Miami Dade College

Course Description

PCB3060 | Principles of Genetics | 3.00 credits

This course is an introduction to the mechanisms of transmission of hereditary information. Students will learn the classical Mendelian principles of heredity, deviation of Mendelian principles, genetic analysis, linkage and mapping, genetics of populations, gene regulation, mutation, the genetic gases of cancer and other genetic disorders will also be studied. Prerequisites: BSC 2010, 2010L, BSC 2011, 2011L.

Course Competencies:

Competency 1: The student will demonstrate knowledge of nucleic acid structure and function

1. Explain Griffith, Avery, MacLeod, and McCarty experiments, as well as Hershey-Chase experiments supporting the role of nucleic acids in inheritance by:
2. Explaining the structure of nucleotides.
3. Relating the Watson and Crick Model of DNA and Chargaff's rule.
4. Explaining the structure and properties of DNA – replication, recombination.
5. Comparing the alternative forms of DNA.
6. Explaining the structure and function of RNA.
7. Identifying the properties of genetic code.
8. Explaining the codon as a triplet, degenerate, and universal

Competency 2: The student will relate how genetic information stored in DNA molecules is used to assemble protein molecules by:

1. Describing the history of the chemistry of the gene.
2. Contrasting gene structure in prokaryotes and eukaryotes.
3. Demonstrating DNA replication's mechanism and enzymology (helicase, primase, DNA polymerase, DNA ligase).
4. Contrasting DNA replication in prokaryotes and eukaryotes.
5. Defining the structure of RNA and giving the function of RNA subtypes.
6. Studying the Central Dogma of molecular biology.
7. Explaining the process of transcription.
8. Explaining the process of post-transcriptional modification in the nucleus.
9. Explaining the control of transcription, including the Operon Model.
10. Explaining the mechanism of translation and furnishing the details of initiation, elongation, and termination.

Competency 3: The student will demonstrate knowledge of cell division and reproduction by:

1. Relating the prokaryotic chromosome and the process of binary fission.
2. Discussing a duplicated eukaryotic chromosome and distinguishing between diploid and haploid chromosome complements.
3. Stating the difference between chromatin and chromosome and explaining how one becomes the other.
4. Explaining the cell cycle and its control.
5. Contrasting the behavior of normal cells with that of cancer cells.
6. Identifying the stages of mitosis and cytokinesis in plant and animal cells.
7. Outlining the process of meiosis and its role in plant and animal life cycles.
8. Explain the stages of meiosis and describe synapsis and cross-over.
9. Comparing the processes of meiosis and mitosis.
10. Interpreting sexual reproduction and how it contributes to genetic variation.

Competency 4: The student will demonstrate knowledge of the basic mechanisms of inheritance by:

1. Analyzing Mendel's methods and results in his monohybrid and dihybrid experiments.

2. Stating Mendel's Principle of Segregation and describing examples.
3. Stating Mendel's Principle of Independent Assortment and describing examples.
4. Explaining the use of the testcross to determine genotype.
5. Solving one-trait and two-trait genetics problems by using Punnett squares and probability laws.

Competency 5: The student will demonstrate knowledge of classic mechanisms of inheritance that extend beyond Mendel by:

1. Identifying and solving problems involving multiple alleles, incomplete dominance, codominance, epistatic genes, pleiotropic genes, and lethal genes.
2. Analyzing the determination of sex and explaining sex-linked inheritance.
3. Solving sex-linked problems and sex-influenced problems.
4. Explaining linked genes and solving linked genes problems using the results of linked gene crosses to determine the map distance of the genes on the chromosome.
5. Review the preparation of a human karyotype and how to use it.
6. Researching variations in chromosome structure through inversions, deletions and translocations.
7. Listing chromosomal abnormalities, aneuploidy, and polyploidy and giving examples.
8. Identifying the patterns of inheritance when viewing a human pedigree.
9. Describing the method of mapping a human chromosome.

Competency 6: The student will demonstrate knowledge of the inheritance of prokaryotic cells (bacterial genetics) and viruses by:

1. Describing bacterial phenotypes.
2. Distinguishing between the lytic and lysogenic cycle in bacteriophage.
3. Distinguishing between transformation, conjugation, and transduction.
4. Explaining how conjugation (interrupted mating) is used in prokaryotic mapping.
5. Explaining the correct sequence of the events in replicating DNA and RNA animal viruses.

Competency 7: The student will demonstrate knowledge of the control of gene expression at the transcriptional level in prokaryotes by:

1. Defining transposons and transposable elements.
2. Explaining the Operon Model (inducible system for prokaryotic control).
3. Explaining the Operon Model (repressible system).

Competency 8: The student will demonstrate knowledge of the organizational level of the eukaryotic chromosome, the control of gene expression and mutations

1. Describing how DNA packing into chromatin affects the accessibility of the DNA for gene expression.
2. Defining and describing euchromatin, heterochromatin, histones, nucleosomes, and different degrees of chromatin packaging.
3. Explaining how chemical modification of chromatin (DNA methylation and histone acetylation) affects DNA packing into chromatin and the availability of DNA for gene expression.
4. Explaining the genetic mechanisms involved in differential gene expression during growth and development.
5. Explaining how gene rearrangements affect immunoglobulin gene expression.
6. Describing control of gene expression at the level of transcription initiation.
7. Describing the roles of transcription factors and activators or enhancers in controlling gene expression in eukaryotes.
8. Describe the different motifs in DNA binding proteins and their role in transcription initiation.
9. Defining post-transcriptional control of gene expression in eukaryotes.
10. Describing pre-mRNA processing, splicing, and alternative or differential splicing in eukaryotes.
11. Explaining how differential splicing has contributed to protein diversity.
12. Defining translational regulatory mechanisms.
13. Describe and provide examples of how regulatory proteins prevent ribosome binding to the mRNA.
14. Explaining how levels of control are affected during cellular differentiation.

Competency 9: The student will describe the current developments in recombinant DNA technology and its applications by:

1. Explaining DNA cloning, restriction endonucleases, palindromes, vectors, and genomic libraries.
2. Defining reverse transcription in forming cDNA.
3. Describe the techniques used in the application of gene probes.
4. Explaining the polymerase chain reaction (PCR).
5. Describing the Sanger (dideoxy) method of DNA sequencing.
6. Outlining the DNA fingerprinting method, including RFLP, electrophoresis, and Southern Blotting.
7. Defining transgenic organisms.
8. Defining the "Human Genome Project" and giving the rationale for such undertaking.

Competency 10: The student will demonstrate knowledge of polygenic inheritance by:
Analyzing continuous traits and polygenes and solving problems involving polygenic inheritance.
Explaining the role of the environment in phenotype.

Competency 11: demonstrate knowledge of the basic concepts of population genetics

1. Analyzing and explaining the Hardy- Weinberg equilibrium.
2. Determining allelic frequencies from phenotypic distributions.
3. Listing the five assumptions of the Hardy- Weinberg equilibrium.
4. Performing chi-square analyses to establish whether a population fits the Hardy-Weinberg equilibrium.
5. Describe the processes that change allelic frequencies.
6. Contrasting and providing examples of genetic drift, gene flow, and natural selection.

Competency 12: The student will demonstrate knowledge of the influence of environmental factors on Gene expression by:

1. Discuss aspects of the variation in the expression of genes.
2. Discussing intrinsic and extrinsic factors influencing variation and expression of genes.
3. Explaining the importance of environmental mutagenesis.
4. Identifying the primary principles of genetic variance.
5. Defining the principles of mutagenesis.

Competency 13: The student will demonstrate knowledge of genetics, diseases, and disorders

1. Describing the role of oncogenes and tumor-suppressor genes in cells and the genetic changes that lead to transforming a normal cell to a tumor cell.
2. Identifying causes and effects of common genetic diseases and or disorders.
3. Discuss the scientific evidence and social implications of research in behavioral genetics and address the complex interplay of genetics and the environment in affecting human behavior.

Competency 14: The student will demonstrate knowledge of scientific developments, public perspectives, and responsibility related to genetic studies and research by:

1. Describing current technological advances in biology and genetic research, including, but not limited to, stem cell research, cloning, and bioengineering.
2. Discussing the social implications of current research and technological advances in biology and genetics, including, but not limited to, the areas of stem cell research, cloning, and bioengineering.

<u>Learning Outcomes:</u>

1. Information Literacy
2. Aesthetic / Creative Activities
3. Social Responsibility
4. Communication
5. Critical Thinking
6. Cultural / Global Prospective

7. Environmental Responsibility