cells.
8. Explain the difference between collagen, elastin and reticular fibers.
9. Explain the differences in function of the following cells found in connective tissues: fibroblasts, fixed macrophages, other leukocytes, mast cells and adipocytes.
10. Describe the structural arrangement and the functions of the areolar connective tissue underlying all epithelial surfaces.
11. Explain the difference between dense irregular and dense regular connective tissue.
12. Explain the functions of the following types of dense irregular connective tissue: investing fascia, deep fascia and organ capsules.
13. Explain the functions of the following types of dense, regular connective tissue: ligaments, tendons, tendon sheaths, bursae and aponeuroses.
14. List the 3 types of cartilage and where they are found
15. Explain why cartilage heals slowly
16. Compare bone matrix to other connective tissue matrices.
17. Describe the structure and function of adipose tissue
18. List and describe the three muscle types of the body.
19. State the major characteristics of nervous tissue.
20. Explain the function of the following types of membranes: mucous, serous and synovial.
21. Explain the difference between endocrine and exocrine glands.

Integumentary system

1. State the different organs that belong to integumentary system.
2. Describe the major functions of integumentary system in reference to its role in protection, insulation, Vitamin D synthesis, thermoregulation and excretion.
3. Describe the structures and features of the epidermis, dermis and hypodermis as they relate their functions. Including
 - a. Location and Type of cells and Connective tissue
 - b. Layers present in thick vs thin skin
4. Describe the location and functions of sensory organs in the hair, skin and nails
5. Describe the role of the exocrine glands in the skin with respect to protection and thermoregulation.

6. Describe the consequences of high UV radiation exposure in reference to melanin production and DNA structure.
7. In a small paragraph, relate the different stages of burning and their consequences.

Skeletal System

1. List and explain the six primary functions of the skeletal system.
2. List the major components of the axial and appendicular skeleton.
3. State the specific functions each of the axial and appendicular divisions.
4. Classify bones of the human skeletal system based on their shape. Give two examples of each group.
5. Describe the microscopic structure of bone.
6. Discuss the role of hormones and bone cells in bone remodeling.
7. Cite the regions of the vertebral column and list the number vertebrae in each region of the adult vertebral column.
8. List the bones that form the cranium and the sutures that join them.
9. Explain the importance of fontanelles in the fetal skeleton.
10. Distinguish between endochondral and intramembranous bone development.

Articulations

1. Explain how joints can be classified according to the type of tissue that binds the bones together.
2. Describe the general structure of a synovial joint and the function of synovial fluid.
3. List six types of freely movable (synovial) joints and describe the actions possible at each of these joints and locate and cite an example of each type that you have mentioned.
4. Describe the location, structure and function of bursae and tendon sheaths.
5. Distinguish between the three types of fibrous joints and cite an example and location for each of the three types you have mentioned.
6. Distinguish between the three types of cartilaginous joints, cite an example of each of the three types and indicate the location of the joint you have mentioned.
7. Clearly indicate the difference between the origin and insertion point of a muscle on a bone.
8. Define the term “articulation” and identify the factors that determine the degree of movement at a joint.
9. Clearly distinguish between the three following terms that are used to classify joints based upon the degree of movement they permit: a. synarthroses, b. amphiarthroses; and c. diarthroses.

Muscle System-

1. Explain the characteristics of muscle tissue.
2. Diagram, label and explain the components of a muscle fiber.
3. Diagram, label and explain the components of a sarcomere and how they relate to muscle contraction, as well as being able to explain the sliding filament theory.
4. Diagram, label and explain all the structures located at the neuromuscular junction and their role as it relates to muscle contraction.
5. Explain the differences and give examples of large motor units vs. small motor units.
6. Explain the events of excitation-contraction coupling and the stages of muscle contraction in detail.
7. Diagram, give examples and explain what is meant by the length tension relationship.
8. Diagram, label and explain all of the components of a muscle twitch.
9. List various ways muscle contraction strength can be increased.
10. Explain and demonstrate the differences between Isometric and Isotonic contractions.
11. Explain and give examples of when and how the various energy systems are used (immediate, short-term and long-term)
12. List the factors responsible for muscles fatigue.
13. Compare and contrast the structure and function of slow twitch and fast twitch muscle fibers.
14. List the main structural and functional differences between cardiac, smooth and skeletal muscle.
15. Identify assigned muscles and be familiar with their origin, insertion and action.
16. Explain criteria used for naming muscles.
17. Give examples and explain the relationship between muscles, antagonists, synergists, and fixators.

Nervous System

1. List three major functions of nervous system.
2. Name the two subdivisions of nervous system. List the anatomical structures that are found in these two divisions.
3. Distinguish **between** afferent/sensory and efferent/motor pathway.
4. Distinguish between somatic nervous system and autonomic nervous system.
5. Draw a generalized neuron and label structures specific/unique/exclusive for it
6. List four types of neuroglia in CNS and two types of neuroglia in PNS. Provide one function of each type.
7. Give two roles that the myelin sheath plays in conduction of electrical signal through an axon.
8. Describe in a paragraph the mechanism of nerve fiber regeneration.

9. Explain difference in CNS vs PNS.
10. Distinguish chemical gradient and electrical gradient.
11. Define resting membrane potential and indicate chemical concentration gradients for sodium and potassium ions.
12. Define depolarization. Describe the role of sodium ions in depolarizing a neuron.
13. Define repolarization. Describe the role of potassium ions in repolarization, hyperpolarization and maintenance of resting membrane potential.
14. Describe the role of ligand and voltage gated channels in generating action potential.
15. Draw a graph of an action potential and indicate absolute and relative refractory period. Explain functional difference between the two.
16. Define a chemical synapse. Draw a labeled diagram of synapse. Describe role of calcium ions in release of neurotransmitter from the synaptic knob.
17. Differentiate between excitatory and inhibitory synapses. Give one example each of excitatory and inhibitory neurotransmitter. What structure within the synapse determines whether it will be excitatory or inhibitory synapse?
18. Define EPSPs and IPSPs
19. List three different types of neuronal circuits and give one example of each.
20. Differentiate between temporal and spatial summation.

Central Nervous System (CNS)

1. Distinguish between grey and white matter.
2. Describe the regions and cross-sectional anatomy of the spinal cord.
3. Differentiate between ascending and descending spinal pathways.
4. Define reflex and the general components of a typical reflex arc.
5. Differentiate between flexor and crossed-extensor reflexes.
6. Describe the embryonic development of the CNS and relate this to adult brain anatomy.
7. Describe the meninges of the brain.
8. Describe the ventricular system of the brain.
9. Discuss the production, circulation, and function of the cerebrospinal fluid.
10. Explain the origin significance of the blood-brain barrier system.
11. Describe the major anatomical features and functions of each adult brain region.
12. List the 12 cranial nerves by name and number.
13. State the functions of each cranial nerve.

Peripheral Nervous Systems (PNS)

1. Describe the gross anatomy of a spinal nerve.
2. Describe the formation and structure of the myelin sheath and relate its importance to a peripheral nerve.
3. List the five major nerve plexuses and describe the general anatomy of each.
4. Describe the neural pathways involved in a simple reflex.
5. Define receptor and sense organ.
6. List the four kinds of information obtained from sensory receptors.
7. Outline three ways of classifying receptors.
8. Describe the seven types of somesthetic receptors.
9. Explain how taste and smell receptors are stimulated, and describe their neural pathways.
10. Describe the gross and microscopic anatomy of the ear and the functions of each part.
11. Explain how the ear converts vibrations to nerve signals.
12. Explain how the vestibular apparatus enables the brain to interpret the body's positions and movements.
13. Describe the anatomy of the eye and its accessory structures, and the function of each.
14. Describe the structure of the retina and its receptor cells.
15. Explain how an image is projected on the retina and how this image is converted into nerve impulses.
16. Differentiate between the function of the cells involved in day and night vision.
17. Differentiate between a nucleus, a ganglion, a nerve and a tract.

Autonomic Nervous System (ANS)

1. Explain how the autonomic and somatic nervous systems differ in form and function.
2. Explain how the two divisions of the ANS differ in general function.
3. Distinguish between preganglionic and postganglionic fibers of the autonomic nervous system.
4. Name the neurotransmitters used at different synapses of the ANS.
5. Describe the different classes of receptors in the ANS and how they relate to autonomic responses.
6. Explain how the ANS controls many target organs through dual innervations, and how control is exerted in the absence of dual innervations.
7. Compare and contrast the locations of sympathetic and parasympathetic neuron cell bodies, dendrites and axons.
8. Compare and contrast the specific anatomical and physiological roles of the sympathetic and parasympathetic nervous systems.