ORIGINAL COURSE IMPLEMENTATION DATE: September 1995
REVISED COURSE IMPLEMENTATION DATE: September 2022
COURSE TO BE REVIEWED (six years after UEC approval)**:** January 2028
Course outline form version: 05/18/2018

OFFICIAL UNDERGRADUATE COURSE OUTLINE FORM

Note: The University reserves the right to amend course outlines as needed without notice.

Course Code and Number: BIO 406	**Number of Credits:** 3 Course credit policy (105)

Course Full Title: Advanced Genetics
Course Short Title:
(Transcripts only display 30 characters. Departments may recommend a short title if one is needed. If left blank, one will be assigned.)

Faculty: Faculty of Science	**Department (or program if no department):** Biology

Calendar Description:

A number of emerging areas of interest in genetics will be covered, including the genetics of human complex disease, epigenetics and environmental influences on our genes, genomics and personalized medicine, the genetics of infectious disease, legal and ethical issues arising from advances in genetics, and quantitative and evolutionary genetics of populations.

Prerequisites (or NONE):	BIO 202 and BIO 220.
Corequisites (if applicable, or NONE):	
Pre/corequisites (if applicable, or NONE):	

Antirequisite Courses *(Cannot be taken for additional credit.)*
Former course code/number:
Cross-listed with:
Dual-listed with:
Equivalent course(s):
(If offered in the previous five years, antirequisite course(s) will be included in the calendar description as a note that students with credit for the antirequisite course(s) cannot take this course for further credit.)

Typical Structure of Instructional Hours

Lecture/seminar hours	45
Tutorials/workshops	
Supervised laboratory hours	
Experiential (field experience, practicum, internship, etc.)	
Supervised online activities	
Other contact hours:	
Total hours	**45**

Labs to be scheduled independent of lecture hours: ☐ No ☐ Yes

Special Topics *(Double-click on boxes to select.)*
This course is offered with different topics:
☒ No ☐ Yes *(If yes, topic will be recorded when offered.)*

Independent Study
If offered as an Independent Study course, this course may be repeated for further credit: *(If yes, topic will be recorded.)*
☒ No ☐ Yes, repeat(s) ☐ Yes, no limit

Transfer Credit
Transfer credit already exists: *(See **bctransferguide.ca**.)*
☒ No ☐ Yes
Submit outline for (re)articulation:
☒ No ☐ Yes *(If yes, fill in transfer credit form.)*

Grading System
☒ Letter Grades ☐ Credit/No Credit

Maximum enrolment (for information only): 24

Expected Frequency of Course Offerings:
annually *(Every semester, Fall only, annually, etc.)*

Department / Program Head or Director: Gregory Schmaltz	**Date of meeting:** October 1, 2021
Faculty Council approval	**Date of meeting:** November 5, 2021
Undergraduate Education Committee (UEC) approval	**Date of meeting:** January 28, 2022

Learning Outcomes:

Upon successful completion of this course, students will be able to:

1. Assess current literature and critically discuss most recent data on select areas of genetic research.
2. Present a critical review on a specific area of interest based on topics discussed in class.
3. Discuss the difficulties associated with the identification of genes responsible for disease.
4. Give examples of how the analysis of the human genome sequence can be used to identify genes associated with complex diseases.
5. Describe how technological development is changing the face of medicine and the ethical and social issues that this is generating.
6. Evaluate, at a genetic level, how selective pressures such as the host immune response or the overuse of antibiotics is driving changes in microbial populations, and how this is resulting in newly emerging infectious disease.
7. Discuss how natural selection and other mechanisms such as mutations, migration, and genetic drift alter allele frequencies to bring about evolutionary divergence in populations.

Prior Learning Assessment and Recognition (PLAR)

☒ Yes ☐ No, PLAR cannot be awarded for this course because

Typical Instructional Methods *(Guest lecturers, presentations, online instruction, field trips, etc.; may vary at department's discretion.)*

A combination of lectures and small group tutorials emphasizing problem-solving.

NOTE: The following sections may vary by instructor. Please see course syllabus available from the instructor.

Typical Text(s) and Resource Materials *(If more space is required, download Supplemental Texts and Resource Materials form.)*

	Author (surname, initials)	Title (article, book, journal, etc.)	Current ed.	Publisher	Year
1.	Klug W. et al	Concepts of Genetics	☒	Pearson	2019
2.	Schuettenngruber B. et al	Genome Regulation by Polycomb and Trithorax: 70 Years and Counting	☐	Cell	2017
3.	Nussenzweig P. et al.	Molecular Mechanisms of CRISPR-Cas Immunity in Bacteria	☐	Ann Rev Genetics	2020
4.	Uffelmann E. et al.	Genome Wide Association Studies	☐	Nature Reviews	2021
5.	Gibson G. and Lacek K..	Canalization and Robustness in Human Genetics and Disease	☐	Ann Rev Genetics	2020

Required Additional Supplies and Materials *(Software, hardware, tools, specialized clothing, etc.)*

Typical Evaluation Methods and Weighting

Final exam:	50%	Assignments:	20%	Field experience:	%	Portfolio:	%
Midterm exam:	30%	Project:	%	Practicum:	%	Assigned Problems:	%
Quizzes/tests:	%	Lab work:	%	Shop work:	%	Total:	100%

Details (if necessary):

Typical Course Content and Topics

Human cytogenetics
Developmental genetics
Genetics of infectious disease
Epigenetics
Medical genetics/genetics of human complex disease
Bioethics
DNA barcoding
Allele frequency changes in Populations

Genetics of Human Complex Disease/Genome Wide Association Studies (GWAS)

- Single nucleotide polymorphisms
- The human haplotype map
- Linkage for common disease
- Common disease common variant hypothesis
- Linkage disequilibrium
- Indirect association

Epigenetic Inheritance: A Contributor to Species Differentiation?

- The concept of the epigenome

- What is epigenetic variation?
- Environmental influences on gene expression
- How multiple epigenetic states can be associated with the same genome
- The transmission of epigenetic states through the germline
- Can epigenetic variation be stable enough to underlie species characteristics?
- Examples of epigenetic inheritance which may mediate Darwinian evolution
- Somatic methylation states as they relate to methylation states of the germline
- Paramutation and genomic imprinting

Genetics of infectious disease
1. Antibiotic resistance:
- Resistance mechanisms to circumvent the toxic action of antimicrobials
- Mutation of normal cellular genes, the acquisition of foreign resistance genes, or a combination of these two mechanisms
- The spread of mobile genetic elements and the acquisition of multidrug resistance in a single genetic event
- The need for infection control in both human and veterinary medicine

2. Antigenic variation
- Mechanisms of antigenic variation; an overview
- Selective pressures imposed on the microbial world
- Phase variation in Helicobacter pylori lipopolysaccharide
- Genetic variation in the pathogenic Neisseria species
- Trypanosome antigenic variation
- Surface antigenic variation in Giardia lamblia
- Emerging infectious disease; the impact of antigenic variation on pathogen population structure, fitness, and dynamics

Genetics in society:
- The development of human genetic and reproductive technologies
- Legal, ethical, and social issues arising from the development of these technologies
- Bioethics associated with research which include areas such as the use of human subjects in the field of genomics, genomic data sharing policy, and how the FDA proposes oversight of laboratory developed tests.