



South Central College

# BIOL 106 Introduction to Cell Biology

## Course Outcome Summary

### Course Information

<b>Description</b>	This is an introductory cell biology course dealing with: the cell structure and organelles; basic chemistry and biochemical molecules; cell transport and energy concepts; cellular respiration; cell reproduction; patterns of inheritance; structure and function of DNA; how genes are controlled; DNA technology.
<b>Total Credits</b>	3
<b>Total Hours</b>	48

### Types of Instruction

Instruction Type	Credits/Hours
Classroom Presentation	

### Pre/Corequisites

Score of 77.5 or higher on the Reading portion of the Accuplacer test or completion of READ 0080 and READ 0090 with a grade of C or higher.

### Institutional Core Competencies

Critical and Creative Thinking - Students will be able to demonstrate purposeful thinking with the goal of using a creative process for developing and building upon ideas and/or the goal of using a critical process for the analyzing and evaluating of ideas.

### Course Competencies

#### 1. Demonstrate a basic understanding of the chemical level of biology

##### Learning Objectives

- Distinguish between matter, chemical elements, and compounds. Give examples of each.
- Explain the significance of trace elements to human health.
- Describe the relative size, location, and electrical charge of protons, neutrons, and electrons within an atom.
- Explain how the atomic number and mass number are determined.
- Define an isotope and explain how isotopes are used in biological research and medicine.
- Explain how the location of electrons determines the chemical properties of an atom.
- Distinguish between ionic, covalent, and hydrogen chemical bonds.
- Describe the structure of water and explain how its shape makes water a polar molecule.
- Write the chemical formula for the creation of water from hydrogen and oxygen. Identify the reactants and products of this reaction.

Describe the four life-supporting properties of water. Describe an example of how each property affects some form of life.

Distinguish between the chemical properties of acids, bases, and neutral solutions. Explain how buffers stabilize the pH of acidic and basic solutions.

**2. Recognize the structures, properties, and roles of the four major classes of organic molecules (carbohydrates, lipids, proteins, and nucleic acids) and their role in biology.**

**Learning Objectives**

Describe the special bonding properties of carbon that allow it to form an endless variety of organic molecules.

Compare a dehydration reaction to hydrolysis.

Compare the structures and roles of monosaccharides, disaccharides, and polysaccharides in living organisms. Give examples of each.

Compare the structure and properties of saturated and unsaturated fatty acids.

Distinguish between steroids and anabolic steroids, and explain how the use of anabolic steroids can be dangerous to a person's health.

Describe the structure of proteins. Distinguish between the primary structure and the final three-dimensional shape.

Describe and compare the structures of DNA and RNA.

**3. Identify how cell structure (cell membrane and organelles) and function impact the understanding of human diseases.**

**Learning Objectives**

Compare eukaryote versus prokaryote cells and plant versus animal cells.

Describe the structure of the plasma membrane and other membranes of the cell.

Describe how the genetic material in the nucleus and the ribosomes are used to direct the synthesis of proteins.

Compare the structures and functions of the RER, SER, Golgi apparatus, mitochondria, lysosomes and vacuoles.

Describe the functions of the cytoskeleton. Compare the structures and functions of cilia and flagella.

**4. Explain the mechanism by which cells transfer energy from reactions that yield energy to processes that consume energy.**

**Learning Objectives**

Explain how ATP powers cellular work.

Compare the amount of energy in a Calorie to that found in a kilocalorie.

Describe the process of energy coupling in cells.

Explain the mechanism by which biological enzymes speed up chemical reactions.

Explain how inhibitors and poisons can affect enzyme activity.

**5. Demonstrate a basic understanding of membrane function.**

**Learning Objectives**

Distinguish between the following pairs of terms: diffusion versus osmosis, passive transport versus active transport, hypertonic versus hypotonic, endocytosis versus exocytosis, and phagocytosis versus pinocytosis.

Explain how signal transduction pathways permit environmental stimuli to impact the activities inside of a cell.

**6. Characterize the process of cellular respiration as food is converted to energy.**

**Learning Objectives**

Explain how the processes of photosynthesis and cellular respiration are complementary to each other.

Compare the relationship between cellular respiration and breathing.

Write and explain the overall equation for cellular respiration, including the role of oxygen.

Explain the role of oxygen in cellular respiration

Describe the metabolic pathway of cellular respiration.

Compare the reactants, products and energy yield of the 3 stages of cellular respiration (glycolysis, citric acid cycle and electron transport chain). Indicate where each process occurs in the cell.

Describe the process of fermentation in human muscle cells.

**7. Describe how the cell cycle control system, mitosis and meiosis normally function and analyze the consequences of errors in this system.**

**Learning Objectives**

Describe the process of in vitro fertilization (IVF). Describe and debate some of the ethical issues raised by this

situation.

Describe cell division by comparing the genetic information in the chromosomes of typical daughter cells.

Compare the cellular processes and cellular products of asexual and sexual reproduction.

Describe the basic structure of a chromosome.

Explain how and when chromosomes are duplicated.

Describe the key events of each phase of the cell cycle, mitosis and meiosis.

Compare the processes and products of meiosis I and meiosis II.

Distinguish between sex chromosomes versus autosomes, somatic cells versus gametes, and diploid versus haploid cells.

Explain how independent assortment of chromosomes during meiosis, random fertilization, and crossing over contribute to genetic diversity in offspring.

Describe the consequences of nondisjunction of autosomes or sex chromosomes.

Explain how cancer cells are different from healthy cells of the body. Distinguish between benign and malignant tumors. Variations of Mendel's laws explain the inheritance patterns of many human traits and diseases.

## **8. Analyze patterns of inheritance to determine the probability of genetic diseases and genetic traits.**

### **Learning Objectives**

Describe the processes and risks associated with amniocentesis and chorionic villus sampling (CVS).

Define and distinguish between self-fertilization, cross-fertilization, true-breeding organisms, hybrids, the P generation, the F1 generation, and the F2 generation.

Define and distinguish between dominant allele versus recessive allele, genotype versus phenotype, heterozygous versus homozygous, and phenotypic ratio versus genotypic ratio.

Define the law of segregation and explain how it applies to reproduction.

Define Mendel's law of independent assortment and explain how it applies to a dihybrid cross.

Explain how a testcross can be performed to determine an organism's genotype.

Explain how a pedigree is used to determine how a particular human trait is inherited. Define a carrier and explain how carriers are revealed in human pedigrees.

Compare the frequency and method of inheritance of recessive and dominant disorders. Explain how a dominant lethal allele can be inherited.

Define and distinguish between complete dominance, incomplete dominance, and codominance.

Describe the selective advantage of people who are heterozygous for sickle-cell disease.

Define and distinguish between pleiotropy and polygenic inheritance. Describe examples of each.

Define the chromosome theory of inheritance and explain how linked genes are inherited differently from nonlinked genes.

Explain why sex-linked diseases are more common in male. Describe the general characteristics of some sex-linked diseases and traits.

## **9. Characterize the structure and function of DNA (every stage of protein synthesis) and the life cycles of viruses.**

### **Learning Objectives**

Describe and compare the chemical compositions and shape of DNA and RNA.

Describe the process of DNA replication, transcription and translation including why the "one gene-one enzyme" hypothesis is not correct.

Describe the synthesis of proteins from RNA.

Compare the structures of mRNA, tRNA, rRNA and codons and their functions in translation.

Describe the processing of RNA before it leaves the nucleus.

Distinguish between insertion, deletion, and substitution mutations. Explain how mutations can be harmful or beneficial to organisms.

Compare the lytic and lysogenic cycles of bacteriophages.

Compare the life cycles of RNA and DNA viruses. Describe the spread, symptoms, and prevention of viral diseases in plants and animals.

Describe the reproductive cycle of retroviruses such as HIV and the mechanisms by which AZT and protease inhibitors limit AIDS.

Describe the processes that contribute to the emergence of viral disease.

## **10. Apply the principles of gene regulation to explain how cells become specialized and how cellular activity leads to a better understanding of development, cancer, and many forms of disease.**

### **Learning Objectives**

Explain how DNA packing influences gene expression

Explain how transcription is usually initiated in eukaryotes. Compare transcriptional regulation in eukaryotes and prokaryotes.

Explain how RNA is processed in eukaryotes before it leaves the nucleus. Explain how this processing can result in different proteins from the same gene.

Describe the significance of cell signaling in multicellular organisms.

Explain how DNA microarrays help scientists visualize gene expression.

Explain how nuclear transplantation can be used to clone animals. Describe advantages of reproductive cloning of animals.

Compare the properties of embryonic and adult stem cells. Analyze the advantages and disadvantages of using adult stem cells to produce replacement tissues.

Explain how mutations in proto-oncogenes and tumor suppressor genes can lead to cancer.

## **11. Analyze the concerns for the abuse of genetic information and technology as it relates to human society.**

### **Learning Objectives**

Explain how recombinant DNA techniques are used to mass-produce a protein from an isolated gene.

Explore the current uses of DNA technology.

Describe the process of cloning genes using plasmids.

Describe the basis DNA fingerprinting.

Describe the goals of the Human Genome Project. Explain why our genome presents a major challenge.

Explain how comparative genomics has been used to track the spread of disease.

Describe the potential benefits, risks, and concerns of producing genetically modified foods.

Analyze the concerns for the abuse of genetic information and technology as it relates to human society.

### **SCC Accessibility Statement**

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Additional information and forms can be found at: [www.southcentral.edu/disability](http://www.southcentral.edu/disability)

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