Course Outline for: BIOL 1101 Introduction to Human Genetics

A. Course Description

1. Number of credits: 4
2. Lecture hours per week: 3
   Lab hours per week: 3
3. Prerequisites: ENGC 0960 (C- or better) OR READ 0960 (C- or better) OR High School GPA of 2.60+ OR ACT Sub-Score of 21+ OR ACT Sub-Score of 19+ and High School GPA of 2.50+ OR SAT Read/Write score of 480+ OR SAT Read/Write score of 440+ and High School GPA of 2.50+ OR Accuplacer Reading score of 250+ OR Accuplacer Reading score of 236+ and High School GPA of 2.50+ OR MCA Reading score of 1047+ OR MCA Reading score of 1042-1046 and High School GPA of 2.50+
4. Corequisites: None
5. MnTC Goal: #3 Natural Sciences

A non-majors general education lab course that explores the basic principles of human genetics. Topics include the scientific method, Mendelian genetics, sex determination, karyotypes, molecular genetics, ethical, legal, and social issues, genetics of cancer, and population genetics. Lecture 3 credits, 3-hour lab 1 credit.

B. Date last reviewed/updated: January 2023

C. Outline of Major Content Areas

Lecture: Subtopics listed under each main topic may vary due to recent developments in the field and current events.

1. Introduction to Genetics
   a. Identification of the major issues within the field of Genetics
   b. Identification of the major applications of Genetics and of some of the ethical, legal, and social problems they pose.
2. Cell Structure and Function
   a. Components of cells
   b. Chromosomes
   c. The cell cycle and mitosis
3. Human Development
   a. The life cycle and meiosis
   b. The reproductive system and the formation of gametes
   c. Prenatal development
4. Mendelian Inheritance
   a. Mendel's principles of dominance, segregation, and independent assortment
   b. Mendelian inheritance in humans and pedigree analysis
   c. Chromosomal basis of Mendelian inheritance

5. Extensions of Mendelian inheritance
    a. Multiple alleles and different dominance relations
    b. Penetrance, expressivity, and the influence of the environment
    c. Maternal inheritance, mitochondrial genes and mitochondrial disorders
    d. Linkage and gene mapping
6. Sex-linked inheritance
    a. Sex determination in human beings
    b. X-linked inheritance and X-linked disorders
    c. Inactivation of X-linked genes in female mammals
7. Multifactorial traits
    a. Quantitative traits and continuous variation
    b. The concept of heritability
    c. Methods to study multifactorial traits: Twin studies
8. The Structure of DNA
    a. The chemical composition and structure of nucleic acids
    b. Chromosome structure
    c. DNA replication and DNA repair
    d. Polymerase Chain Reaction (PCR) and its applications
9. Gene Action
    a. Transcription, splicing, and RNA processing
    b. Translation and the genetic code
10. Gene Mutation
    a. Phenotypic effects of mutation
    b. Spontaneous and induced mutations
    c. Different types of mutations
11. Chromosomes
    a. Prenatal diagnosis and cytological techniques
    b. Abnormal chromosome number and structure
12. Population Genetics
    a. DNA fingerprinting
    b. Hardy-Weinberg equilibrium
    c. Changing allelic frequencies
    d. Natural selection and balanced polymorphism
13. Human Origins and Evolution
    a. Molecular evolution and molecular clocks
14. Medical Genetics
    a. Genes and cancer: oncogenes and tumor-suppressor genes
    b. Prevention and treatment of cancer
15. Advances in Genetics
    a. DNA Technologies
        i. DNA cloning and DNA sequencing
        ii. Genetically modified organisms
        iii. Somatic and germ-line gene therapy
        iv. Cloning of organisms
        v. Ethical, legal, and social issues
        vi. DNA editing

b. Reproductive technologies
   i. Infertility
   ii. Assisted reproductive technologies

Laboratory: Students will actively participate in lab by engaging in studies related to:

1. Microcopy and Cells
2. Mitosis and Meiosis
3. Fruit Fly Life Cycle and Dihybrid Cross
4. DNA Extraction
5. Polymerase Chain Reaction
6. Gel Electrophoresis
7. DNA Sequence Analysis
8. Bacterial Transformation
9. Karyotype Analysis
10. Natural Selection

D. Course Learning Outcomes

Upon successful completion of the course, the student will be able to:

1. Recognize and explain the major concepts and principles of Classic, Molecular and Population Genetics and apply them. (Goal 2a, 3a)
2. Identify the basic steps of the scientific method by analyzing classic experiments in genetics, applying these steps in laboratory and computer exercises, and communicating experimental findings by writing lab reports. (Goal 2a, 2b, 2c, 3a, 3b, 3c)
3. Explain the genetic basis of some common medical disorders and the genetic foundation of human diversity. (Goal 3a, 3d)
4. Gather information and compare and contrast different points of view surrounding controversial topics in genetics and articulate, justify and defend their personal point of view in writing or in discussions. (Goal 2d, 3a, 3c, 3d)
5. Translate verbal material to mathematical expressions, apply mathematical formulas and statistics, solve problems, and interpret and construct charts and graphs. (Goal 2c, 3b)

E. Methods for Assessing Student Learning

A variety of evaluation and assessment methods may be used:

1. Written examinations that may include multiple choice, true-false, fill-in the blank, matching, short answer, problem solving, and critical thinking essay questions.
2. Writing assignments
3. Home study assignments
4. Laboratory reports
5. Discussions
6. Comprehensive final exam

F. Special Information

Instructors will include the most recent version of the Departmental Expectations document in their course syllabus.

When offered on-campus:

- The laboratory portion of the course is delivered in the Biology Learning Center (BLC).
- Instructors will include the most recent version of the Biology Learning Center (BLC) Expectations document in their course syllabus
- Laboratory procedures require handling and killing of fruit flies; there are no exceptions or alternate activities.
- Laboratory procedures require genetic modification of bacteria; there are no exceptions or alternate activities.