BIOL C283: GENETICS

Item	Value
Curriculum Committee Approval Date	10/17/2008
Top Code	040100 - Biology, General
Units	4 Total Units
Hours	72 Total Hours (Lecture Hours 72)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S)
Local General Education (GE)	• Area 5B Life Sciences (CB2)
California General Education Transfer Curriculum (Cal-GETC)	• Cal-GETC 5B Biological Sciences (5B)
Intersegmental General Education Transfer Curriculum (IGETC)	• IGETC 5B Biological Sciences (5B)
California State University General Education Breadth (CSU GE-Breadth)	• CSU B2 Life Science (B2)

Course Description

This course covers the principles of Mendelian and non-Mendelian inheritance, eukaryotic and prokaryotic gene transmission, replication, mutation, recombination, gene expression and regulation, cell division, meiosis, human genetic diseases, and ethical implications of genetics. Emphasis is placed on problem solving. PREREQUISITE: BIOL C180 and CHEM C180 or CHEM C185. Transfer Credit: CSU; UC.

Course Level Student Learning Outcome(s)

1. Utilize concepts in Mendelian genetics to analyze data and solve common problems in transmission genetics.
2. Describe the principal structures, organization and molecular mechanisms involved in the transmission of genetic information and how DNA mutations affect these processes.
3. Summarize and evaluate the hypotheses, experimental design, results and conclusions in a genetics-related journal article from primary research literature.
4. Knowledgeably discuss ethical implications of emerging genetic technologies.

Course Objectives

- I Introduction
- I. 1. Describe common model organisms and how they are used in the field of genetics.
- II Mendelian Genetics
- II. 1. Explain Mendel?s postulates of inheritance and apply these to problems of inheritance.
- II. 2. Describe how chromosome theory relates to postulates of Mendelian inheritance.
- II. 3. Use chi-square analysis to determine whether a data corresponds to a genetic model.
- II. 4. Analyze pedigrees to determine possible modes of inheritance and predict mating outcomes.
- III Non-Mendelian Genetics
- III. 1. Identify non-Mendelian ratios and explain three factors that modify Mendelian inheritance ratios.
- III. 2. Contrast dominant epistasis, recessive epistasis, duplicate gene action and complementary gene action.
- III. 3. Use complementation analysis to determine the number of genes controlling a particular trait.
- III. 4. Explain how traits can be affected by the sex of the individual.
- IV Chromosomes
- IV. 1. Describe the following chromosomal rearrangements: deletions, insertions, inversions, reciprocal translocations and non-reciprocal translocations.
- IV. 2. Identify human karyotypes that are aneuploidy.
- IV. 3. Describe three genetic conditions arising from chromosome abnormalities
- V Linkage and Genetic Mapping
- V. 1. Compare and contrast the effect of linkage and independent assortment on genetic outcomes.
- V. 2. Analyze data from a three-point cross to create a genetic map and calculate whether interference occurred.
- V. 3. Construct a bacterial chromosome map using gene transfer date from a set of Hfr strains.
- VI Molecular Genetics
- VI. 1. Outline the experiments that identified DNA as hereditary material.
- VI. 2. Compare and contrast the molecular structures of DNA, RNA and proteins.
- VI. 3. Describe the experiment that elucidated how DNA is replicated.
- VI. 4. Explain the principal steps and major molecules involved in DNA replication, transcription and translation.
- VI. 5. Compare and contrast transcription and RNA processing in eukaryotes and prokaryotes.
- VI. 6. Derive a biochemical pathway from data showing how mutants grow in the presence of various supplements.
- VI. 7. Describe types and causes of DNA mutation, as well as the molecular mechanisms that repair damaged DNA.
- VI. 8. Describe the mechanisms that regulate gene expression in prokaryotes and eukaryotes.
- VI. 9. Contrast the stages at which gene regulation can occur in prokaryotes and eukaryotes.
- VI. 10. Analyze mutations in the lac operon and predict whether functional enzyme will be produced.
- VII Cancer
- VII. 1. Compare and contrast the cell cycle in normal cells and cancer cells.
- VII. 2. Describe the characteristics cells must acquire to become cancerous.
- VIII Biotechnology and Genomics
- VIII. 1. Describe how PCR, DNA cloning and DNA sequencing work.
- VIII. 2. Describe principal characteristics of vectors and identify them on a restriction map.

- VIII. 3. Given a set of restriction digests, construct a restriction site plasmid map.
- VIII. 4. Compare and contrast the following terms: homologs, orthologs and paralogs.
- VIII. 5. Compare and contrast, genomics, transcriptomics, proteomics.
- VIII. 6. Describe major differences between eukaryotic and prokaryotic genomes.
- VIII. 7. Describe three applications of genetic technologies and discuss associated ethical issues.
- VIII. 8. Describe how microarrays are used in genetic analysis.
- IX Development
- IX. 1. Explain the molecular roles of segmentation and homeotic selector genes in Drosophila development.
- IX. 2. Compare and contrast among gap, pair-rule and segment polarity genes.
- X Quantitative Genetics
- X. 1. Identify whether offspring from a genetic cross suggests a polygenic mode of inheritance and calculate the number of gene pairs involved.
- X. 2. Describe how quantitative trait loci are identified and mapped.
- XI Population Genetics and Evolution
- XI. 1. Apply the Hardy-Weinberg Law to determine whether a population is in equilibrium.
- XI. 2. Calculate allele frequencies and heterozygote frequencies using the Hardy-Weinberg Law.
- XI. 3. Describe how DNA mutation and natural selection drive changes in allele frequency.
- XI. 4. Describe prezygotic and postzygotic isolating mechanisms that drive speciation.

Lecture Content

History of Genetics Mendelian Inheritance Mendel s experiments Laws of Segregation and Independent Assortment Monohybrid, Dihybrid and Multihybrid crosses Chi-square analysis Pedigree analysis Non-Mendelian Inheritance Maternal Inheritance Codominance, Incomplete dominance, lethal alleles X-linkage Epistasis Complementation analysis Genetic Background, environmental effects and extranuclear inheritance Chromosomes Chromosome Structure Sex determination and sex chromosomex Chromosome mutations Linkage and Gene Mapping Linkage Mapping in Eukaryotes Three-point cross in Drosophila Somatic cell hybrids and synteny testing Tetrad analysis in yeast Mapping in Prokaryotes Molecular Genetics DNA Replication Transcription Translation Gene Expression and Regulation Recombination Mutation Cell Division: Mitosis and Meiosis Human Genetic Diseases Autosomal Diseases Sex-linked Diseases Multifactor Diseases Cancer Genetic Penetrance and Expressivity Genetic Technologies Hybridization Techniques Polymerase Chain Reaction DNA Sequencing Gene Delivery and Transfer Cloning Genomics, Bioinformatics and Proteomic Ethical Implication of Genetic Technologies Current Medical Treatment for Genetic Disorders Genetically Modified Organisms Developmental Genetics Quantitative Genetics Population Genetics Hardy-Weinberg Equilibrium Allele f requencies Number of heterozygotes in a population Natural selection Microevolution, Macroevolution and Speciation

Method(s) of Instruction

- Lecture (02)
- DE Online Lecture (02X)

Instructional Techniques

This course is presented through four hours of lecture material per week. The lectures are supplemented with visual materials, such as PowerPoint slides, movies, podcasts and demonstrations. Case-based learning and small group activities can also be used to reinforce course content. Class discussion will also be an integral part of the lecture.

Reading Assignments

Readings from text Reading genetics-related articles from science websites Reading journal articles for capstone projects

Writing Assignments

Evaluation of genetics-related articles Report on off-campus seminar

Out-of-class Assignments

Online quizzes Participation Forums Ethics Participation Forum Oral Journal Club presentation Attend off-campus seminar Vocabulary terms Homework Problems from text

Demonstration of Critical Thinking

Critical evaluation of a journal article given in an oral presentation Participation in the Ethics of Genetic Engineering Forum

Required Writing, Problem Solving, Skills Demonstration

Genetics in the News writing assignment Quizzes and Exams are primarily composed of genetics problems.

Eligible Disciplines

Biological sciences: Master's degree in any biological science OR bachelor's degree in any biological science AND master's degree in biochemistry, biophysics, or marine science OR the equivalent. Master's degree required.

Textbooks Resources

1. Required Pierce, B. A. Genetics: A Conceptual Approach, 6th ed. W. H. Freeman, 2017 2. Required Klug, W. S., M. R. Cummings, C. A. Spencer and M. A. Palladino. Essentials of Genetics , 10th ed. Pearson Benjamin Cummings, 2019 3. Required Griffiths, A. J. F.; Wessler, S. R.; S. B. Carroll and Doebley., J. Introduction to Genetic Analysis, 11th ed. W. H. Freeman, 2015 Rationale: - Legacy Textbook Transfer Data: Legacy text

Other Resources

1. Coastline Library