



BIOL-134: HUMAN HEREDITY AND EVOLUTION

Effective Term

Fall 2025

BOT Approval Date

11/09/2023

Discipline

BIOL - Biology

Course Number

134

Course Title

Human Heredity and Evolution

Short Title

Human Heredity and Evolution

Credit Status (CB 04)

D - Credit - Degree applicable

Units**Lecture Units**

3.00

Total Units

3.00

Hours**Lecture Contact Hours**

48-54

Out of Class Hours Lecture

96-108

Total Contact Hours

48 - 54

Total Out of Class Hours

96 - 108

Total Student Learning Hours

144 - 162

Distance Education

Yes

Distance Education**Distance Education Type**

Both Fully Online and Hybrid Online

Fully Online Delivery Requirements:

- a. Students must be notified via the college schedule of classes and the syllabus for the class if proctored tests are required for this course
- b. Any planned face-to-face meetings, such as an orientation or study session, must be optional

c. The MSJC curriculum committee requires the use of accessible, asynchronous discussion as a component of every fully online course

Are you using publisher content?

No

Regular Substantive Interaction

Instructor-to-student, student-to-student, and student-to-content contact shall be distributed in a manner that will ensure regular substantive interaction (RSI) is maintained not only weekly but also for the duration of the course. Instructor interactions should be equivalent in time, quality and consistency to the engagement students would receive in a face-to-face course—for example, through announcements, discussion participation, personalized feedback, video messages, or other instructional communications. Instructors are expected to be responsive to student inquiries within a 24-72 hour time frame excluding holidays. RSI will be maintained through a variety of methods:

- Orientation - Students must be oriented to the online and face-to-face portions at the start of the course.
- Announcements - Announcements using the course management system must be posted at least weekly to keep students current on course events, due dates, materials, etc.
- Discussion Forums - Content-related discussion forums within the designated CMS will include appropriate instructor participation and will be initiated and maintained, with timely feedback provided. Instructors are required to monitor the discussions and related activities to provide guidance and direction. Open-ended discussion boards may be used to further learning and interaction.
- MSJC Communication – Instructor will use MSJC-administered communication tools (such as email or the designated CMS communication tools) to regularly communicate with and provide ease of access to students.
- Timely Feedback - Timely feedback on student work will be provided by the instructor, which may include comments and/or rubrics, within the Grades area of the designated CMS.
- Scheduled Meetings – Hybrid and synchronous courses will meet at regularly scheduled times.

ADA Compliance - All course interactions and content must be designed with accessibility in mind and meet ADA requirements.

Catalog Description

This is an introductory course in molecular genetics with an emphasis on basic human genetics and evolution. This course introduces students to central theories of the biological sciences using chemical and biological aspects of human genetics as its main theme. In addition, students are introduced to the political, philosophical, social, and ethical implications of genetics including genetic modification. This course is not intended for biology majors.

Codes

TOP Code (CB 03)

0401.00 - Biology, General

CIP Code

26.0101 - Biology/Biological Sciences, General.

Repeatability Code

No

Grading Option

Letter grade OR P/NP

GE Information

Check GE Types Requested

AA/AS A - Natural and Physical Sciences

Cal-GETC Areas

Approved Cal-GETC Area

AREA-5B

Learning Objectives

Learning Objectives

Learning Objective

1. Appraise the human genome as defined by genes arranged in DNA sequences; to include: the effects of genes at a molecular, cellular, organismal, and population level

2. Compare and contrast the differences between how environmental factors and inherited factors influence gene expression as they relate to cytogenetics and evolution
3. Evaluate cell theory and its relationship to molecular and cellular causes of genetic expression and their relationship to elementary concepts of biochemistry as they relate to DNA, RNA and protein synthesis; including diagramming the structure of DNA and explaining its function in replication; outlining the processes of transcription and translation as they relate to the expression of genetic information contained in the genome
4. Analyze and evaluate cell division, mitosis and reproduction, in relationship to cell structure/morphology and physiology
5. Analyze Mendel's laws pertaining to one and two gene inheritance, and discuss these laws in relationship to probability theory, genetic heterogeneity and sexual inheritance, sex-linkage and gender effects on phenotypic expression
6. Evaluate and differentiate complex trait expression, multifactor and heritability relationships; and identify and define the factors involved in genetic mutation including spontaneous and induced mutations, types of mutations and natural protection against mutation
7. Compute gene frequency as it relates to Hardy-Weinberg Equilibrium (Punnett square) and population genetics
8. Assess and categorize the impact of genetics on various biomedical issues such as gene therapy, genetic modification, tissue transplantation, stem cell research, cloning, and immune disorders; and describe the processes of genetic engineering including the biotechnology of recombinant DNA, transgenic organisms, gene targeting and the relationship to political and ethical implications
9. Review and propose agricultural and environmental applications of genetic biotechnology through the lens of genetic modification
10. Evaluate and criticize independent research on a topic of human genetics using a variety of library resource materials; and write a position paper using a writing style recognized in the natural science community
11. Judge the value of genetic testing and gene therapies given the possibility of misuse and the potential for eugenics

Learning Outcome Information

Course Learning Outcomes

Learning Outcome

1. The student will demonstrate the ability to use the scientific method and to evaluate data in the field of human heredity and evolution.
2. The student will organize their time and exhibit persistence in completing course work.
3. The student will critically examine the diversity of scientists and career pathways in biology and genetics, fostering an inclusive mindset towards various identities and experiences within the scientific community.

Program Learning Outcomes

Learning Outcome

1. Students through persistence will develop problem solving skills in science thinking both critically and abstractly about issues using science as the foundation for understanding.
2. Students will gain scientific awareness with a flexible approach including a willingness to change perspectives and an ability to weigh alternative options while staying rooted in the understanding of their impact as local, national, and global citizens.
3. Students will apply past knowledge to new scientific situations, being able to think abstractly regarding science and communicate this newfound knowledge in the language of science and the scientific method.
4. Students will achieve literacy in the language of science and the scientific method, demonstrating a willingness to respond with wonderment and awe with regards to the physical and biological principles of science, and gather data through all senses.
5. Students will learn hands-on skills in the laboratory, demonstrate how to measure and collect data from experiments with accuracy and precision, and think critically about the results.

Institutional Learning Outcomes

Aesthetic Awareness: The student will identify and evaluate how aesthetic expression leads to an appreciation of social and cultural context as well as the values of art and nature.

Communication: The student will effectively express and exchange ideas through listening, speaking, reading, writing, visual works, and other modes of interpersonal expression.

Critical Thinking: The student will analyze problems, gather and synthesize relevant information, evaluate ideas, information, and evaluate alternative points of view to create, innovate and implement effective solutions.

Information and Technology Literacy: The student will access, interpret, evaluate, and apply relevant information sources and digital media effectively, and in an ethical and legal manner.

Scientific Awareness: The student will apply the scientific method of inquiry to assess potential solutions for real-life challenges by employing science-based knowledge and methodologies in daily life.

Social Awareness: The student will recognize and analyze the interconnectedness of global, national, and local concerns, analyzing cultural, political, social, and environmental issues from multiple perspectives and appreciate similarities and differences among cultures.

Civic

Personal

and Professional Responsibility

Content

Course Lecture Content

1. Overview of Human Genetics Current Topics in Genetics
 - A. Introduction to Genetic Investigation Genetics vs Environment
2. Nature vs Nurture
3. Introduction to Cells
 - A. Molecular Medicine
 - B. Cell Composition and complexity
 - C. Cell Cycle
4. Meiosis and Gametes
 - A. Aging Historical perspectives on genetics
 - B. Mendel's Laws Segregation Independent Assortment
 - C. Gene Expression and Human Characteristics
 - D. Penetrance and Expressivity
 - E. Genetic Heterogeneity
 - F. Functional Distribution of Genes
5. Human Development Reproductive Anatomy and Physiology
 - A. Prenatal Development Maturation
 - B. Sexual Expression / Gender Genotypes and Phenotypes
 - C. Sexual Development
 - D. Sex linked Inheritance
 - E. Skin color as a function of environmental pressure
6. Complex Genetic Expression
 - A. Multifactorial Traits
 - B. Common Human Traits
 - C. Behavioral Genetics
 - D. DNA Structure and Replication DNA as the Hereditary Molecule
 - E. Roles of Protein in Genetic Expression
 - F. Replication of Genetic Information
 - G. Gene Function
 - H. Transcription
 - I. Translation
 - J. Types of RNA
 - K. Gene Mutation
 - L. Types of Mutation: Spontaneous Mutation, Induced Mutation, Cancer and other Environmental Mutagens
 - M. Cytogenetics
 - N. Anatomy of Chromosomes Chromosome Number
 - O. Abnormal Chromosomes
 - P. Chromosome Analysis
 - Q. Gene Frequency
 - R. DNA Fingerprinting
 - S. Population Genetics
 - T. Hardy-Weinberg Equilibrium Changing Gene Frequencies

- U. Mating, Migration, and Genetic Drift
- V. Natural Selection
- W. Human Origins and Evolution Origins – Multiple Theories Out of Africa; Multi-regional Molecular Evolution
- X. Eugenics
- 7. Genetics of Immunity and Cancer Immunity
 - A. Transplantation and Tissue Rejection
 - B. Allergy
 - C. Immunotherapy
 - D. Genetics of Cancer
 - E. Cancer as a Genetic Disorder
 - F. Characteristics of Cancer Cells Oncogenes and other mutation genes
 - G. Innate Immunity, Adaptive Immunity, and Vaccine Science
- 8. Genetic Technology
 - A. Engineering Recombinant DNA
 - B. Transgenic Organisms
 - C. Gene Therapy
 - D. Mechanisms of Gene Therapy
 - E. Sites of Gene Therapy
 - F. Genetic testing
 - G. Ethical considerations of modern genetic technology
- 9. Agricultural and Environmental Technology
 - A. Economics of Biotechnology
 - B. Genetically Engineered Organisms
- 10. Reproductive Technologies
 - A. Infertility Assisted Reproduction
 - B. Genome Modification using Biotechnology
 - C. Sexual differentiation X and Y chromosomes and their genes
- 11. The Human Genome Project
 - A. Technology Human Genome Mapping of Human Genes from diverse populations
 - B. Gene Sequencing
- 12. Critical Discoveries in Genetics made by women such as Rosalind Franklin, Emmanuel Charpentier, and Jennifer Doudna

Methods of Instruction

Method

Group Projects

Integration

Group Projects - Case studies are inspected, evaluated and appraised by students to aid them in developing the ability to access the importance of biology to their own lives.

DE Adaptations for MOI

Case study evaluations and presentations are made both in the discussion board of the course management system. Individual assignments will be evaluated by the instructor for content and quality.

Method

Individual Projects

Integration

Individual Projects - Using individual projects and presentations students present position discussions that address current topics in human genetics and evolution such as the appropriate use of genetic testing in vulnerable populations, the mechanisms complex trait expression, multifactor and heritability relationships related to social and political organization of humans, or how agricultural and environmental applications of genetic biotechnology are changing the potential for human population growth and development.

DE Adaptations for MOI

Students complete a position paper as described in the on-campus course outline. These papers are "presented" to the class using the course management system. Papers are made available to the on-line class for review and critique by fellow students in a discussion format.

Method

Discussion

Integration

Group Discussions – Concept and Research Analysis. In discussion groups students evaluate a variety of genetic and evolutionary principles and relate them to current life issues such as how are Mendel's laws pertaining to one and two gene inheritance related to genetic heterogeneity and sexual inheritance, sex-linkage and gender effects on human phenotypic expression. This is also an opportunity for students to work in cooperative groups that mimic scientific community discussions. Discussions also provide an opportunity for them to acquire, review and interpret published scientific material on genetics and human genetics issues.

DE Adaptations for MOI

Group discussions are accomplished using the "Discussion Board" topic facility of the CMS. Students are randomly assigned to different discussion groups over the course of the class. Discussion topics are similar to those of the on-campus course

Method

Field Trips

Integration

Field Trips - Periodic field trips to museums and research demonstration sites are designed to help explain basic human reproductive anatomy and physiology including hormonal control, gamete maturation, meiosis, fertilization and prenatal embryo development; stimulate discussions of the impact of genetics on various biomedical issues such as gene therapy, tissue transplantation, and immune disorders; and to identify and define the factors involved in gene expression related to genetic mutation as it relates to human evolution.

DE Adaptations for MOI

Students are required to attend one on-site field trip to a museum or to complete a "virtual" field trip assigned by the instructor. The field trip exercise covers the same materials and information as the on-campus class. Students participate in a minimum of one (1) field trip exercise. This requirement is satisfied by physically attending a field trip destination or by "virtual" attendance at selected Web site destinations. A variety of field trip destinations are available to students in the Southern California region. Students not living in the Southern California region will work with the instructor to substitute a destination in proximity to their home or may be given the option of using the virtual destinations. Field trip assignments are presented to the students in the course management system. Field trip write-ups will be evaluated for content and quality.

Method

Lecture

Integration

Lecture - Instruction is in a lecture format enhanced with audiovisual, computerized multimedia and experiment demonstration techniques. Extensive reading and a structured research paper are utilized as instructional tools.

DE Adaptations for MOI

Lectures will be accomplished using instructor and publisher prepared web-based lectures and links to appropriate reference websites. Lectures will take place using the course management system discussion board in both group and whole class setting. Students may be required to access a limited number of recent popular movies if they wish to do some of the optional assessment exercises. These movies are readily available at most video rental outlets and online sources. These exercises are not mandatory, but represent one of a variety of ways in which students can demonstrate proficiency in the subject area. Closed captioning is available on the DVD and most VCR versions of these videos. Any required viewing of video will be accomplished either through streaming video clips or the videos can be obtained by students at local video stores. All use of video in this online course will follow appropriate Section 508 guidelines.

Methods of Evaluation

Method

Class Participation

Integration

Class participation - Students may be required to participate in at least three position discussions which address current topics human genetics. These position discussions include, but are not limited to: identifying the differences between how environmental factors and inherited factors influence gene expression; explaining cell theory and its relationship to molecular and cellular causes of genetic expression; description of how biochemistry relates to cell function; description of cellular morphology and cellular physiology as they relate to genetic processes; description of cell division, mitosis and meiosis and their relationships to human reproduction and genetic expression; and explanation of basic human reproductive anatomy and physiology including hormonal control, gamete maturation, meiosis, fertilization and prenatal embryo development.

DE Adaptations for MOE

Students are required to participate in weekly group discussion sessions in the course management system. Students are required to post a discussion thread as well as respond to at least two other posted discussions each week. Groups are changed weekly. Response Assignments are required. Response assignments are completed using asynchronous communication with the instructor and other students.

Method

Exams/Tests

Integration

Mid-term evaluations - Mid-term evaluations are essay examinations requiring critical thinking and collegiate writing skills. These evaluations are used to demonstrate the students ability to describe in writing complex human genetics ideas such as; what is cell theory and how is it related to molecular and cellular causes of genetic expression; describe elementary concepts of biochemistry as they relates to the genetics of cell function; cellular morphology and basic cellular physiology; describe cell division, mitosis and reproduction; Students are required to explain basic human reproductive anatomy and physiology including how genetics is involved in hormonal control, gamete maturation, meiosis, fertilization and prenatal embryo development.

DE Adaptations for MOE

Examinations are presented in the course management system. Examinations may contain a variety of questions including but not limited to multiple choice, fill-in the blank, and essay. Essay components of the examinations are sent to the instructor using the course management system. Examinations are similar to those given to on-campus students with the exception that a greater variety and differential presentation of questions are used such that students do not necessarily have the same questions on the same test. Online mid-term examinations, response assignments, field-trip reports, final examination and the position paper are submitted via the course management system. There is no requirement for proctored, on-campus attendance for examinations. Examination and assignment grades are delivered privately to students via the course management system.

Method

Final Performance

Integration

Final evaluation – This essay examination is a comprehensive examination of the student's ability to evaluate basic concepts of genetics and evolution as they relate to humans and to recall and synthesize knowledge previously evaluated in mid-term examinations.

DE Adaptations for MOE

Final exam is similar to the on-campus exam, but taken in the course management system. A comprehensive final exam is designed to assess the student's ability to evaluate, analyze and synthesize course materials and objectives. The Final Examination is presented in the course management system.

Method

Quizzes

Integration

Weekly quizzes are used for the evaluation of general genetics concepts presented, utilizing short essay, multiple choice, true/false tests and take home assignments. These assignments will focus on human genetics including solving genetics problems, using case studies to explain relationships between genes and various diseases, identifying mode of inheritance, and role of the environment in phenotype, etc.

DE Adaptations for MOE

Weekly evaluations will be accomplished using instructor and publisher prepared web based evaluations similar to those use in the on-campus course. Questions will be chosen from a data bank of questions such that individual students will have similar but not necessarily the same questions on evaluations.

Method

Research Projects

Integration

Structured Research Report - The research report is a 5 - 8 page written report on a current topic of human genetics or genetics related to human issues. This report requires the student to use APA writing style and must express independent research and critical thinking. This assignment demonstrates that the student can acquire and interpret published data for an area of interest to human genetics. Students demonstrate an ability to research and find current genetic data from online databases. Reports may discuss topics such as the impact of genetics on various biomedical issues such as gene therapy, tissue transplantation, and immune disorders; genetic engineering; agricultural and environmental applications of genetic biotechnology, etc.

DE Adaptations for MOE

This project is the same as the on-campus course with the exception that the paper is presented in the course management system.

Assignments**Assignment Type**

Reading

In-class and/or outside of class

In-class

Outside of class

Formative or Summative

Formative

Assignment

Read the following article and be prepared to summarize the author's three main points. Brian C. Verrelli and Sarah A. Tishkoff (2004) Signatures of Selection and Gene Conversion Associated with Human Color Vision Variation, American Journal of Human Genetics.

From the reading you learned about the genetics of color vision. Using a Punnett square, diagram the gene for eye color in your family. Speculate on the eye color of your children (if you don't have any) given the eye color of your ideal mate. Cite evidence that genetic contributions from both parents are necessary for normal prenatal development.

How assignment will be adapted in online format

Discussion items will be submitted to the Discussion board facility in the Online Course Management System (CMS). Assignments and associated materials will be submitted through the CMS via document upload, using the assignment tool in the CMS.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Five patients meet at a clinic for families in which several members have early-onset Parkinson disease. This condition causes rigidity, tremors, and other motor symptoms. Only 2 percent of cases of Parkinson disease are inherited. The five patients all have mutations in a gene that encodes the protein parkin, which has 12 exons. For each patient, indicate whether the mutation shortens, lengthens, or does not change the size of the protein: Albert Gonzales' parkin gene is missing exon 3; Sonja Johnson's parkin gene has a duplication in intron 4; Judy Ney's parkin gene lacks six contiguous nucleotides in exon 1; Tom Cavanaugh's parkin gene has an altered splice site between exon 8 and intron 8; Niko Shapiro's parkin gene is deleted. Mark and Louise are planning to have their first child, but they are concerned because they think that they have an Rh incompatibility. He is Rh- and she is Rh+. Will there be a problem? Why or why not. Ruth is 102 years old, and she still walks at least half a mile a day. She is a trim vegetarian who has rarely been ill her entire life. Morris is an obese, balding 62 year old man who has high blood pressure and colon cancer. How might their proteome portraits differ?

How assignment will be adapted in online format

Discussion items will be submitted to the Discussion board facility in the Online Course Management System (CMS). Assignments and associated materials will be submitted through the CMS via document upload, using the assignment tool in the CMS.

Assignment Type

Writing

In-class and/or outside of class

Outside of class

Formative or Summative

Summative

Assignment

Prepare a research paper of at least 5 and no more than 10 double spaced type-written pages on a current topic in medical therapeutics and/or genetics. The paper must include a cover page, brief background information, current knowledge in the field on the topic, student perspectives on the topic, and a bibliography in addition to the 5 to 10 pages of the main body of the paper. A minimum of three references is required. This is an independent work project which should demonstrate critical thinking. Topics might include: the effect of gene therapy in controlling human diabetes; the genetics of Alzheimer's disease, the risks and benefits of labeling GMO containing food.

How assignment will be adapted in online format

Research papers and associated materials will be submitted through the Course Management System (CMS) via document upload, using the assignment tool in the CMS.

Assignment Type

Other

In-class and/or outside of class

In-class

Formative or Summative

Summative

Assignment

Lecture Exams - At least three (3) lecture examinations will be given to students over the course of the semester in order to accurately assess reading, writing, and speaking comprehension of various topics in the molecular aspects of human genetics, human heredity, contributions to science by women and people of color, genetic modification and evolution presented in lecture. A mid-term and a final exam are to be employed at a minimum for this course. Exams shall be a mixture of many question types including, but not limited to: Multiple Choice, Multiple Answer, Matching, Labeling, Short Answer, Long Answer Essay, and True/False.

How assignment will be adapted in online format

Exam will administered through the online Course Management System (CMS). Students will log into the CMS and access exams virtually.

Course Materials**Textbooks**

Lewis, Ricki (2021). Human Genetics: Concepts and Applications (13th ed). McGraw Hill. ISBN13: 9781260240894
James Watson (1969). The Double Helix Mentor. ISBN: 0451627873

Class Size Information**Class Size**

40

Class Size Category

A - Lecture/discussion 40

Diversity and Inclusion**Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.**

This course provides a broad framework in human genetics literacy with a focus on how traditional and molecular genetics translate to human diversity as reflected in gender, culture, race, and individual identity. Assignments invite students to explore human genetic issues that affect marginalized communities both domestically and abroad. For example, students will consider how different genetic characteristics reflected in cultural groups differ in terms of their contributions to individual and community viability. Students will also consider the extent to which individuals and populations are impacted by these characteristics and have access to the biological reasons that issues of gender, sexuality, race and culture impact social organization. Considerations of social justice, such as the history of eugenics, are integrated into the content and students are invited to explore the ways in which the effects of human genetics impact cultures and genders in diverse and unequal ways.

Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.

The course invites students to explore how our modern understanding of human genetics impacts diverse cultures, voices, and lived experiences. Instruction is focused on eliminating structural barriers to success by incorporating open educational resources and presenting a diverse array of media to connect with a spectrum of learning styles. In addition, students are expected to interact with one another in discussions focused on contemporary human and agricultural genetic issues and to share their perspectives and personal experiences while adhering to norms of inclusivity. Students are encouraged to challenge normative expectations of what it means to engage in discussions about how our genetics affect our humanity and are provided with the tools to be active in the scientific endeavor regardless of their chosen major or career path.

Interactions**Explain how the course will incorporate student-to-student interaction.**

Students will have frequent opportunities to interact with one another in online or in-person discussions focusing on human genetics issues. These interactions will augment the other forms of content delivery employed in this course by exposing students to diverse perspectives held by members of their own communities. Students will be encouraged to develop and abide by norms of tolerance and inclusivity.

Explain how the course will incorporate instructor-to-student interaction.

Instructors will participate in and guide group discussions. In the distance education modality, these interactions may be either asynchronous, taking place in the discussion forum or via email communication, or synchronous, via video conferencing. For challenging assignments and projects, instructors will model metacognitive approaches, engaging with students to guide them through complex critical thinking processes. This may include demonstrations of human genetic mechanisms, data interpretation approaches, or interactions with complex primary literature sources. Feedback will be provided either verbally, in writing, or in the course management system. Instructors will be available to answer questions and interact with students directly.

Explain how the course will incorporate student-to-content interaction.

Students will be provided with a variety of accessible forms of media for content delivery. These may include written narratives, journal articles, textbook materials, videos, or verbal lectures. A diverse array of approaches will be employed to accommodate a spectrum of learning styles. For the online modality, these materials will be posted in an accessible format in the course management system, with the lecture component being recorded and captioned. Students will work towards concept mastery through formative assessments, engage in deeper more reflective work through critical writing assignments, and will assess their assimilation of the content through summative assignments. Students will engage with content in active ways, bringing their schema to bear with reading assignments, mining data for meaning, and providing feedback to enhance relevance and relatability.

Explain how the course will incorporate student-to-self interaction (metacognitive).

Students will engage in critical thinking activities that require them to explore issues related to genetics that directly affect their lives. They will be encouraged to critically assess their ethical stance on modern genetic technology. Students will have the opportunity to reflect on any discordance between their subjective worldview and their understanding of objective science. Students will consider their own relationship to their inner genetic code through a variety of analysis projects that explore differences in the ways people around the world interact with their genetic ancestry in the development of their ethnic identity. Through reflection, students will be immersed in the global context of human genetic issues of concern to diverse human populations.

Key: 472