BIOLOGY 4563F:

genome evolution

FALL 2025

instructor: **David Smith** | office: BGS3028 | office hours: | dsmit242@uwo.ca

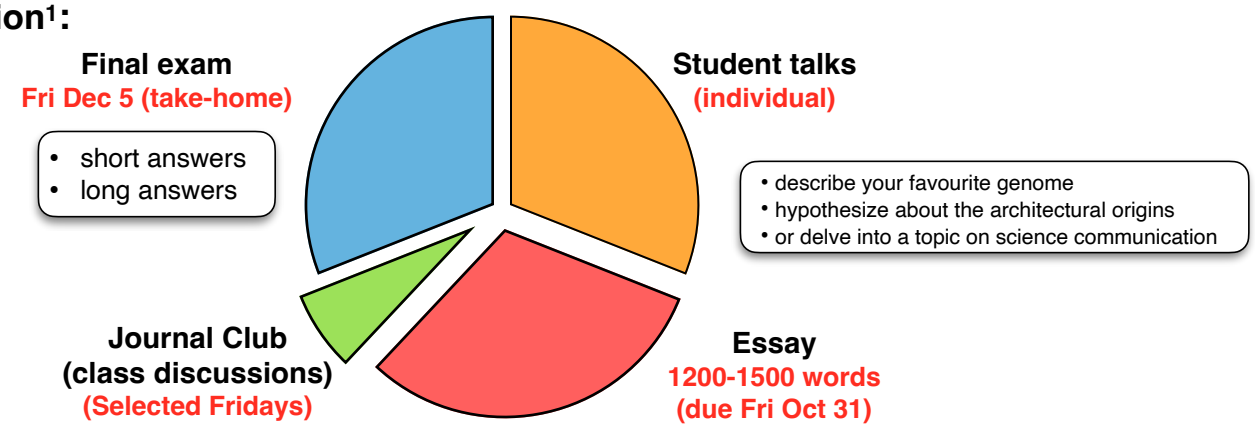
About the class: Ever wonder why some genomes are gigantic and others are so tiny? Why some are simple, circular molecules while others are fragmented into hundreds of linear chromosomes? This course will try to answer these & other questions about genome evolution. It will explore the diversity in genomic architecture across the Tree of Life. Through lectures, student presentations, and group discussions, we will examine strange and bizarre genomes – genomes that break all the rules. We will discuss controversial hypotheses about genome evolution and the scientists who developed them. The course also has a strong "communications" component, with lectures on scientific writing and speaking – all with a bend on genomics, of course.

Prerequisites: 4563F: 1.5 Bio courses at 3000 level or above & registration in Year 4 of an Honours specialization module.

Text: All materials will be provided in class or online (via Brightspace).

Course website: Brightspace will be the location for materials relating to 4563F.

Evaluation[1]:



[1]FULL DETAILS BELOW

ASSIGNMENTS & GRADING

1. Class presentation: "a genomic show and tell"

Pick a genome, any genome, and describe its architectural features and endearing qualities to the class in a ~30 min presentation. Explain what makes this genome interesting and unique (or just plain weird) from an evolutionary and biological perspective. For example, is the genome massive or minuscule? Does it have thousands or only a few genes, and what do these genes encode? Is the genome linear or circular, intact, or fragmented? Is it AT- or GC-rich, or maybe a bit of both? Is the nucleotide sequence cluttered with repetitive elements and bloated with introns or is it a paragon of compactness? Are the coding regions contained in a single unit or are they scrambled throughout the chromosome? Does the DNA sequence of the genome correspond to the RNA sequence or is there post-transcriptional editing? Overall, choose a genome that intrigues you and explain to the class what it teaches us about genome evolution. (**Note: see "Sample genome papers" in Brightspace for potential ideas and topics**).

The presentation should also include some aspects of the following: **I)** A brief overview of the organism and cellular compartment in which the genome is found. If you're presenting the mitochondrial genome of a box jellyfish, tell us a bit about mitochondria, their DNA, and jellyfish. **II)** A quick summary of who sequenced and analyzed the genome and their motivations for doing so. Did the United States Department of Energy sequence the genome or a PhD student from Iceland, and were they trying to cure malaria or understand the origins of life? **III)** Where, when, and how the genome was sequenced—was it sequenced yesterday or twenty years ago, did the scientists use next-generation sequencing technologies or Sanger sequencing, and was it published in *Nature* or the *Canadian Journal of Botany*? **IV)** Background information and evolutionary hypotheses. For instance, if the talk is about a giant genome from lungfish, touch upon what is known about the variation in genome size among animals and the various hypotheses for explaining it. And **V) (this is mandatory)** A one-page handout summarizing the main message and key points of your talk. The information on these handouts, which can contain bullet points, figures, and/or tables, will be used to develop questions for the take-home exam. If you are unable to print the handout, please email me (dsmit242@uwo.ca) an MS word or PDF version of it 24 hours before your talk.

Note: I'm open to students presenting on topics/subjects/themes that deviate from those described above (genomics). If you have an idea that would you think would work for the course (e.g., communicating genomics to the public, the future of bioinformatics, designer babies, etc.) please run it by me. I'll probably say Yes.

Presentation group size, length, and format: All presentations are done individually (i.e., groups of 1). Only one presentation is required per person. Talks should be 30-35 min, which will leave ~10 min for class discussion. Format: PowerPoint, Canva, Keynote, chalk and blackboard, short videos, skits … it is all fair game. Just make sure that you get your point across effectively, and that you have fun doing so.

Grading: Each presentation will be given a mark out of 31 based on:

- Effective communication (**5**)
- Quality of presentation materials (**5**)
- Scientific content (**12**)
- The one-page handout (**5**) (***email to David before the talk and I'll post on Brightspace***)
- Topic selection (**4**). *For the topic selection please submit a one-paragraph statement including: a) The name of the presenter. b) The key topic of the presentation (i.e., the tomato genome or cancer genomics …). And c) The title/citation of the key paper(s) that will be summarized.* ***Deadline for topic selection is Wed Sep 17 (11:59 pm).*** *Please submit via the Assignment section in Brightspace.*

The presentation represents 31% of the final grade.

Time and place: All presentations will take place during class hours (Wednesdays 9:30am-11:30am and Fridays 9:30-10:30am). **Presentation time slots open on WED Sep 10 at 10:30 am**. Sign-up is on a first-come, first-serve basis and is done through the "Presentation Sign-up" tab on Brightspace**.** On the day of your assigned talk, make sure you have everything you need, such as laptop cables, plugins, laser pointer, handouts, etc.

2. Essay Assignment: "portrait of a genome"

Write a 1,000- to 1,500-word essay on one of the following topics: **I)** Select a genome that you find intriguing, perhaps one of the genomes presented or discussed in class. Similar to the Presentation assignment, describe any aspects that make this genome interesting from an evolutionary perspective. **II)** Pick a contemporary or controversial hypothesis on genome evolution, such as Michael Lynch's mutational burden hypothesis, explain it and argue, using examples from the literature, why you agree or disagree with it. **III)** Highlight a scientist or personality that has had a major impact on the field of genomics or genome evolution, such as Richard Dawkins, Craig Venter, Barbara McClintock, or the double noble laureate Richard Sanger. Summarize the person's work or discovery, place it in context to the current research landscape, and the impact it has had on genome science. **IV)** Investigate a political or cultural theme or technological innovation that has influenced the trajectory and/or our understanding and appreciation of genome evolution, such as next-generation sequencing technologies or personalized genomics. **V)** Discuss a theme in science communication, such as the use of social media by geneticists or communicating genomics to the general public.

I have no strict guidelines for the style of the essay. It can be similar to that of a review article for an academic journal or it can be more light-hearted, like a piece for a popular-science magazine or national newspaper. Please be creative—if you are an aspiring journalist, author, or blogger do take advantage of this assignment to test your inventive abilities at combining creative writing with genome evolution. I will also consider first-person accounts or interviews about genome science—for example, the essay could be a news piece focusing on research being done in a lab at Western. Just make sure your message is accessible and poignant and related to genome evolution. If you are

thinking of writing something more unconventional, do run your idea by me first. All essays must include a figure, image, cartoon, comic, or table (created by the student, not taken off of the internet) that helps convey the main theme of the article.

The use of generative AI tools (e.g., ChatGTP, Copilot, Gemini) are prohibited.

Grading: Each essay will be given a mark out of 31 based on:
- style and grammar (**5**)
- scientific content (**12**)
- persuasiveness (**5**)
- figure/graphic component (**5**)
- & topic selection (**4**) **Deadline for topic selection is WED Oct 8 (11:59 pm).** *Please submit a one-paragraph outline summarizing the main topic and key paper(s) via the Assignment section in Brightspace.*

The essay represents 31% of the final grade. Based on university policy for "F" courses, failure or non-completion of the written component is an automatic failure of the course.

Due dates: Please upload completed essays to Brightspace (via the Assignment section) by **FRI Oct 31 (11:59 pm)**.

3. Take-home exam: "genome trivia"

This exam will include content taken from class lectures, student presentations, particularly the "handout" portion of the presentations, and journal club. The exam will contain seven short-essay questions (350-500-word answers). Students will be asked to answer FIVE of the seven questions.

The use of generative AI tools (e.g., ChatGTP, Copilot, Gemini) are prohibited.

Grading: The exam will be given a mark out of 31 based on short-essay questions (5 questions x 6 marks each; + a one-point bonus). **The exam represents 31% of the final grade.**

Due dates: The take-home exam will be made available on Brightspace (via the assignment section) on **FRI Dec 5 (9:30 am)**. Completed exams must be uploaded to Brightspace (again via the assignment section) by **SAT Dec 6 (11:59 pm)**.

4. Journal club & class discussions

All students will be expected to have read the journal club paper before class and to contribute to class discussions on the paper. **Journal club discussions (and discussions following student presentations) represent 7% of the final grade.**

Time and place: Selected Fridays throughout term.

Key dates

Sep 10	(Wed)	Presentation time-slots open on Brightspace.
Sep 17	(Wed)	Submit 1-paragraph outline of presentation topic via assignment section (Brightspace).
Oct 8	(Wed)	Submit 1-paragraph outline of essay topic via assignment section (Brightspace).
Oct 31	(Fri)	Submit essays via assignment section (Brightspace).
Dec 5	(Fri)	Take-home exam released via assignment section (Brightspace).
Dec 6	(Sat)	Submit take-home exam via assignment section (Brightspace).

TENTATIVE COURSE SCHEDULE (SUBJECT TO CHANGE)

Lecture	Date	Day & Time	Length	Speakers	Topic	Reminder
1	**Sep-05**	Fri, 9:30-10:30	1h	David	Course Outline	
2	**Sep-10**	Wed, 9:30-11:30	2h	David	Effective Communication	Presentation time-slots open (10:30 am; Brightspace)
3	**Sep-12**	Fri, 9:30-10:30	1h	David	Introduction to Journal Club	
4	**Sep-17**	Wed, 9:30-11:30	2h	David	Mock Genome Lecture	Presentation topic due (11:59pm; Brightspace)
5	**Sep-19**	Fri, 9:30-10:30	1h	David	**Journal Club 1**	
6	**Sep-24**	Wed, 9:30-11:30	2h		Student Talks	
7	**Sep-26**	Fri, 9:30-10:30	1h		Student Talks	
8	**Oct-01**	Wed, 9:30-11:30	2h		Student Talks	
9	**Oct-03**	Fri, 9:30-10:30	1h	David	Effective Science Writing	
10	**Oct-08**	Wed, 9:30-11:30	2h		Student Talks	Essay topic due (11:59pm; Brightspace)
11	**Oct-10**	Fri, 9:30-10:30	1h	David	**Journal Club 2**	
12	**Oct-15**	Wed, 9:30-11:30	2h		Student Talks	
13	**Oct-17**	Fri, 9:30-10:30	1h		Student Talks	
14	**Oct-22**	Wed, 9:30-11:30	2h		Student Talks	
15	**Oct-24**	Fri, 9:30-10:30	1h	Matheus	**Journal Club 3 (guest speaker)**	
16	**Oct-29**	Wed, 9:30-11:30	2h		Student Talks	
17	**Oct-31**	Fri, 9:30-10:30	1h		Student Talks	Essay due (11:59pm; Brightspace)
FALL READING WEEK	**Nov 3-7**					
18	**Nov-12**	Wed, 9:30-11:30	2h		Student Talks	
19	**Nov-14**	Fri, 9:30-10:30	1h		Student Talks	
20	**Nov-19**	Wed, 9:30-11:30	2h		Student Talks	
21	**Nov-21**	Fri, 9:30-10:30	1h		Student Talks	
22	**Nov-26**	Wed, 9:30-11:30	2h		Student Talks	
23	**Nov-28**	Fri, 9:30-10:30	1h	David	**Journal Club 4**	
24	**Dec-03**	Wed, 9:30-11:30	2h		Student Talks	
25	**Dec-05**	Fri, 9:30-10:30	1h			Final exam (Fri 10:30am - Sat 11:59pm; Brightspace)

(Note: the most up-to-date version is posted on Brightspace under the “Course Schedule” tab.)

RESOURCES

Where do you find information on genomes and genomic evolution and architecture? There are many academic journals that regularly publish interesting articles on genomics and genome evolution. By skimming through these journals, going through back issues, looking at the advance access articles, you will likely find a wide range of genome papers, from bizarre mitochondrial DNAs to massive nuclear chromosomes to the genomes of ancient creatures found in polar ice. Please see the “Sample Genome Papers” tab in Brightspace for examples of journals that regularly publish genome papers.

ADDITIONAL STATEMENTS

1. Student absences:

Please familiarize yourself with the University Policy on Academic Consideration – Undergraduate Students in First Entry Programs, posted on the Academic Calendar: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/academic_consideration_Sep24.pdf

This policy does not apply to requests for Academic Consideration submitted for attempted or completed work, whether online or in person. The policy also does not apply to students experiencing longer-term impacts on their academic responsibilities. These students should consult Accessible Education.

For procedures on how to submit Academic Consideration requests, please see the information posted on the Office of the Registrar's webpage: https://registrar.uwo.ca/academics/academic_considerations/

All requests for Academic Consideration must be made within 48 hours after the assessment date or submission deadline.

2. Accommodation, accessibility & acknowledgments:

Religious Accommodation

When conflicts arise with a religious holiday that requires an absence from the University or prohibits certain activities, students should request an accommodation for their absence in writing to the course instructor and/or the Academic Advising office of their Faculty of Registration. This notice should be made as early as possible, but not later than two weeks prior to the writing of the examination (or one week prior to the writing of the test). Please visit the Diversity Calendars posted on our university's EDID website for the recognized religious holidays - https://www.edi.uwo.ca

Accommodation Policies

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic%20Accommodation_disabilities.pdf

3. Academic Policies

The website for Registrar Services is http://www.registrar.uwo.ca. Use of @uwo.ca email: In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university email address. It is the responsibility of the account holder to ensure that emails received from the University at their official university address are attended to in a timely manner.

Requests for Relief (formally known as "appeals")

Procedures on Request for Relief from Academic Decision (Undergraduate): https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_requests_for_relief_procedure.pdf

Scholastic Offences

Procedures on Scholastic Offences (Undergraduate): https://uwo.ca/univsec//pdf/academic_policies/appeals/undergrad_scholastic_offence_procedure.pdf

All required papers may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All papers submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between The University of Western Ontario and Turnitin.com (http://www.turnitin.com).

4. Support Services

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on add/drop courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/.

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at: https://www.uwo.ca/health/student_support/survivor_support/get-help.html. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

5. Equity, Diversity, Inclusion and Decolonization (EDID)

Land Acknowledgement: We acknowledge that Western University is located on the traditional lands of the Anishinaabek, Haudenosaunee, Lūnaapéewak, and Chonnonton Nations, on lands connected with the London Township and Sombra Treaties of 1796 and the Dish with One Spoon Covenant Wampum. This land continues to be home to diverse Indigenous peoples (First Nations, Métis and Inuit) whom we recognize as contemporary stewards of the land and vital contributors of our society. Throughout Canada, North America, and the world, Indigenous Peoples are vital contributors to their communities, and we greatly value their presence, knowledge, and wisdom.

The pronouns used by instructor are he/him.