NORTHWESTERN CONNECTICUT COMMUNITY COLLEGE

Course Title: Cell Biology with Organ System **Course #:** BIO* 127

Course Description: This one semester laboratory science course covers principles of cell biology, including basic biological chemistry, cell structure and function, human genetics, cell division, cellular respiration, and protein synthesis. These concepts are applied to a study of the structure and function of the major organ systems human body. Aspects of health and disease are presented including basic elements of nutrition, exercise, cancer, and chemical addictions. The course can be used as a prerequisite for BIO 211 or BIO 235.
(3 hours of lecture, 2 hours of laboratory)

Pre-requisite: Recent college preparatory biology recommended or COL 100 – Health Careers

Goals: To provide the student with an understanding of the biological principles of animal cell physiology as it applies to the structure and function of the human body. To provide students with a basic understanding of the structure and function of the human body and how the systems work together to promote life. To develop a basic understanding of the conditions necessary for good health and examples of major causes of human disease.

Outcomes:
Cell Biological and Physiological Principles

Identify and describe specific chemical and cellular biological principles
Scientific Method

- Recognize the process of scientific method
    - Identification of control group and experimental group
    - Identification of an appropriate hypothesis
- Identification of characteristics of living organisms
- Identification and classification of living organisms into domains and kingdoms

Basic chemistry and biochemistry

- Recognize the basic structure of atoms, isotopes, ions, and molecules
    - Predict ion charge for specific atoms
    - Calculate atomic number, mass number, number of protons, neutrons and electrons for specific elements and isotopes
    - Predict chemical formula for specific ionic compounds
    - Define pH and relate pH to concentration of hydrogen and hydroxide ions
    - identify the importance of pH in living organisms
    - Describe the role of buffers
    - Recognize basic functional groups such as amino, carboxyl, hydroxyl and phosphorylation and identify the type of functional group(s) associated with carbohydrates, lipids, proteins and nucleic acids
    - Identify the building blocks of carbohydrates, lipids, protein, and nucleic acids and roles of each in the body and major reaction categories important in physiology such as hydrolysis, dehydration synthesis, decarboxylation, and deamination

Cell structure and physiology

- Identify the difference between prokaryotic and eukaryotic cells
- Identify the basic structure and function of the plasma membranes, nucleus, organelles and cytosol of an animal cell

Cellular physiology

- Describe the sequence of events involved in protein synthesis
    - Using a specific DNA nucleotide sequence identify the steps in transcription and translation to identify the correct mRNA and amino acid sequence and all of the steps necessary to produce the peptide strand
    - During translation explain the significance of initiation, elongation and termination
    - Explain the difference between a point mutation and a frame shift mutation
- Identify the steps in DNA replication and recognize the significance of mutations and recognize the difference between DNA replication and protein synthesis
- Identify the steps in cellular respiration and the significance of specific steps in each process (glycolysis, oxidation of pyruvate, Krebs cycle, ETC and chemiosmosis)
    - Identify specific enzymes in glycolysis
    - Identify specific types of reactions (isomerization and phosphorylation)
    - Identify the locations in the process where ATP is synthesized
- Recognize components of cellular signal transduction in animal cells using the adenylate cyclase pathway

Cell reproduction

- Identify the phases of mitosis and meiosis
- Recognize the difference between mitosis and meiosis and determine their role in the organism

Genetics

- Describe terms used in Mendelian genetics including allele, homozygous dominant, homozygous recessive, heterozygous, incomplete dominance, complete dominance, polygenic inheritance, genotype and phenotype
    - Predict genotype and phenotype when given parental genotypes
- Identify the differences between inheritance patterns including autosomal recessive, autosomal dominant and X-linked recessive
- Use molecular genetics principles to identify outcomes and significance of specific genetic disorders including sickle cell anemia, hemophilia, cystic fibrosis and Huntingdon's disease

Histology

- Recognize and identify specific examples of the four basic types of body tissues
- Recognize specific subtypes in each category, and identify the function of each type
- Identify location where each type and subtype of tissue are located in a mammal

Organismal System Principles

- Identify components of a negative and positive feedback system and explain the role in maintaining homeostasis in an organism

- Identify and recognize and describe the anatomy and physiology on an organ and cellular level for the:
    1. **Integumentary system** including: layers of the skin, structural and functional elements such as hair and hair follicles, sebaceous glands, sweat glands, and arrector pili

    2. **Skeletal system** including comparison and contrast of compact bone versus spongy bone, structure of a long bone, endochondral ossification and growth of a long bone, significant of bone remodeling and the role of osteoclasts and osteoblasts in remodeling and the importance of diet in maintaining health bones

    3. **Muscular system** including the organization of an entire muscle beginning with an individual fiber and its cellular components, to fascicles, and to the entire muscle including role of connective tissue in holding the muscle together. Students should be able to explain the structure and functional role of contractile elements of myofibers including myofibrils,

sarcomeres and myofilaments. Students should be able to discuss the sliding filament model of muscle contraction and explain how this leads to movement of a bone**.**

4. **Nervous system** including division of the nervous system, types of neurons, anatomy of a neuron and events that occur at a synapse. Students should be able to explain the difference between an excitatory postsynaptic potential and an inhibitory post-synaptic potential and how graded potentials relate to an action potential. They should be able to give examples of excitatory and inhibitory neurotransmitters and Students should be able to recognize the regions of the brain and spinal cord and identify their functions. They should be able to recognize the components of a withdrawal reflex.

5. **Digestive system** including the role of the accessory organs and where each of the major category of nutrients is digested. Students can identify the order in which the food passes through the digestive system and the contribution of each specific organ in digestion and should be able to recognize specific digestive enzymes and where they are produced.

6. **Cardiovascular system**, including the composition and role of each of the blood cells, the composition of plasma and the role of hemostasis. Students should be able to recognize the final common pathway in hemostasis. Students should be able to identify the structure and function of the heart, veins, arteries, capillaries and explain the movement of blood through the heart and circulation through blood vessels back to the heart. Students should be able to recognize the major components of an EKG and understand basic pathology including an MI.

7. **Respiratory system** including flow of air into the lungs and the structure and function of each component, the dynamics of breathing, and the process of internal and external respiration and the forces that drive gas exchange during each. Students should be able identify how both CO_2 and O_2 are carried in the blood.

8. **Urinary system** including the kidneys, ureters, urinary bladder and urethra. Students should be able to identify the role of each component of the nephron and how it contributes to the formation of urine and maintenance of homeostasis. Students should be able to explain how the kidneys maintain the volume, composition and oxygen carrying capacity of blood.

9. **Endocrine system** including the major endocrine glands such as the hypothalamus and its role in regulating the pituitary and producing oxytocin and antidiuretic hormone. Due to time constraints, the primary focus for endocrine is on the role of insulin and glucagon. Other hormones are mentioned in context of the appropriate systems including calcitonin and parathyroid hormone, erythropoietin, and digestive hormones.

10. **Reproductive system** is mentioned during meiosis. Students should understand the role of gamete production and meiosis in the context of human species reproduction. Function of ovary and testes is covered along with evolutional strategies for mammalian reproduction are covered.

- Discuss basic principles in nutrition – discussed in laboratory

- Identify examples of pathologies for each of the above systems including but not limited to:
  Decubitus ulcers, fractures, sprains, carcinoma, basic principles of chemical addiction, gastroesophogeal reflux, , myocardial infarction, anemia, asthma, pneumonia, emphysema, diabetes type I and type II
- Recognize basic diagnostic tests including x-ray, MRI and CT Scans

- Integrate the structure and function of the major body systems to demonstrate how the body systems work together to support an activity and maintain homeostasis. Students should be able to explain and demonstrate how the body systems are interdependent and work together to support life.

Transfer and Articulation Outcomes:

Scientific Reasoning: Upon the completion of this course, students should be able to:

1. Explain the methods of scientific inquiry that lead to the acquisition of knowledge. Such methods include observations, testable hypotheses, logical inferences, experimental design, data acquisition, interpretation, and reproducible outcomes.

2. Apply scientific methods to investigate real-world phenomena, and routine and novel problems. This includes data acquisition and evaluation, and prediction.

3. Represent scientific data symbolically, graphically, numerically, and verbally.

4. Interpret scientific information and draw logical references from representations such as formulas, equations, graphs, tables, and schematics.

5. Evaluate the results obtained from scientific methods for accuracy and/or reasonableness

Scientific Knowledge: Upon the completion of this course, students should be able to:

1. Communicate using appropriate scientific terminology.

2. Use representations and models to communicate scientific knowledge and solve scientific problems.

3. Plan and implement data collection strategies appropriate to a particular scientific question.

4. Articulate the reasons that scientific explanations and theories are refined or replaced.

5. Evaluate the quality of scientific information on the basis of its source and the methods used to generate it.