Biology 3330: Molecular biology of development

Course outline

FDE/FDF sections

2025F

A zebrafish (*Danio rerio*) embryo, which is a useful model for studying cell fate and other developmental processes in vertebrates.
Ledford H (2018) Nature.

THE BASICS

About the instructor

My name	Dr. David Law
My office	Simcoe Hall/OA 3004, in Orillia
My email	dlaw@lakeheadu.ca. I check my email daily Monday to Friday, and will try to respond to your questions as quickly as possible during those days.
Office hour	No preset office hour since this is a web course; email me or make an appointment here for a Zoom meeting.
My phone number	None; email me or make an appointment here for a Zoom meeting.
Call me	Dr. Law or David
My preferred pronouns	He, him, you

About the class

- The course runs for 13 weeks: Tuesday September 2 to Monday December 1, 2025. One of these weeks is the fall study break when there won't be any coursework.
- All material is posted on myCourseLink/D2L (mCL); check there for the latest course updates and information.
- Biology 3330 is an asynchronous web course and does not have any "live" content. This means that you can proceed through the material at your own pace.

Calendar description

Biology 3330 | Molecular biology of development

Description	DNA replication and repair; cell cycle regulation. The role of differential gene expression in the regulation of development of model organisms: *Drosophila*, *Caenorhabditis*, yeasts, amphibians and mice.
Credit weight	0.5 FCE
Prerequisite(s)	Biology 2230 and 2910, or permission of the Chair of the Department of Biology
Offering	3-0; 0-0
Course classification(s)	Type C: Engineering, Mathematical and Natural Sciences

Important dates

Take note of the following important dates, as per the academic schedule of dates:

- Final date to add a course for 2025F: Fri. Sept. 12
- Final date to withdraw from a course without academic penalty (a/k/a drop date): Fri. Nov. 7
    - I aim to provide you with at least 25% of your final mark by this date so that you can make an informed decision about your progress and projected future performance in the course.

LEARNING OUTCOMES

During this course, you will develop both your "hard" science-based skills and "soft" social and literary skills.

Science-based skills

- Develop new knowledge in developmental biology, molecular biology and comparative biochemistry that logically follows from your previous courses in lab biology, cell biology and biochemistry

- Understand common terms used in developmental biology
- Discuss experimental model organisms amenable to the study of developmental biology
- Discuss common cross-species themes in
    - The regulation of gene expression
    - Biochemical changes during development
    - Adaptive responses to abiotic and biotic stresses
- Discuss several experimental laboratory methods used in developmental biology research, such as
    - Cell culture
    - Epigenetics
    - Protein:protein interactions
    - DNA and protein detection techniques

Social and literary skills

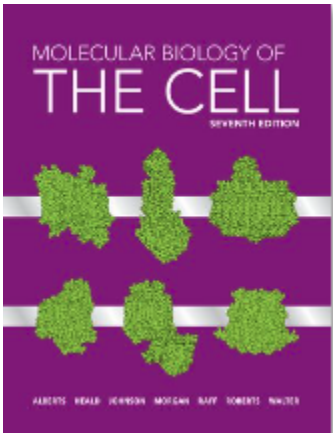
- Conduct a respectful, informed discussion about the past, present and future of developmental biology with your peers
- Read, interpret and extract useful information from primary and secondary scientific journal articles and your textbook
- Developing job-searching techniques and learning what you can do with an undergraduate degree in biology

LEARNING MATERIALS

I'll post videos and other readings by week under **Content** in mCL. Course material is derived mainly from the books below.

Textbook

Alberts B et al. (2022) Molecular Biology of the Cell, 7th edition, W.W. Norton, New York, USA, ISBN 978-0-393-42708-0.



This textbook is optional, but is useful for background on many of the topics we'll cover. However, I'll provide readings and videos to explain the concepts in the course. We'll concentrate on Chapter 21: "Development of multicellular organisms".

If interested, you can rent the e-book from a few places:

- VitalSource
- W. W. Norton, the publisher
- Redshelf

If you have access to an older version, that's fine, but chapter and page numbers will likely be different. The 6th edition is available at both Paterson Library in Thunder Bay and Harvie (500 University Ave.) in Orillia; both are on 1-day (overnight) loan and available at the Reserves desk. The fourth (2002) edition is available for free on the US National Institutes of Health bookshelf. By agreement with the publisher, this book is accessible by the search feature, but cannot be browsed.

I'll also use material from two other sources:

- **Barresi MJF, Gilbert SF** (2020) *Developmental biology*, 12th edition, Sinauer, New York, USA, 978-1-6053-5822-2.
- **Wolpert L, Tickle C** (2011) Principles of development, 4th edition, Oxford University Press, Oxford, UK, ISBN 978-0-19-954907-8.

Older or current versions of these textbooks are on reserve in the Paterson (Thunder Bay) and Harvie (500 University Ave., Orillia) libraries, as detailed below.

Cost of textbooks and learning materials

The information provided below complies with the Ontario Ministry of Colleges and Universities requirement for disclosing the cost of learning materials to students.

Cost of textbooks and learning materials	None; all are optional
Restrictions preventing students using a different edition of the textbook or other learning material	None
Use of Open Educational Resources (free resources)	Allowed
Required use of educational materials previously acquired for another course	No

On reserve at the libraries

All available on one-day (overnight) loan - ask at the circulation desk of the library.

In Orillia at Harvie/500 University Ave.:

- Molecular biology of the cell
  Alberts, Bruce; Wilson, John ; Hunt, Tim; *et al.*
  2015; 6th edition
  QH 581.2 M64 2015
- Developmental biology
  Gilbert, Scott F., 1949- author.; Barresi, Michael J. F., 1974- author.
  2016; 11th edition
  QL 955 G48 2016

In Thunder Bay at Paterson:

- Molecular biology of the cell
  Alberts, Bruce; Wilson, John ; Hunt, Tim; *et al.*
  2015; 6th edition
  QH 581.2 M64 2015
- Developmental biology
  Gilbert, Scott F., 1949-
  2020; 12th edition
  QL 955 G48 2020
- Principles of development
  Wolpert, Lewis
  2007; 3rd edition
  QH 491 P74 2007

SCHEDULE AND MARKING SCHEME

- Each week, you have one or two deliverables to submit by the next Monday evening at 11:59 PM EDT:
    - **Quiz** (required; 12 quizzes @ 3.33% each = 40% of your final mark)
        - Online, using the Quizzes tool in mCL
        - 12 weekly quizzes of 10 multiple choice questions each
        - Note that there isn't a final exam
    - **Written assignment** (required; two total during term @ 10% each = 20% of your final mark)
        - Week 4: *Curriculum vitae*
        - Week 11: What have you learned?
    - **Discussion post** (five total during term @ 8% each = 40% of your final mark)
        - Weeks 1, 2, 3, 5, 6, 7, 8, 9, 10, 12
        - Video or written post, depending on the week
        - Ten weekly opportunities to post; post to any 5**.** You may post one extra (sixth) time; if you do, I'll use your highest 5 marks to calculate your final discussion mark. If you post more than 6 times, I'll mark your earliest 5 submissions.
- Discussion forum posts + written assignments are worth 60% of your final mark and quizzes 40%. This emphasizes the importance of showing me your personal views in the assignments and practicing your writing and oral presentation skills.
- The next week's work will go live at 12:01 AM each Tuesday. You have 7 days to review and complete each week's work (until 11:59 PM the next Monday evening). mCL won't allow you to write your test or post after this time, so plan ahead and complete the week's work early.

Week	Dates *Tuesdays to Mondays*	Deliverables due *Mondays at 11:59 PM*	Assignments		
			Video discussion post *Optional**	Written discussion post *Optional**	Written *Required*
1	Sept. 2 - 8	Sept. 8	X		
2	Sept. 9 - 15	Sept. 15		X	
3	Sept. 16 - 22	Sept. 22		X	
4	Sept. 23 - 29	Sept. 29			X
5	Sept. 30 - Oct. 6	Oct. 6		X	
6	Oct. 7 - **20**	**Oct. 20**		X	
	Oct. 13 - 17	No classes; Lakehead fall study break			
7	Oct. 21 - 27	Oct. 27	X		
8	Oct. 28 - Nov. 3	Nov. 3		X	
9	Nov. 4 - 10	Nov. 10		X	
10	Nov. 11 - 17	Nov. 17		X	
11	Nov. 18 - 24	Nov. 24			X
12	Nov. 25 - Dec. 1	Dec. 1		X	

***Note:** you must submit a total of 5 "optional" video and/or written discussion posts by December 1.

DELIVERABLES

General advice

All work is due each week by Monday at 11:59 PM EDT. You won't be able to write that week's quiz or contribute to its discussion forum after this day/time. Don't wait until the last minute to complete your work; I won't give extensions for any internet challenges you have within the last hour of the submission deadline (i.e., after 11 PM on Mondays).

Each week, you have a quiz and an assignment to complete. The assignment will be optional or required depending on the week. I suggest you tackle each week's work in this order:

- Review the readings and take notes.
- Watch the videos and take notes.
- Do the quiz, which will be based on all of the week's material, while it's fresh in your mind.
- When possible, choose your assignment based on the course material you found most interesting. For example, for video or written discussion forum posts, choose your favourite topic.
- Complete your assignment, following its instructions closely to maximize your mark; for example, find, read and incorporate information from peer-reviewed articles in your discussion post.
- After viewing or reading your assignments, I may have follow-up questions that require us to have a brief discussion in person or on Zoom before I give you a mark. If this happens, I'll email you to set up a meeting time.

Assignments

This is an asynchronous web course where we never meet in person. Such anonymity means that it's tempting to use AI to complete written work. My job is to make sure your work reflects genuine understanding and effort and is an honest evaluation of your knowledge. As such, I make it difficult for you to use chatbots to complete written work. Make note of my specific requirements for each assignment. I always require examples, citations and direct quotes with page number/time in video from the assigned readings/videos; this forces you to demonstrate to me that you watched/read them. You must also write in the first person, telling the reader (your peers and/or me) your own opinion. Be warned: generic vagueness will get a failing mark.

Video assignments

There are 2 video assignments. These will let you practice

- showcasing your knowledge of the course material in a different way, and
- giving oral presentations in a friendly forum.

If you choose to complete the video assignments, you'll post a video of yourself discussing course content. These recordings will be on the course mCL site and viewable to the instructor and all students registered in the course.

- These videos
  - are strictly confidential;
  - may be used only by the instructor and students registered in the course only for purposes related to the course, and

        - may not be otherwise shared or distributed.
    - Students who are concerned about posting videos of themselves must recognize that these recordings are an intrinsic part of the course; as such, you may choose not to participate in them but this means your mark will be zero for these deliverables. These recordings are made under the authority of sections 3 and 14 of the Lakehead University Act, 1965. Questions about the collection of images and sounds in these recordings may be directed to the chair of biology, Dr. Michael Rennie (mrennie@lakeheadu.ca).

Access the assignments and their details/instructions in mCL at **Content > Week x > Video assignment #y**.

Discussion forums

Discussion forums are an important part of online classes because there is no face-to-face time with your fellow students or prof like there is in a classroom-based course. Posting in forums helps you understand the course content, deepens your learning experience and sharpens your critical thinking skills.

For you to receive discussion participation marks, you must participate regularly with thoughtful posts. For each of the 2 written discussion forums during the course, I will post specific instructions, such as "post one reply to other posts to obtain your participation marks for this forum."

For discussion forums, I'll post topics. One student may reply directly to each of my original topics; there is thus an advantage to posting early. Further posts must be formatted as replies to those student posts and not directly as replies to my original post. This means **only one thread is allowed for each discussion topic**. Replying to others' posts will encourage your

- deep thought about the subject,
- consideration of other students' points of view, and
- formatting of discussion topics like a conversation, often one that does not have one right answer, rather than an information download.

Thus, other than the first reply to each discussion topic, further direct replies to the original topics will not count as posts towards your mark for that forum.

I may also contribute to the forums to try to clarify arguments and prod further thought and replies. I encourage you to reply to my posts… I will be respectful of your point of view. How do you contribute effectively to discussion forums? Follow these discussion guidelines

from Debbie Morrison's *Online Learning Insights* for some hints:

- Use a subject line that relates to your post; this will help create interest and focus for the discussion.
- Write clearly and with expression. Communicating online requires careful and concise writing, but also allows your personality to come through. Though humour is effective and at times relevant in discussion, be sure to avoid sarcasm, which does not translate well online.
- Be supportive, considerate and constructive when replying to your classmates. Do not use jargon, slang or inappropriate language. If you disagree with a classmate, please respond in a respectful and tactful manner. Any posts that I deem inappropriate will be removed from the discussion board.
- Focus on the topic, relating any class readings and materials from the current module in your post (as applicable).
- Proofread and review your response before hitting the submit button.
- Participate regularly. Improve your learning by being an active and engaged student. Follow and participate in the assigned discussion throughout the module, logging on at least every couple of days while reading and participating in forums as assigned in the module.

Access the discussion forums in mCL at **Content > Week x > Discussion forum #y**.

Written assignments

Note the page limits in the instructions for each written assignment… generally 2 to 3 double-spaced pages. Provide cited sources for your statements. For in-text citations and your reference list, use the Chicago author-date format, noting the use of quotation marks and italics. Include a DOI that includes a direct link to the article at the end, if available. For example, for a journal article, the format is

> Dittmar, Emily L., and Douglas W. Schemske. 2023. "Temporal Variation in Selection Influences Microgeographic Local Adaptation." *American Naturalist* 202 (4): 471–85. https://doi.org/10.1086/725865.

Submit a well-researched review that demonstrates that you have sought out multiple sources to support your statements and that you've thought about the material we've covered in previous weeks.
Access the assignments and their details/instructions in mCL at **Content > Week x > Written**

assignment #y.

Quizzes

Each week you have a 10-minute 10-question multiple choice quiz to complete in mCL at any time during the week. These test your knowledge of all of the week's material. As long as you complete the readings, watch the videos and take notes on these, you will have what you need to do well.

Access the quizzes and their details/instructions in mCL at **Content > Quizzes > Week x**.

COURSE IMPROVEMENT

I value student feedback to help me improve my courses. Below are some data from the Student Feedback on Teaching survey the last time I taught this course in 2024A. The comments are complete and unedited (except for spelling and grammar).

Based on the comments below, I will try to improve in this version of the course:

- **Limit penalizing overtime video discussion posts**. All the overtime penalties are set out in the instructions. Practice your posts to be within the time limits before recording them. I'll be reasonable when applying penalties, especially for the first video post. But I expect you to read my feedback and act on it to improve your subsequent posts..
- **Release all of the lecture material at the start of term so I can work ahead.** Not possible in this course as I revise the content during term prior to posting it.
- **Record lectures where I go over the material.** Not this year. This course is self-driven rather than led by me. Instead of watching/listening to lectures, please read/watch the material I assigned.

Marks

For the 23 questions where 1 = strongly disagree and 5 = strongly agree,

- Average score = 4.73 / 5
- Standard deviation +/- 0.25
- Number of survey participants = 4 or 5 out of 19 students

Comments

What did you like about this course?

- I really enjoyed not only the content of the course but the layout as well, with our video and written discussions (with it being an online class) I felt more connected to my other classmates and I was able to really improve my presentation/speaking skills which is something I have struggled with in the past. The material was also very stimulating and interesting, and the videos, readings, and any extra resources Dr. Law provided helped me understand the material so much better than I would have with just the slides. Overall I enjoyed not only the content but the setup of the online course. I was able to complete all work within the given timeframe and it didn%E2%80%99t feel like an overwhelming amount of assessments each week. The weighting of the assessments was also really nice and I prefer it over having an exam worth ~30% of my grade, instead it was divided up appropriately.
- I think that the routine of having one quiz and one assignment each week is very effective. I was worried, with this being a summer course that is shorter compared to a normal term, that the content would be rushed through in a way that would just make me frustrated with the course content instead of enthusiastic to learn more: I am very glad to say this was not the case. This routine provides a very good balance between time for students to read through the course content, time to prepare for the quiz evaluations, and time to do assignments or participate in class discussions.
- I found the workload to be just right for a summer course. The material was interesting, and I enjoyed the mix of readings and videos. Although I had learned a lot of the course content in other classes, I found this course extremely helpful for connecting all these concepts.
- I valued your feedback on my work and found it constructive and helpful in improving my performance in the course deliverables.
- The initial feedback at the beginning was timely and very valuable, it helped to prepare me for expectations and helped me to understand where i could improve. I also enjoyed the organization of the class everything was outlined and the schedule followed an organized outline, work load was manageable and expectations were clear

What suggestions do you have for improving this course?

- The only suggestion I have would be releasing the content (just lecture slides and readings) earlier or all at once in the beginning like some other online courses do, I am someone who likes to get ahead sometimes with the readings and I also work throughout summer so it allows me to plan accordingly and get ahead if I know I have a busy week ahead. Although I can see why it is released weekly as it makes it less overwhelming for

some and allows us to really get to know the material before moving on or doing the assessments. This was definitely not a dealbreaker for me but it is the only suggestion I could think of.

- My main criticism with the course is regarding the video deliverables: I think that the grade penalty of 10% for every 5 seconds over 3 minutes is an extremely disproportionate penalty, which discourages students from discussing things they were enthusiastic about learning in depth and showing deeper levels of understanding of the course content, in favour of rigidly/robotically designing their video presentations around the rubric as opposed to designing them for viewing by human beings.
- There were many times I would be working on a video presentation, where it would unfortunately go just over the 3 minute time limit, and then I would subsequently find myself having to cut out important information (which I would then receive criticism for in my feedback for not including) while also speaking at a pace far faster than I am comfortable with--often leaving me out of breath. This process often would take far longer than the actual research or organizing of my talking points--sometimes taking hours of tedious minor revisions just to shave off a handful of seconds from my recording.
- I think that the enjoyment and accessibility of the video assignments would be significantly improved by removing the 5 second penalties, and instead providing a guideline to aim for 3 minutes. Alternatively, changing it from a penalty of -10% every 5 seconds to -10% every 1 minute over the recommended time limit could also be extremely helpful, as measurements in minutes would be more reflective of an overly extended script length as opposed to seconds, which can easily result from variances in the way someone speaks (i.e. a group of people reading through a script of the same length will likely have a range in time spent reading that goes well over 5 seconds. Even a single person reading over the same script multiple times may find themselves having a time range larger than 5 seconds, which is something I can very much attest to from personal experience).
- A recorded lecture where the slides are discussed would be valuable for auditory learners.

Additional Comments

- (none)

USING ARTIFICIAL INTELLIGENCE

Wondering whether you can use AI like ChatGPT to complete coursework? You're not alone. First, read Lakehead's checklist for its appropriate use. Using AI may violate the Lakehead Academic Integrity Code (Section III) and be subject to disciplinary action. It's best to check with me prior to using it if you are unsure. There is no shame in doing so since I'm very aware of these tools. As this technology evolves, it's up to your instructors to ensure that student marks reflect their own work.

To get an idea about how chatbots can be used in higher ed, watch this Vox video. It summarizes my thoughts about acceptable and unacceptable use of AI to complete coursework.

A list of the possible ways to use AI for your coursework as listed in the Vox video is below. I'm OK if you use AI for most of their examples; exceptions are listed below:

Research

- Answers to a homework question (sometimes)
    - It's very tempting to let AI do all the work and once you have it for you to say "I have the answer; I'll go back and understand it later". But will you?
    - As long as you're not handing in the answer for marks… where is the ethical line?
- Background information on a topic
- Definitions or explanations of a concept
- Sources to find more information
    - To me, these 3 uses are no different than a Google search or looking up a topic on Wikipedia, but keep in mind how flawed these sources can be
    - Your sources must be
        - Genuine and relevant
        - Specifically, mostly reviews and primary literature articles from peer-reviewed journals
- Summaries of readings and lectures
- Study guides for an exam
    - OK, but read and/or watch these first to make sure you understand and can summarize them without AI help

Ideas

- Ideas for how to respond to an assignment
    - But not using AI to actually write your assignment…again, where is the line?
- Instructions for solving a problem

    - But don't rely on it to do your work for you since you'll have to do it yourself on a test
- Outline for a paper or presentation
    - AI can suggest how to best organize your thoughts
- Examples, analogies and counterarguments
    - Use at your own risk

Writing

- Script for a presentation
    - As long as it's based on your own original work and not AI-generated text… AI summarizing AI is bad
- Feedback on your work
    - This one is for your profs. I haven't used AI yet for this purpose, but I can see how it might be useful
- Revision of a text to improve it
    - While being aware that AI doesn't always "improve" written work
- Revision of a text to change word count
    - Sometimes a necessary editing step
    - Summarizing and collating ideas is a key part of work life, and AI doesn't always do a great job

There's only one use of AI from the Vox list that I consider plagiarism:

- Writing a draft of a paper or discussion post
    - It's too tempting to let it do all the work, including writing the final version

ACADEMIC DISHONESTY

Lakehead has a Student Code of Conduct – Academic Integrity. All students in this course should read the Code and become familiar with it.

To summarize the relevant parts of the Code, the penalty for plagiarism or cheating on any part of this or any other course is zero for the work where the student is caught. Serious or repeated plagiarism, including cheating on an examination or test, will result in a mark of zero for the course and may result in expulsion from Lakehead.

There are two particular places in this course where cheating might occur:

1. submitting written work that you did not research and write;
2. participating in a discussion forum under any name other than your own.

Academic dishonesty for any of these areas will result in a mark of zero for the work concerned. I'll also submit the appropriate forms to the Dean of Science and Environmental Studies so that the incident becomes part of your academic record.

To ensure academic fairness for students who work hard, rest assured that I will take every precaution to ensure that potential cheaters are caught and subjected to the appropriate penalty.