

**J. Sargeant Reynolds Community College
Course Content Summary**

Course Prefix and Number: BIO 101 **Credits:** 4

Course Title: BIO 101 - General Biology I

Course Description:

Focuses on biological processes with a chemical foundation, including macromolecules, cellular structure, metabolism, and genetics in an evolutionary context. Explores the core concepts of evolution; structure and function; information flow, storage and exchange; pathways and transformations of energy and matter; and systems biology. Emphasizes the process of science, interdisciplinary approach, and relevance of biology to society. Part I of a two-course sequence. Assignments require college-level reading fluency, coherent written communication, and basic mathematical skills. This is a Passport Transfer course. Lecture 3 hours. Recitation and laboratory 3 hours. Total 6 hours per week. 4 credits

General Course Purpose:

Biology 101 and Biology 102 comprise the standard sequence for Introductory Biology for science majors and also serve as a general education science course for non-majors. The courses use an interdisciplinary approach emphasizing the process of science and includes the relevance of science to society. The core concepts covered include: the process of science; evolution; structure and function; information flow, storage and exchange of genetic information; pathways and transformations of energy and matter; and systems biology. These two courses will expose students to a broad body of biological concepts that will guide them in building and developing skills that they can apply to real world situations. The lecture and laboratory components will emphasize the acquisition and integration of knowledge using the process of science as the basis for inquiry and analysis.

Course Prerequisites/Corequisites:

None.

Student Learning Outcomes:

Upon completing the course, the student will be able to:

Core Competencies

Competency 1: Process of Science

- Explain the process by which science seeks to understand the world around us.
- Design of a hypothetical experiment to test a hypothesis either given to the student or derived by the student from observations provided.
- Identify the role of observation in this process.
- Define independent and dependent variables

Competency 2: Pathways and Transformations of Energy and Matter

- Describe how energy and matter are related to each other
- Identify the sources of energy in living things
- Identify the sources of matter in living things
- Discuss the processes by which energy enters living systems.
- Describe how living systems use energy to transform matter.

Competency 3: Information Flow, Exchange, and Storage:

- Explain how information is stored in biological systems
- Describe how biological information is accurately replicated and how the information is processed and used by individual cells/organisms.
- Explain how the information flows from generation to generation
- Describe how the information flow results in the observable patterns of inheritance.
- Provide specific examples that show the application of these concepts.

Competency 4: Evolution

(These concepts are a primary focus in BIO 102, BIO 101 contains a broad overview.)

- Explain the process of evolution by natural selection, including molecular influences and how that process has affected all life forms in the past and continues to do so today.
- Students should be able to summarize the evidence for evolution and modifications made to the basic Darwinian explanation, using historical and current examples.

Competency 5: Structure and Function

- Give examples of how structure and function are interrelated in organisms at molecular, cellular, and organismal levels.

Competency 6: A Systems Approach to Biology

- Explain how the parts of the system interact to make the functioning system a whole entity.
- Describe the emergent properties in biological systems.

General Learning Outcomes

Scientific Literacy

- Evaluate different perspectives, opinions, and statements about biological issues in terms of their logic, content, scientific merit, and biases.

Quantitative reasoning

- Perform accurate calculations, interpret scientific data and graphs, and use results to support conclusions.
- Analyze data collected through experiments in lab. Present and discuss the findings and conclusions derived from data, with chart/spreadsheet and graphs.

Critical thinking

- Discriminate among degrees of credibility, accuracy, and reliability of inferences drawn from given data, determine whether certain conclusions or consequences are supported by the information provided and use problem solving skills.

Additional Course Content

(Core competencies from above that apply to the unit are identified.)

Overview of Biology: Characteristics of life, Scientific method, Levels of biological organization, Diversity of life

Core Competencies: 1, 2, 3, 4, 5, and 6

- List the shared characteristics of living systems
- Differentiate basic science from applied science
- Differentiate inductive from deductive reasoning
- Summarize the steps in the scientific method
- Describe the levels of biological organization
- List the three biological domains and briefly describe the characteristics of the organisms in each domain

Chemistry of Life: Foundations of biological chemistry, Atoms and molecules, Chemical bonds, Organic and inorganic compounds, Organic macromolecules

Core Competencies: 1, 2, 3, and 6

- Diagram the structure of an atom, label the subatomic particles, and describe the properties of subatomic particles
- Differentiate between isotopes, ions, molecules, and compounds
- Differentiate between organic and inorganic compounds
- Discuss how covalent, ionic, and hydrogen bonds are formed
- Discuss how the properties of water impact the characteristics of life
- Identify the building blocks of the macromolecules and their role in living organisms

The Cell: Prokaryotic and Eukaryotic cells, Plasma membranes, Membrane Transport, Energy and Metabolism, Enzymes, Cellular Respiration, Photosynthesis, Cell Reproduction

Core Competencies: 1, 2, 3, 5, and 6

- Discuss the cell theory and list its provisions
- Differentiate between prokaryotic and eukaryotic cells
- Discuss the fluid mosaic model
- Describe the processes by which substances cross the plasma membrane
- Summarize the Laws of Thermodynamics and explain how the laws of thermodynamics govern energy and metabolism in cells
- Demonstrate how enzymes facilitate and control metabolic processes
- Summarize aerobic cellular respiration, including glycolysis, the krebs cycle, and the electron transport system.
- Compare and contrast aerobic and anaerobic respiration
- Summarize photosynthesis, including the light dependent and light independent reactions
- Discuss the modifications in photosynthesis used by C4 and CAM
- List the similarities and differences between cellular respiration and photosynthesis
- Differentiate between the processes of cell division in prokaryotic and eukaryotic organisms
- Differentiate between the processes of mitosis from meiosis
- Discuss the significance of mitosis and meiosis in asexual and sexual reproduction
- Explain how meiosis is involved in the inheritance of genetic traits and the formation of new species

Molecular Biology and Genetics: Simple Mendelian inheritance, Non-Mendelian Inheritance, DNA structure and function, The Genetic Code, Protein synthesis, Gene expression, Biotechnology

Core Competencies: 1, 2, 3, 5, and 6

- Demonstrate the processes of Mendelian inheritance and describe the processes of non-Mendelian inheritance
- Compare and contrast DNA replication from transcription
- State the major differences between DNA and RNA structurally and functionally.
- Explain the concepts of the gene, state the central dogma, and discuss the exceptions
- Demonstrate the relationships between the genetic code and protein synthesis
- Discuss the concept and the processes of gene expression
- Describe some of the recent developments in biotechnology

Evolution

Core Competencies: 1, 4, 5, and 6

- Describe Theory of Evolution
- List the evidence that supports evolution

Major Topics to be Included:

- **Overview of Biology:** Characteristics of life, Scientific method, Levels of biological organization, Diversity of life
- **Chemistry of Life:** Foundations of biological chemistry, Atoms and molecules, Chemical bonds, Organic and inorganic compounds, Organic macromolecules
- **The Cell:** Prokaryotic and Eukaryotic cells, Plasma membranes, Membrane Transport, Energy and Metabolism, Enzymes, Cellular Respiration, Photosynthesis, Cell Reproduction
- **Molecular Biology and Genetics:** Simple Mendelian inheritance, Non-Mendelian Inheritance, DNA structure and function, The Genetic Code, Protein synthesis, Gene expression, Biotechnology
- **Evolution**

Effective date/Updated: Jan 1, 2023