

**FOUNDATION BLOCK
200 - MOLECULAR BIOLOGY
(LIBERAL ARTS & SCIENCE SECTION)
SYLLABUS**

Course Description (from Calendar)

Recent advances in genome sequencing are offering fascinating glimpses into our evolutionary past, are being used to solve crimes, to develop new medicines, and to rescue endangered species. The Human Genome Project is used to illustrate today's cutting-edge genetics and molecular biology techniques, and to introduce the ethical and political challenges that arise from the use of these biotechnologies. This course is conducted in the classroom and is supplemented with laboratories.

Section Description

“What is DNA?” This is the central question that this course proposes to address. By exploring the perspectives of various fields (for example, computer science, anthropology, visual arts, biology) on this question, students will gain an appreciation of the many ways in which DNA is regarded by different people, as well as develop a deep understanding of how the discovery of this molecule has impacted many areas of human endeavor. The course satisfies the requirements for a Molecular Biology Foundation block. Students intending to apply to medical school or graduate programs in the life sciences are encouraged to take the Pre-Med Section of this course.

Day:

Semester:

Year:

Time:

Location:

Website:

Instructor: Dr. Annie Prud'homme Généreux

Phone: 604-898-7446

Office:

e-mail: annie.prudhomme-generoux@questu.ca

Credits: 1 block

Pre-requisite:None

Course Goals

In this course, students will explore their own perception, as well as the way in which specialists in many discipline regard DNA. At the end of this course, students should be able to answer the question “what is DNA?” using the multifaceted perspectives of a

variety of fields. Students should also be able to describe how the discovery of the DNA double helix merely 50 years ago has impacted our society.

The following Quest outcomes will be developed:

- Critical thinking
 - Students will maintain a blog, which will record their thoughts and impressions on the different perspectives to the question “what is DNA?”
 - Students will produce a digital movie in which they explore how DNA has affected their lives, and is changing our society
 - Students will compare science reported in the news with the original research article to determine the validity of the news reports
 - Students will participate in debates over such issues as whether genes should be patented
 - Students will evaluate the work of peer at a scientific conference held in class
- Communication
 - Students will work collaboratively with their peers on daily assignments
 - Students will use images and videos to illustrate their thoughts in the production of a digital movie
 - Students will communicate the results of their assignments in a variety of formats (orally, written, pictures, blogs, etc...)
 - Students will take part in a debate, arguing the pros and cons of gene patenting
- Research
 - Students will learn how to search for and read primary scientific literature
 - Students will gain exposure to basic molecular biology laboratory techniques
- Ethics
 - Students will analyze the ethical and legal ramifications of emerging biotechnologies by exploring case studies
- Integration/breadth
 - Students will explore how our society (culture, art, laws) have been affected by the discovery of the double helix
 - Students will explore how different discipline might answer the question “what is DNA?”

A particular emphasis will be placed on the following quantitative reasoning outcomes:

- IV – Practical probabilities (Finding probabilities from frequencies; Basic laws (sum/products))
- V – Basic Statistics (Descriptions of center and spread; Using the normal distribution; Correlation vs causation)

Method of Instruction

The format of this class consists in small group and individual activities, lectures, exercises, case studies, and discussions. Students will also gain some laboratory experience.

Students are expected to come to class having read the assigned readings and must submit a reading assignment (to be completed individually) at the start of every class. The format of the reading assignments will vary from day to day and instructions will be given the day before the assignment is due. Class time will consist in collaborative and individual activities aimed at exploring important topics from the reading and at gaining first hand practical experience. Some lectures will be given, but students will be encouraged to explore the topics themselves through a guided enquiry-based pedagogy (cased-based and problem-based learning, discussions, web quests, exercises, etc...). Students will be asked to produce a summative work at the end of every section of the course. Some of these assignments will be in groups, some individually, some will be completed in-class, others will be homework. The format will vary from day to day, and instructions will be given in class. Unless otherwise instructed, these assignments are always due at the start of the next class. There are no midterms or final examinations in this course, rather, the daily assignments ensure absorption and synthesis of the material. Students are asked to work on a term-long project involving the production of a digital movie which explores how a particular aspect of the discovery or applications of DNA is changing our society and affecting our lives.

Textbooks & Reading Materials

TBD

Articles & Chapters

TBD

Other Required Materials

- Lab coat
- Safety goggles

Tentative Course Schedule

DAY	TOPIC & OUTCOMES	EVALUATION	READING ASSIGNMENT
1	Personal and class reflections on “what is DNA?” Library use: searching for scientific literature	Begin Blog	
2	For an Artist <ul style="list-style-type: none"> • Source of identity • Basis for destiny/fate • Icon ingrained in public 	Blog – adding your visual interpretation of DNA	

	<p>consciousness</p> <ul style="list-style-type: none"> • Source of concerns (potential for misuse) 		
3	<p>For an Artist</p> <ul style="list-style-type: none"> • Subject of art • Tools for art 	<ul style="list-style-type: none"> • Short student presentations: DNArt • Deadline for meeting with instructor about movie topic, and conference topic 	
4	<p>For a Science Historian</p> <ul style="list-style-type: none"> • One of the most important discoveries of the 20th century • Recount how the DNA double helix was discovered • Explain why this discovery was significant 	<p><?></p> <p>Short Essay: DNA double helix or atomic bomb: Which is the most significant discovery of the 20th century?</p>	<p><i>The Double Helix</i> by James Watson</p>
5	<p>For a Biologist</p> <ul style="list-style-type: none"> • An assembly of chemicals that define life • Name and describe the basic building blocks of DNA • Draw the structure of DNA, being mindful of base pairing rules 		
6	<p>For an Astronomer</p> <ul style="list-style-type: none"> • Chemical found in space • Describe the conditions leading to DNA synthesis • Speculate about the origins of DNA • Speculate whether DNA might be found on other planets, and whether it would be used by extraterrestrial life 		
7	<p>For a Biologist</p> <ul style="list-style-type: none"> • Source of heredity • Describe the link between 	<p>Compare news article with scientific article</p>	

	<p>heredity and DNA</p> <ul style="list-style-type: none"> • Describe the central dogma of gene expression • Explain the roles of DNA, RNA and protein in cell function • Compare the differences in DNA, RNA, and protein in different cell types • Summarize the interaction of genes and environment on phenotype • Determine the relative contribution of genes and environment on a trait based on experimental results 		
8	<p>For a Biologist</p> <ul style="list-style-type: none"> • Tool to transform and improve life forms • Select the appropriate techniques used to manipulate DNA to solve specific problems (eg., amplify a specific section of a gene) • Describe how biotechnologies are being used to alter life forms, including humans, and improve our world (eg., GMO, biomedical, forensic, etc.) 		
9	<p>Lab - Isolation and visualization of DNA</p>	Lab report	
10	<p>Lab – Manipulation of DNA</p>	Lab report	
11	<p>Scientific Conference Day: Innovations in Uses of DNA</p> <ul style="list-style-type: none"> • Research the primary literature • Read and understand the primary literature • Prepare and present a poster or oral presentation at a scientific conference 	<ul style="list-style-type: none"> • Poster or Oral Presentation • 5 peer evaluations 	

	<ul style="list-style-type: none"> • Evaluate the work of peer at a conference 		
12	<p>For a Biologist</p> <ul style="list-style-type: none"> • Molecule on which evolution works • Gage of the relatedness of species <ul style="list-style-type: none"> • Describe how DNA sequences are used to determine evolutionary relatedness • Assess the genetic relationship between humans and other life forms 		
13	<p>For an Anthropologist</p> <ul style="list-style-type: none"> • A clock <ul style="list-style-type: none"> • Explain the concept of a molecular clock • Describe the DNA evidence (and techniques) used to retrace pre-historic human evolution and migration 	Short Essay: mtDNA or Y-chromosome: which is a better tracer of history?	
14	<p>For an Anthropologist</p> <ul style="list-style-type: none"> • Clue to past human evolution • Clue to past human migrations <ul style="list-style-type: none"> • Outline current thinking about human evolution and migration, based on DNA evidence • Describe how the DNA of other species can be used to infer information about human history 		
15	<p>For a Computer Scientist</p> <ul style="list-style-type: none"> • Coded information <ul style="list-style-type: none"> • Compare and contrast a DNA sequence in a cell, and in a 	Bioinformatics exercise	

	<p>computer</p> <ul style="list-style-type: none"> • Discuss the implications of DNA as coded information • Describe the contribution of computer science to various genome projects • Compare DNA sequences using BLAST tools • Retrieve information on human genetic diseases using OMIM • Identify gene features from a DNA sequence using bioinformatics tools 		
16	<p>For a Computer Scientist</p> <ul style="list-style-type: none"> • Hardware for future computers • Describe how DNA is inspiring the design of computer technologies 	Digital Movie: How is DNA changing our society?	
17	<p>For a Law Maker/Biotech Firm</p> <ul style="list-style-type: none"> • A patentable commodity • Describe the criteria for patentability of DNA • Describe the pros and cons of patenting DNA 	In-Class Debates: Should DNA be patentable?	
18	<p>For a Political Economist</p> <ul style="list-style-type: none"> • Source of global industry 	Blog due – Personal reflections on “What is DNA?”	

Method of Assessment

- 20% Daily exercises, presentations, assignments (?X18)
- 10% Lab reports (X2)
- 15% Conference presentation
- 10% Peer evaluation at conference (X5)
- 25% Student movie project
- 20% Blog
- 100%

Daily Assignment Based on Class Work and Readings. Each class will consist in a variety of activities, the culmination of which is a student assignment. The nature of the assignment will vary, as will the requirement for individual or group work. Assignments are always due the following day at the start of class, unless otherwise indicated in class. Unless arranged with the instructor, late assignments will not be accepted and will be given the mark of “0”.

Student Movie Project. Every student must produce a short (~8-10min) digital movie which is due on the 16th day of class. The movie must be a personal reflection on DNA and how it is affecting the life of the student and our society. Students are encouraged to focus their explorations on one particular aspect of DNA (eg., the judicial system’s use of forensic DNA evidence in court cases; the depiction of DNA in feature films; the history of the Human Genome Project; the ethics of DNA databanks; etc.), to use and cite references as appropriate (more information on this will be provided in class), and to incorporate personal reflections on the topic. This is an individual assignment. The movies will be evaluated with a rubric, which is available on the Course Management System. Students will have the option to show their movie to the class. Students must schedule a meeting with the instructor in the first 3 days of class to discuss the topic selected. This is a time-consuming project, and it is recommended that students tackle it as early as possible. More details will be provided in class.

Blog. As one of the goals of this course is for students to reflect upon the importance of the discovery of the DNA double helix to themselves and to our changing society, students will be asked to keep a blog in which they comment upon the material they are learning and reflect upon how this material is affecting their lives, helping them understand themselves or others better, changing their views of the world, the implications they see for our changing society, or is simply irking them or igniting their interest. A rubric will be used to evaluate the blogs, and will assist students in determining what constitutes a good entry (hint: a reflective, personally meaningful entry is desirable). A minimum of 10 entries are required (reflections on at least 10 different subjects/days). A reflection on specific days will be mandatory (details will be provided in class). The length of these entries is up to the student but should be at least 5 sentences long. The rubric is available on the Course Management System. This is an individual assignment. It is due at the end of the last day of class. Unless arranged with the instructor, no late assignment will be accepted.

Conference Presentation. Students will participate in an in-class scientific conference where they will present either an oral or a poster presentation. Students have the option to select the presentation format they are most comfortable with. Students must declare which format of presentation they will use on the Course Management System – there will be a limited number of spots for each, filled on a first come first served basis. The topic of the presentations will be one use of DNA in biotechnology (some sample topics are provided in the Appendix). Students are free to select a topic of their choice, but must confer with the instructor to ensure that no two students select identical topics. The deadline for informing the instructor of the topic is the 3rd day of class. A minimum of one review paper and one research paper must serve as the basis of the

presentation, and must be referenced. The aim of the presentation is to inform a group of peers (i.e. scientifically literate, but non-experts) about the use, techniques employed, and potential to change our society of the biotechnology selected. Five anonymous peers will be assessing the presentation. The evaluation will consist in a rubric (available on the Course Management System) and some written feedback. Their evaluation reports will serve as a basis for the student's grade. The written feedback will be forwarded to the students.

Peer Evaluation at Conference. During the scientific conference, students will be asked to evaluate five of their peers. The quality of the feedback will be used to evaluate the evaluator. A template of the evaluation report is available on the Course Management System. The evaluation report will ask students to evaluate presentation skills and content using a combination of rubric and comments. The form will also ask students for a summary of the information learned by attending the presentation. Student reports will be assessed based on insightfulness and thoroughness and will be assessed using a rubric.

Students will be given a final mark on 100% which will be converted to a letter grade in their transcript using the following conversion:

Mark (%)	Grade	Grade Point
95-100	A	4.0
90-95	A-	3.7
85-90	B+	3.3
80-85	B	3.0
75-80	B-	2.7
70-75	C+	2.3
65-70	C	2.0
60-65	C-	1.7
55-60	D	1.0
< 55	F	0.0

Course and University Policy

Students are referred to the Quest University Canada Calendar for information on academic policies, including plagiarism, grading, the honour principle, attendance and participation.

Appendix

Possible topics for the scientific conference

- 1- DNA fingerprinting
- 2- Gender Determination
- 3- Green Fluorescent Protein
- 4- Xenografts
- 5- DNA/Gene Chip
- 6- Pharmacogenomics
- 7- Nutrigenomics
- 8- Personal medicine
- 9- Toxicogenomics
- 10-Cloning Trees
- 11-Gene Therapy
- 12-Bt-Corn
- 13-Golden rice
- 14-Cat cloning
- 15-Prenatal genetic screening
- 16-Breast cancer gene
- 17-Genetically engineered biological weapons
- 18-Spider's silk in goat milk for bulletproof vests
- 19-Bioremediation
- 20-Alcoholism genes in flies
- 21-Salt-tolerant plants
- 22-Drought-tolerant plants
- 23-Delivering a vaccine through a banana
- 24-Bacterial drug resistance