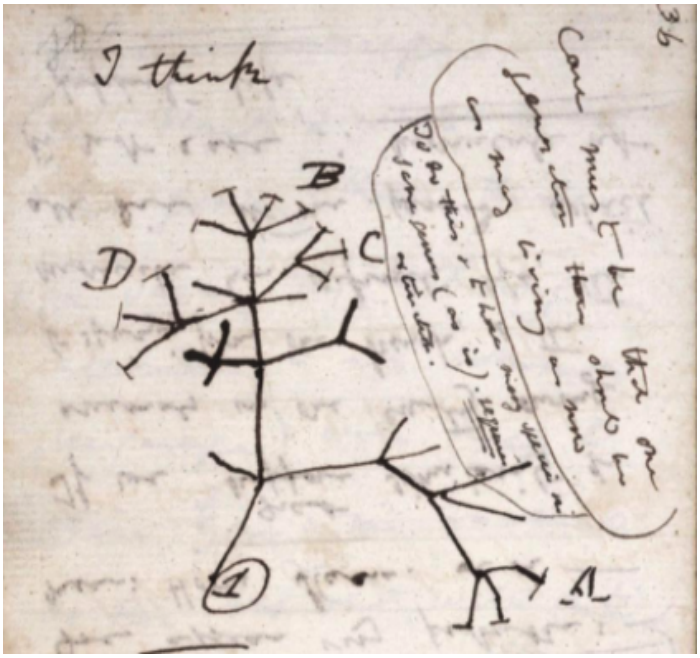

The first cladogram. Image from Charles Darwin's *First Notebook on Transmutation of Species* in 1837 showing his first iteration of an evolutionary tree. Note his humility in proposing how new species arise by his inclusion of the phrase "I think". Darwin only very rarely drew pictures in his notebooks, and this is one of his few sketches of any kind. (Here's another of an orchid from 1833 during his trip to Argentina aboard the *Beagle* that was found 25 years ago in the Royal Botanic Gardens herbarium at Kew in London.) While this and other notebooks were stolen from the Cambridge University library in 2000, they were returned in 2022.

Biology 2310: History of biology

Course outline

ADE section

2025A

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

About the class

- The course runs for 6 weeks: July 2 to August 18.
- All material is posted on myCourselink/D2L (which I'll call MCL below); check there for the latest course updates and information.
- Biology 2310 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, keeping in mind that there is an assignment due and a quiz to write every week.
- Two of the deliverables are videos that you will post of yourself discussing course content These recordings will be on MCL 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).

Calendar description

Biology 2310 | History of Biology

Description	Development of fundamental concepts in biology from Antiquity to contemporary times, with emphasis on species and researchers that have progressively expanded human knowledge of the living world.
Credit weight	0.5 FCE
Offering	3-0; or 3-0
Course classification(s)	Type C: Engineering, Mathematical and Natural Sciences

LEARNING OUTCOMES

At the end of this course, you should be able to:

- Distinguish science-based and non-science-based approaches to understanding the natural world.
- Recognize how biology researchers build on previous knowledge when they conduct experiments to answer questions.
- Know the names and backgrounds of key historical figures in biology.
- Identify the model organisms that have made progress in biological research possible and explain why they are useful for addressing specific biological questions.
- Conduct a respectful, informed discussion about historical biological questions with your peers.

LEARNING MATERIALS

There is no course textbook. I'll give you required readings by posting the material online. Course material is derived mainly from the 3 books below; physical (paper) copies of these are available on 1-day (overnight) reserve on both Lakehead campuses.

1. A Guinea Pig's History of Biology by Jim Endersby (2007) Harvard University Press, Cambridge, MA, ISBN 0-978-674-02713-8 (hardcover); 9780099471240 (paperback).
    - TB/Paterson: QH 431 E56 2007a
    - OR/University Ave.: QH 431 E56 2007
2. Deep Things out of Darkness: A History of Natural History by John G.T. Anderson (2013) University of California Press, Berkeley, CA, ISBN 0-978-520-27376-4 (hardcover).
    - TB/Paterson: QH 15 A72 2013
    - OR/University Ave.: QH 15 A72 2013
3. The Gene: An Intimate History by Siddhartha Mukherjee (2016) Scribner, New York, NY, ISBN 0-978-14767-3350-0 (hardcover).
    - TB/Paterson: RB 155 M85 2016
    - OR/University Ave.: RB 155 M85 2016

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
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

MARKING SCHEME

- One assignment is due every week, Tuesday evening at 11:59 PM EDT.
- The next week's work will go live no later than 12:01 AM EDT Thursday of that week. This means that you have at least 7 days to review and complete each week's work.
- There are 3 tests, which can be written at any time during weeks 2, 4 and 6.
- Assignments are worth 60% of your final mark and tests 40%. This emphasizes the importance of showing me your personal views in the assignments and practicing your writing and oral presentation skills.

Assignments

6 pieces of written or video work (@ 10% each = 60 marks total) due every 7 days during the course. All are posted in that week's discussion forum in MCL.

• 4 x text-based posts	40
• 2 x video-based posts	20

Tests

Written every 2 weeks in Quizzes in MCL (40 marks total). You may write at any time during the week of the test; for example, write test #1 at any time in week 2.

• Test 1 (on week 1 and 2 material)	13
• Test 2 (on week 3 and 4 material)	13
• Test 3 (on week 5 and 6 material)	14
TOTAL MARKS	**100**

The due dates for the above deliverables are all posted on the course MyCourselink page on the right side under **Calendar**.

SCHEDULE

Notes:

- The schedule below is tentative and subject to change.
- The material in this class will be covered in half the usual time of a F or W term course: 6 weeks instead of 12. This means that you will have to devote at least twice as much time per week to reading and thinking about the material than for a F or W 0.5-FCE course.
- A course "week" is 7 days long and runs from Wednesday at 12:01 AM to the following Tuesday at 11:59 PM. The deadline for you to submit that week's deliverables is Tuesday at 11:59 PM.

Week 1: July 2-8 (3 modules)

Module 1: The prehistory of biology

- Course info and introduction
- Hunting and gathering requires biological knowledge
- The development of agriculture
- Assyrian natural history
- The dawn of history: Asurbanipal and the first library

Module 2: Ancient Greek and Roman science

- Greek influences
- Biology = medicine
- The birth of rationalism: Hippocrates and Aristotle

Module 3: Roman natural history

- The influence of Alexander the Great
- Ptolemy and his museum
- Pliny and Roman natural philosophy
- Galen and medicine
- The decline of Roman Empire and learning

Task #1: Video intro and discussion forum on modules 1-3

Week 2: July 9-15 (3 modules)

Module 4: Medieval biology

- The east/west division of the Roman Empire
- The spread of Christianity and rejection of science as a philosophy
- Byzantium: armchair natural philosophy and preservation of the work of the Ancients
- The rise of the Arab Empire
- Arab science: strengths (optics, alchemy) and weaknesses (natural philosophy)

Module 5: Medieval biology in Europe

- Stagnation in the early Middle Ages
- The Great Chain of Being
- Frederick II: first challenge to the wisdom of the Ancients and the rebirth of direct experimentation
- Rebirth in the 13th century and founding of the first universities in Italy
- Albert: doctor and encyclopedist
- The Black Death and beginnings of the Renaissance

Module 6: The Renaissance

- Renaissance Italy discovers Roman writings
- Development of the printing press
- Realization of the world's size and complexity
- The rise of sailing ships
- The Columbian Exchange
- Herbals and Gerrard
- The internationalization of science

Task #2: Discussion forum on modules 4-6

Test #1

- *Covers modules 1-6.*
- *Open during week 2.*

Week 3: July 16-22 (4 modules)

Module 7: The ordering of the world in the 17th and 18th centuries

- The development of science and decline of magic

- Optics and the macro and micro worlds
- Systematics
- Biology as natural history: Ray and Willughby
- Linnaeus and modern biological nomenclature
- The benefits of being a generalist

Module 8: Approaching the *Origin*

- World travel's impact on the number of species discovered
- Natural selection background
- The relationship to typology
- Buffon's ideas approach natural selection
- Lamarck and the realization that change occurs to all species
- The Darwin family: Charles' grandfather Erasmus

Module 9: Charles Darwin and the *Origin*

- Voyages on the *Beagle*
- Passionflowers and the rise of greenhouses
- Pollination and the exchange of gametes
- Natural selection: a way to improve species
- Orchids, pollination and reproductive success
- Climbing plants
- Cross fertilization and vigour: the purpose of sexual reproduction
- Darwin's belief in eugenics

Module 10: The mystery of heredity

- Heredity is a contradiction
- Mendel and the emergence of experimentation in genetics
- Darwin's gemmules and pangenesis theory
- Mendel deduces how heredity works using statistics
- The hazards of publishing in obscure journals
- Weismann experimentally refutes gemmules
- DeVries confirms Mendel's work in other plants
- Bateson coins "genetics"

Task #3: Discussion forum on modules 7-10

Week 4: July 23-29 (3 modules)

Module 11: Genes and identity

- The rise of biology and the research lab
- de Vries uses plants to study evolution
- Thomas Morgan Hunt and the Mutation Theory
- *Drosophila* as an animal model organism for genetics
- Kornberg asks “What is a gene?”
- Morgan discovers linkage and crossing over
- Fisher and the central role of statistics in biology
- Dobzhansky simulates evolution and the effect of geographic isolation in the lab
- Dobzhansky demonstrates that there are no superior alleles

Module 12: After the Modern Synthesis

- Genetics and evolution reconcile
- Griffith and horizontal transformation of genes
- Muller and mutation
- Lysenko’s Lamarckism
- Schrödinger and the nature of the gene
- Miescher and nuclein
- Avery determines that DNA is the hereditary material

Module 13: Deducing DNA

- Biology appeals to physicists after World War II
- The links between chemistry, physics and biology and the power of multidisciplinary
- approaches to tough research problems
- Wilkins and Franklin butt heads at King’s College
- The power of X-ray crystallography: Pauling solves protein structure
- Watson and Crick meet at Cambridge
- Model-building to solve DNA’s structure
- Chargaff’s rules help solve the structure

Task #4: Video discussion forum on modules 11-13

Test #2

- *Covers modules 7-13.*
- *Open during week 4.*

Week 5: July 30-August 5 (4 modules)

Module 14: Gene regulation

- Beadle and Tatum: one gene, one protein
- Brenner and Jacob discover RNA
- Codons and translation: the Central Dogma
- Pauling and Itano discover the structure of hemoglobin
- Monod et al. discovers gene regulation in *E. coli*
- Genes, development and disease

Module 15: The development of ecology

- Development from natural history at the end of the 19th century
- von Humboldt and biogeography
- Haeckel and holism versus Darwin's materialism
- Experimentation in natural systems
- Warming and the interdependence of species
- Clements and succession
- Shelford, Allee and animal ecology
- The Lotka-Volterra equations and population modelling

Module 16: Genes to genesis

- The role of heredity in development
- Lewis and the animal body plan
- Nusslein-Volhard and Wieschaus probe early embryo development
- The link between regulatory proteins and development
- *C. elegans* and cell fate
- Kerr and apoptosis
- Multicellular organisms: organization and interaction of cells

Module 17: The beginnings of recombinant DNA

- Berg's lab creates recombinant DNA
- Mertz: plasmids as clone factories
- Cohen, Falkow and Boyer simplify cloning recombinant DNA

Task #5: Discussion forum on modules 14-17

Week 6: August 6 - 12 (4 modules)

Module 18: Sequencing, cloning and ethics

- Sanger and DNA sequencing
- Roberts and Sharp discover introns

- Watson's Old and New biology
- "New" molecular techniques could link gene sequence and disease
- Asilomar II and biohazards
- Boyer and Cohen patent molecular biology techniques
- Genentech and medical biotechnology
- First maps of the human genome for finding disease genes
- Support and skepticism about biotechnology

Module 19: Modern ecology

- Ecology as a tool to quantify anthropocentric environmental change
- Using the Modern Synthesis to explain Darwinian evolution
- Population vs. systems ecology
- Lack's role in promoting the Modern Synthesis
- Hutchinson promotes mathematical modelling of natural populations using the Lotka-Volterra equations
- Hutchinson and Wilson found community ecology
- Weiner's feedback loops
- Lovelock and unease over the Gaia hypothesis

Module 20: The Human Genome Project

- Scale and conceptual shifts in science
- The drive to find genes causing polygenic diseases
- Ethical considerations: do bad genes make bad people? Can genes be patented if we don't know their function?
- Venter and expressed sequence tags as a sequencing shortcut
- Shotgun sequencing complete genomes
- The public-private rivalry of the HGP
- The discovery of non-coding genes in *C. elegans*
- The challenge of deciphering our "instruction manual"

Module 21: Biology in context: what have we learned?

- What is science?
- Development of the scientific method
- The best way to teach biology
- Uniting the silos of biology
- Reductionism vs. expansionism

Task #6: Discussion forum on modules 18-21

Test #3

- *Covers modules 14-21.*
- *Open during week 6.*

DELIVERABLES

Assignments

Video assignments (Weeks 1 and 4)

There are 2 video assignments during the course. Submitting an assignment in an alternative format will let you practice a different way of showcasing your knowledge of the material in the course. It will also let you practice giving brief oral presentations in a friendly forum. All course participants (students and me) will see these posts.

Follow the instructions for each forum in **Discussions**. Due dates at 11:59 PM:

- Task #1: Video intro (Tues. Jul. 8)
- Task #4: Video discussion forum (Tues. Jul. 29)

Discussion forum posts (Weeks 2, 3, 5 and 6)

Discussion forums are an important part of online classes, because other than meetings you schedule with me, there is no face-to-face time with your prof like there is in a classroom-based course. Most of you have vast experience about virtual classes from the pandemic years.

My goals with the discussion forums are to (1) help you understand the course content, (2) deepen your learning experience, and (3) sharpen your critical thinking skills.

For you to receive marks for forum posts, you must participate regularly and thoughtfully. For each of the 4 written discussion forums, I will post specific instructions. For example, for week 1, the instructions are “Post once in this forum.”

For all written discussion forums, I will post at least 3 discussion topics. One student may reply directly to each of my original questions; there is thus an advantage to posting early. **Further direct replies to the original topics will not count as posts towards your mark for that forum… one thread per topic.** When you reply to others' posts, you must take previous posters' points of view into consideration. In your posts, make sure you

1. Demonstrate that you read and/or viewed the background material and thought deeply about it by citing it extensively in your post,
2. Consider other students' points of view in your reply, and
3. Format your discussion like a conversation (often one that does not have one right answer) rather than an information download.

Include a few (one to three) relevant primary literature and/or review articles in your reply that show that you did extra research to deepen your understanding of the topic. Be sure to include these citations in writing at the end of your post.

Note that if necessary, I will also contribute to the forums to (1) clarify arguments, (2) prod further thought and replies, and (3) steer them back on track to answer the questions I originally posted if they go too far into the weeds. I encourage you to reply to my posts… I will be respectful of your point of view regardless of your background in biology.

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.
- Keep your post focused 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.
- Successful students 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.

Tests (dates indicated above and in Calendar)

There are 3 tests during the course, written during weeks 2, 4 and 6. These cover the lecture ranges as indicated above and are **not cumulative**. They are written in Quizzes in MCL at any time during those weeks and are 20 min long. I will forward other details in **Announcements** as the dates approach.

COURSE IMPROVEMENT

It's important to me to continuously improve it, so I value student feedback. As such, some data from the *Student Feedback on Teaching* survey from 2021S are below.

My average score for the 23 questions was 4.86 / 5 (standard deviation +/- 0.14; number of survey participants = 11).

Below are all SFT participants' answers to "What suggestions do you have for improving the course?" (number of survey participants providing comment on this question = 8) from the 2021S version of this course. I offered BIOL-2310 in 2023S but didn't receive enough SFT surveys to see those results. My replies/action items for this term follow each of these.

- potentially reducing the amount of discussion posts required, so that we can focus more on course content and studying for exams
    - I think it's important to post every week, which forces you to keep up with reading and viewing the material. You only have to post once on weeks where there is an exam.
- I appreciated having to only do one post on the discussion forums for weeks 4, 5, and 6. I found 2 posts was really hard to give a good response to. I found it a bit tough when the discussions veered way off from the original topic when there wasn't any material in the readings available to respond to the questions the other students asked. If there are a lot of students in the class maybe it might be an idea to allow two initial posts per topic in the future.
    - I participate regularly in the forums to help steer commentary back to the original questions. Note that to get a good mark for your posts, you have to comment at least in part on the original questions that I posted.
- The practice exams were really helpful, please continue to use them in the future! They really helped me succeed with focusing my studying.

    - All 3 tests will have mock exams posted in advance to help with your studying.
- posting recorded lectures sunday night along with the powerpoints if possible
    - I will do my best to post my video lectures at the same time as the rest of the course material each week.
- Please talk more about your educational experience, you seem like an interesting guy. Maybe sharing your experiences would inspire students.
    - If you watch my videos, I'm sure you'll see me go off topic and discuss parts of my career.
- I think this course would be valuable to be during the W/F semesters. As a summer course it is great but I believe students would enjoy taking the course during the in-person semesters as well.
    - Unfortunately, I have other courses to teach in the F and W terms, so this will have to remain as a spring course for now.
- the distribution for marks and stuff could be revised and something else should be included
    - I've made the discussion posts worth half of the course marks this time, which aligns with the amount of work required to compose good posts.
- I think it was great. I liked the three midterms, and 6 discussion posts. Good job on a great online course!
    - I hope you feel this way about this term, too.

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 a head start, watch this Vox video about chatbot use in higher education. 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.

The consequences of plagiarism are:

- First offense: mark of zero for that deliverable
- Second offense: mark of zero in the course

Any suspected plagiarism in the course will result in me filing a **Form 1- Advisory of Suspected Breach of Academic Integrity** with Student Conduct and Case Management and the SES dean. This will record the incident on your Lakehead academic record.

If I suspect that you've plagiarized on a course deliverable, I will give you the opportunity to demonstrate your knowledge orally. You will therefore have to answer a few questions about the material with me live on Zoom at a mutually agreeable time to receive your mark on the midterm.

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.