J. Sargeant Reynolds Community College
Course Content Summary

Course Prefix and Number: BIO 256 Credits: 4

Course Title: General Genetics

Course Description

Explores the principles of genetics ranging from classical Mendelian inheritance to the most recent advances in the biochemical nature and function of the gene. Includes experimental design and statistical analysis. Prerequisites: BIO 101 & BIO 102 or equivalent. Lecture 3 hours. Recitation and laboratory 3 hours. 4 credits.

General Course Purpose

BIO 256 is designed as an introduction to genetics and the techniques used for genetic analysis at the biochemical, organismal and population levels. This course has both a lecture and lab component where students are exposed to many different techniques used to assess and apply genetic information to given scenarios. This course is designed to fulfill a second-year laboratory requirement and provide students with a foundation in how genes function, how they are inherited and how we study them.

Course Prerequisites/Corequisites

BIO 101 & BIO 102 or equivalent

Course Objectives

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

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 the 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.

Nature of a Gene: DNA replication, Transcription, Translation, Mutations
- Describe the molecular structure of DNA and RNA and indicate similarities and differences.
- Describe the mechanisms used by the cell for DNA replication
- Describe the pathway connecting the information in a gene, through its expression, to a phenotype

- Describe the various types of mutations, including causes, consequences
- Describe how DNA damage is detected and repaired and determine the appropriate repair pathway for specific types of damage
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- Analyze problems in DNA replication, transcription, translation and determine their outcomes phenotypically.

Gene Expression and Regulation: Gene expression, Gene regulation, Epigenetics, Sex determination, developmental genetics

- Describe mechanisms regulating various stages of gene expression in both prokaryotes and eukaryotes.
- Explain how epigenetic changes can alter gene expression without changing the underlying DNA
- Describe how regulating changes in gene expression are essential for development, cell identity, and sex determination
- Analyze anomalies in gene expression and predict their phenotypic outcomes.

Eukaryotic Cell Cycle: Mitosis, Meiosis, Chromosome Structure, Chromosomal Abnormalities

- Describe the cellular and chromosomal events that occur during the cell cycle and gamete formation
- Explain how meiosis and random fertilization contribute to genetic variation
- Explain the chromosomal basis of inheritance
- Describe normal chromosomal structure
- Describe abnormalities in chromosome structure and number and explain how these anomalies arise and are detected.
- Connect abnormalities in chromosome structure and number back to sex determination and describe expected phenotypic outcomes

Mendelian Genetics: Mendelian crosses, pedigree analysis, Chi square analysis

- Use Punnett squares to predict offspring ratio for different inheritance patterns
- Use probability and statistics to predict outcomes and conclude if actual outcomes are expected
- Predict the types and frequencies of offspring in Mendelian crosses
- Analyze progeny numbers to determine mode of inheritance
- Use a pedigree to determine the mode of inheritance for a gene
- Analyze a pedigree and use probability to determine carrier status or progeny outcomes

Non-Mendelian Genetics: Sex-Linked traits, Incomplete dominance, codominance, Qualitative traits, Linkage mapping

- Describe how different types of dominance affect phenotypes
- Explain how genes can be linked and how this affects inheritance patterns
- Use Punnett squares and probability to predict offspring ratio for different inheritance patterns
- Calculate the location of a gene on a chromosome
- Describe the process of gene mapping in Eukaryotes

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Population Genetics: Hardy Weinberg Equilibrium, Selection, Genetic Drift
- Describe importance of genetic variation for evolution
- Apply Hardy-Weinberg Equilibrium principles to a population to determine if evolution is occuring
- Analyze population data using hardy-weinberg equilibrium principles to predict carriers of mutations and mating outcomes.
- Describe and apply various evolutionary tests
- Differentiate between different types of selection

Molecular Genetics: Genomes, Genomics, Molecular Techniques, Bioinformatics
- Describe methods used to isolate, amplify and study genes of interest
- Describe methods used to identify and alter genes of interest
- Compare genome sequencing approaches and applications
- Discuss the limitations of genetic research
- Interpret a basic phylogenetic tree

Genetics in Society: Societal Impact, Genethics, Medicine
- Discuss the ethical, legal, medical, and social implications of the study of genetics

Major Topics to be Included

- **Nature of a Gene:** DNA replication, Transcription, Translation, Mutations
- **Gene Expression and Regulation:** Gene expression, Gene regulation, Epigenetics, Sex determination, developmental genetics
- **Eukaryotic Cell Cycle:** Mitosis, Meiosis, Chromosome Structure, Chromosomal Abnormalities
- **Mendelian Genetics:** Mendelian crosses, pedigree analysis, Chi square analysis
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Effective Date/Updated: January 1, 2022