

Special Topics in Molecular Biology (LIF2004)

Course Description

“Almost all aspects of life are engineered at the molecular level, and without understanding molecules we can only have a very sketchy understanding of life itself.” – Francis Crick

As Dr. Crick suggests, to have an understanding of cell and molecular biology is to better understand the world around us. Implicit to this knowledge is an understanding of the scientific process and how research innovation and technological advances have facilitated our ever-growing knowledge of molecular mechanisms. DNA technology and cellular/genetic research is fascinating! Looking through the lens at a molecular scale reveals many secrets and complex processes that influence biology, ecology, medicine, politics, conservation, ethics, psychology, sociology, art and more!

WELCOME! This course is geared toward students who have an introductory background in gene expression. During this block, we will explore in depth some chosen frontiers in cell and molecular biology. Students will become familiar with some of the most current tools used in molecular research to dive into the areas of cancer biology, conservation genetics, regenerative medicine, and evolutionary genetics. We will study the function of cells and principles of genetics to understand how cells become cancerous, how the immune system fights invasions, how infectious diseases are transmitted, how embryos develop, how stem cells work, how genes and tissues are cloned, how natural selection operates, and how micro- and macroevolutionary processes occur. Emphasis will be placed on understanding the scientific process and interpreting experimental research. Students will become comfortable with the use of primary research literature, formulating hypotheses, analyzing data, designing experiments, discussing results, working in the lab, and presenting ideas.

Learning Outcomes

By the end of this course students will be able to:

- Better understand primary scientific literature, gain confidence in interpreting and reading peer reviewed journal articles, and think like a scientist to evaluate experimental methods, data, and conclusions.
- Convey an in-depth knowledge of the chosen focus areas of this course (cancer biology, stem cell biology, and evolutionary genetics).
- Understand and apply the process of scientific research: establishing hypotheses, designing experiments to address them, collecting data, performing lab experiments, interpreting data in graphs and figures, extrapolating conclusions, sharing results, and participating in peer review.
- Communicate effectively using formats that are standard in the scientific community: scientific writing and oral presentation.
- Communicate scientific ideas and understanding in a creative and engaging manner through developing a pod cast and arguing different perspectives in a scientific debate.

Who, when, where?

Tutor: Jenn Burt

Email: jenn.burt@questu.ca

Office: A445

Office phone: 606 898 8025

Office hours: 2:30-3:30pm on Tuesdays, Wednesdays, and Fridays. I'll be on campus most weekdays if you'd like to meet at a different time. Please email to make an appointment.

Class times: 9:00am – 12:00pm, Monday to Friday

Classroom: Academic building, room 216

Pre-requisite: High school biology 11, or IB Biology, AP Biology, or equivalent

Required Materials

There are two books required for this course. These are available for purchase at the Quest Bookstore.

1. Alters, S. & Alters, B. (2006). *Biology: Understanding Life*. Hoboken, NJ: John Wiley and Sons, Inc.
2. Ridley, M. (2006). *Genome: The autobiography of a species in 23 chapters*. New York, NY: HarperCollins Publishers.

Additional readings from other sources will be sent via email, posted on our course website, or provided in class. You are expected to do the assigned readings thoroughly, to make notes, and to identify terms and concepts that you do not understand. All readings will be relevant to topics discussed in class, so please come prepared – you may be called upon to summarize content or discuss readings in class!

Course Policies

Attendance: It is expected that students will attend every class. It is also expected students will show up ON TIME at the beginning of class and after breaks. As with many Quest courses, this class will move at a fast pace, and missing one class means you will miss a lot of material. If you miss a class, it is your responsibility to catch up on material, obtain relevant notes, and complete in-class assignments you may have missed. Repeated lateness will negatively affect your class participation grade. Any work missed as a result of an absence will be given a mark of 0 unless you have a medical note.

Note taking: It is highly advised that you take notes during lectures, readings, discussions, lab activities, and during group work. Writing notes will help you organize your ideas and synthesize information and lead to a better understanding of course concepts, more valuable contributions to group work and likely better performance on assignments. This is a critical skill to develop in the science disciplines, and if you need help improving your note taking, please see the Learning Commons for suggestions.

In-class conduct: Class time is a period for engaging in learning. Out of respect for your classmates and myself, it is important that you be attentive and conduct yourself appropriately. This means no chatting, texting, social networking (Facebook, Twitter, etc.), or random internet browsing (no email). You are required to bring your laptop to class, however, they are to be used only in break-out sessions (unless otherwise indicated). PLEASE TURN OFF YOUR CELL PHONES. Quest University's policy states that food is not permitted in the classroom. Beverages (with sealed lids) will be permitted, but please be careful not to spill and to take bottles/mugs with you at the end of class.

Field trips: Our first field trip is to the UBC Michael Smith Biotechnology Laboratory on FRIDAY, FEBRUARY 10th to perform a PCR and DNA fingerprint assay. We will be leaving at 7:30 AM (sharp!!) from the loading zone in front of the Library Building, and returning around 4-5pm that evening. This field trip is required as part of the course (and is worth marks). Please see me if there is a conflict in your schedule. Please bring a packed lunch, your notebooks/writing utensils, and wear long pants and closed covered shoes.

The second field trip will be on MONDAY, FEBRUARY 27th. We will be going to visit Stem Cell Tech, a leading biotechnology company located in Vancouver. We will leave at 11:30 AM (sharp!!) from the loading zone in front of the Library Building. Please either bring a lunch to eat on the bus, or eat beforehand and bring a snack. Please be sure to wear long pants, covered shoes, and bring your notebooks/writing utensils. Any sort of recording devices (ie. phones) are not permitted in the building and laboratories – please either leave your phones at Quest, or they will be kept under security during the fieldtrip.

Assignments: All papers MUST be typed in 12 point font with 1.5 line spacing and 1" margins. All writing assignments must be in Word (.doc or .docx) format. I will not accept assignments in Pages, Open Office, or PFD format. Please adhere to the page limit specifics. In-text citations and 'References' section should be formatted using APA style guidelines. I am interested in how well you can write and I will grade the FORM as well as the CONTENT of your essays. You will lose marks on all assignments for bad grammar and improper syntax. You will also lose marks for bad spelling and typographical errors on the paper.

I will specify whether assignments are to be 1) handed in at the beginning of class, OR 2) submitted via a new program that Dr. Rob Knop has developed called "TurnIn". To access, please go to

<https://pub.questu.ca/turnin> login using your Quest ID and password. If for some reason you have to email an assignment to me, please follow the naming convention: Lastname.Assignment#.doc

Assignments must be submitted BEFORE the beginning of class on the day that they are due. Late assignments will immediately lose 20% of the total mark. Every additional day late will result in an additional 20% deducted.

Grading Policy: Your final grade for this course is a letter grade. Assignments will be marked with a numerical grade and converted to a letter grade using the following grading scale:

A	90-100	C+	65-69
A-	85-89	C	60-64
B+	80-84	C-	55-59
B	75-79	D	50-54
B-	70-74	F	49 and under

Plagiarism and Academic Integrity: Plagiarism is a VERY SERIOUS academic offence. There will be NO TOLERANCE for plagiarism or cheating in this course. Any offenses will result in an automatic zero for the assignment, and potentially worse consequences under the discretion of the Chief Academic Officer.

Plagiarism is the unreferenced use of someone else's words, work, or ideas. It includes such acts as (1) turning in a friend's paper and saying it is yours; (2) using another person's data, words or ideas without proper acknowledgement; (3) copying another author's exact words without quotation marks (this includes during oral presentations and pod casts!); and (4) using wording that is very similar to that of the original source but passing it off entirely as your own (again, this includes during oral presentations and pod casts!). The excuse, "I didn't know that was plagiarism" will not be accepted. If you are unsure, it is best to ask. Please refer to Kiersten in the Learning Commons or myself if you need clarification.

Course Breakdown

Assessment Breakdown: Detailed instructions for each assignment will be provided in class.

25% Topic Assignments (There may be more or less of these, five will be chosen worth 5% each)

- Individual research report 1- assigned topic (Day 2, Tuesday Feb. 7)
- DFTD group research proposal (Day 4, Thursday Feb. 9)
- Group Stem cell research puzzle (Day 8, Wednesday, Feb. 15)
- Individual research report 2 - assigned topic (Day 13, Wednesday Feb. 22)
- Stickleback research case report, (Day 15, Friday Feb. 17)
- Evolution short writing piece (Day 16, Monday Feb. 27)

25% Papers

- 10% DFTD essay (Day 6, Monday Feb. 13)
- 15% Book summary report (Day 15, Friday Feb. 17)

30% Presentations

- 15% Exploring molecular research – student presentation on topic of choice (approved by me)
– topic selected and sign-up for presentation due Day 10, Friday Feb. 17
- 15% Stem cell research pod-cast (Day 11, Monday Feb. 20)

10% Quizzes

- there will be multiple quizzes throughout the course, each quiz will be worth a proportion of this 10%

10% Participation

Schedule Breakdown: The following schedule is tentative. We may spend more time on some subjects and less on others. Due dates are fixed (unless I inform you otherwise).

Day / Date	Class Activities	Readings (for class)	Assignments
1 / Mon Feb 6	Introduction to course Review of gene expression		
2 / Tue Feb 7	Group work – presenting research		Individual research report 1 due
3 / Wed Feb 8	DFTD case, article analysis The process of science		
4 / Thu Feb 9	Grant committee presentation and voting DFTD – further analysis		Group research proposal due
5 / Fri Feb 10	FIELDTRIP – please meet bus at 7:30am for departure	Short readings 1,2 Readings 3, 4, 5 (draft a concept map)	In class lab notes due
6 / Mon Feb 13	Class discussion DTFD Introduction to cells and cell processes		DFTD essay due
7 / Tue Feb 14	Stem cell biology and research Article analysis	Reading 6	
8 / Wed Feb 15	IPS cells Article analysis	iPS cell readings 7,8	- Group Stem cell research puzzle (podcast topic chosen)
9 / Thu Feb 16	iPS continued Library Session		
10 / Fri Feb 17	Stem Cell Debate	Bioethics and research readings 9, 10, 11, 12	(Mol. Bio. Res. Presentation topic chosen)
11 / Mon Feb 20	Pod-cast peer review Introduction to natural selection and phylogenetic classification	Darwin readings 13, 14	Stem cell research pod cast
12 / Tue Feb 21	Student Topic Presentations (2) Evolution in action		
13 / Wed Feb 22	Evolution in stickleback fish	Reading 15	Individual research report 2 due
14 / Thu Feb 23	Student Topic Presentations (2) 14 / Thu Feb 23 Stickleback continued	Reading 16	
15 / Fri Feb 24	Student Topic Presentations (2) 15 / Fri Feb 24 Stickleback continued	Reading 17, 18, 19	Stickleback research case report due Book report due
16 / Mon Feb 27	Field trip: Stem Cell Tech		Evolution short writing piece due
17 / Tue Feb 28	Student Topic Presentations (5)		
18 / Wed Feb 29	Student Topic Presentations (6)		

Readings

- 1) Alters, S. & Alters, B. (2006). Section 9.4: DNA is a self-replicating molecule. In *Biology: Understanding Life* (pp.131-132). Hoboken, NJ: John Wiley & Sons Inc.
- 2) Alters, S. & Alters, B. (2006). Section 11.7: DNA fingerprinting is done by copying, decoding, and “reading” DNA. In *Biology: Understanding Life* (pp.164-165). Hoboken, NJ: John Wiley & Sons Inc.

- 3) Quammen, D. (2008, April). Contagious cancer; The evolution of a killer. *Harper's Magazine*, 33-43. Retrieved from <http://harpers.org/archive/2008/04>
- 4) Dingli, D., & Nowak, M.A. (2006). Infectious tumour cells. *Nature*, 443, 35-36. Retrieved from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2711443/?tool=pubmed>
- 5) Jones, M.E., & McCallum, H. (2011, June). The Tasmanian devil's cancer: Could contagious tumors affect humans? *Scientific American*, 72-77.
- 6) Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Scott, M.P., Bretscher, A., Ploegh, H., & Matsudaira, P. (2008). Chapter 21: The Birth of Cells: Stem Cells, Niches, and Lineage. In *Molecular Cell Biology* (pp. 905-921). New York, NY: W.H. Freeman.
- 7) Hochedlinger, K. (2010, May). Your inner healers: A look into the potential of induced pluripotent stem cells. *Scientific American*. This is a special web-only interactive article. Retrieved from <http://www.scientificamerican.com/article.cfm?id=interactive-your-inner-healers>
- 8) Ramalho-Santos, M., & Willenbring, H. (2007). On the origin of the term "stem cell". *Cell Stem Cell*, 1, 35-38.
- 9) Warnock, M. (2007). Chapter 20: Do human cells have rights? In *The Bioethics Reader: Editor's Choice* (pp. 313-327). Oxford, UK: Blackwell Publishing.
- 10) Holm, S. (2007). Chapter 21: Going to the roots of the stem cell controversy. In *The Bioethics Reader: Editor's Choice* (pp. 328-341). Oxford, UK: Blackwell Publishing.
- 11) Ehrich, K., Farsides, B., Williams, C., & Scott, R. (2011). Constructing an ethical framework for embryo donation to research: Is it time for a restricted consent policy? *Human Fertility*, 14, 115-121.
- 12) Cyranoski, D. (2008). 5 things to know before jumping on the iPS bandwagon. *Nature*, 452, 406-408.
- 13) Stix, G. (2009, January). Darwin's Living Legacy. *Scientific American*, 38-43.
- 14) Alters, S. & Alters, B. (2006). Chapter 15: The history and development of evolutionary theory. In *Biology: Understanding Life* (pp. 232-250). Hoboken, NJ: John Wiley & Sons Inc.
- 15) Grant, R. & Grant, P.R. (2003). What Darwin's Finches can teach us about the evolutionary origin and regulation of biodiversity. *BioScience*, 53, 965-975.
- 16) Carroll, S. (2005, November). The Origins of Form: Ancient genes, recycled and repurposed, control embryonic development in organisms of striking diversity. *Natural History*. This article is available only on the web. Retrieved from <http://www.naturalhistorymag.com/features/061488/the-origins-of-form>
- 17) Carroll, S., Prud'homme, B., & Gompel, N. (2008, May). Regulating Evolution. *Scientific American*, 60-67.
- 18) Culotta, E., & Pennisi, E. (2005). Evolution in Action. *Science*, 310, 1878-1879.
- 19) Pennisi, E. (2004). Changing a Fish's Bony Armor In the Wink of a Gene. *Science*, 304, 1736-1739.