



**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.)

## History of Biology

Biology 2310 | Spring 2019

**Instructor** D. Law

### Contact info

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Please use the lakeheadu.ca email address above to contact me, not the email within D2L. I will check my email daily Monday to Friday, and will try to respond to your questions as quickly as possible during those days.

## Class info

All material is posted on MyInfo/D2L; check there for the latest course updates and information. Biology 2310 is an asynchronous web course and does not have any “live” content. However, I will go through the lectures using the Virtual Classroom tool in D2L and will include a link to these videos in D2L. You can watch (and rewatch, if desired) these as many times as you like.

## 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.

*Offering:* web

*Credit Weight:* 0.5

*Prerequisite(s):* none

*Course Classification(s):* Type C: Engineering, Mathematical and Natural Sciences

## Textbook

There is no course textbook. I will give you required readings by posting the material online. Course material is derived mainly from the 3 books below; copies of each are available for overnight (1-day) loan from the reserve desk on each campus as follows:

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

## Learning objectives

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.

## Marking scheme

### A. Assignments

12 pieces of written or video work (@ 3.33% each = 40 marks total) are due every 3.5 days during the course:

- |  |    |
|--|----|
| • 9 x text-based postings in discussion forums | 30 |
| • 3 x video assignments                        | 10 |

### B. Tests (all written online)

- |                              |    |
|------------------------------|----|
| • Midterm exam 1 (May 12-13) | 20 |
| • Midterm exam 2 (May 26-27) | 20 |
| • Final exam (June 14-15)    | 20 |

**TOTAL MARKS**

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**100**

## Assignments

### 1. Discussion forums (Modules 2, 3, 4, 6, 7, 8, 9, 10 and 11)

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.

My goal with the discussion groups is to demonstrate to you that participating helps you understand the course content, but more importantly 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 9 discussions during the course, I will post specific instructions. For example, for module 2, the instructions are “Post two replies to other posts to obtain your participation marks for this forum.”

For all 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 posts must be formatted as replies to those student posts and not directly as replies to my original post.** This is to encourage your (1) deep thought about the subject, (2) consideration of other students’ points of view in your reply, and (3) 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 my original topics, further direct replies to the original topics will not count as posts towards your participation mark for that forum.**

Note that I will also contribute to the forums, often 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.
- 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.

## 2. Video assignments (Modules 1, 5 and 12)

There are 3 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 oral presentations in a friendly forum. These are due on various days during the term; check Calendar for details.

Access the assignments in D2L under **Other Tools > Video Assignments**. Follow the instructions below for each assignment.

**Important: use either Chrome or Firefox browsers (not Safari) to ensure that the Video Assignment tool works correctly.**

Have fun with these.

### ***Task #1: Video intro (due May 5)***

I will be the only one who will see this assignment (e.g., your classmates will not see it). Even though this course is online and asynchronous, I would like to know a bit about your background and motivation for taking the course. Therefore, in this assignment:

- A. Briefly introduce yourself.
- B. Tell me a bit about your progress through your program so far: what year are you in? Where did you go to high school? Is Lakehead your first postsecondary institution?
- C. Give a brief summary of the most interesting postsecondary course you have taken so far, at Lakehead or elsewhere. Why was it so great?
- D. Why did you decide to take History of Biology? Some possible reasons are: I like the anonymity of a web course; the topic really interested me; I like the idea of working at the intersection of science and the humanities; Dr. Law is/seems awesome; etc.

Practice your submission prior to recording it. When you are ready to go, hit the video symbol with the plus sign in the black square.

Your assignment should be between 1.5 and 3 minutes long. Keep it brief; I will take off 10% of the assignment mark for every 5 seconds you go longer than 3 minutes. You have 4.5 days instead of the usual 3.5 days to complete this assignment. Submit by Sunday May 5 at noon.

**Task #5: Video discussion forum (due May 19)**

This assignment is similar to other discussion forums, only this time you will post your topics using video rather than text. Unlike task #1, but like all the text-based discussion forum posts, your posts will be visible to your classmates. The same rules apply here as in the text-based forums: anyone may post a reply to one of my original questions, but subsequent posts on the 3 topics have to include a consideration of the points of view of those who posted before you.

Format your video as follows:

- A. Introduce yourself and tell us your program and year level.
- B. Tell us what question you are replying to. If you are replying to another student's reply, summarize their original post.
- C. Tell us your point of view, and how you support or disagree with the content of the previous posts.

Practice your submission before you record it, like you did for assignment 1. Time it to be between 1.5 and 3 minutes long. Keep it brief; I will take off 10% of the assignment mark for every 5 seconds you go longer than 3 minutes. Submit by Sunday May 19 at noon.

**Task #12: What have we learned? (due June 12)**

Biology may be the most rapidly developing field of science. In this assignment, I'd like you to tell me a bit about what you've learned in the course and what you feel is the next great area of biological research. I'd also like you to tell me about an area of biology that you'd like me to cover the next time I teach this course. Format your video as follows:

- A. Introduce yourself.
- B. What is one new and memorable thing about biology that you learned in the course? Why do you feel that way about this subject?
- C. What do you think is an area of biology that needs further research? Why?
- D. Among the topics I presented, what would you like me to spend more time discussing the next time I offer this course? Did I completely miss any part of biology that you wanted to hear about?

Practice your submission before you record it, like you did for assignments 1 and 2. Time it to be between 1.5 and 3 minutes long. Keep it brief; I will take off 10% of the assignment mark for every 5 seconds you go longer than 3 minutes. Submit by Wednesday June 12 at 11:59 PM.

## Schedule and important dates

Note that the schedule below is tentative and subject to change.

It's also important to note that 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.

### Week 1: May 1 – 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

*Task #1: Video intro (open 12:01 AM May 1 to 11:59 AM May 5)*

#### **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 #2: Discussion forum (open 12:01 PM May 5 to 11:59 PM May 8)*

### Week 2: May 9-15 (3 modules + midterm #1)

#### **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 13<sup>th</sup> century and founding of the first universities in Italy
- Albert: doctor and encyclopedist
- The Black Death and beginnings of the Renaissance

*Task #3: Discussion forum (open 12:01 AM May 9 to 11:59 AM May 12)*

**Midterm #1**

- Covers modules 1-5. Open from noon Sun. May 12 to noon Mon. May 13.

**Module 6: The Renaissance**

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

*Task #4: Discussion forum (open 12:01 PM May 12 to 11:59 PM May 15)*

**Week 3: May 16-22 (4 modules)****Module 7: The ordering of the world: 17<sup>th</sup> and 18<sup>th</sup> 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

*Task #5: Video essay (open 12:01 AM May 16 to 11:59 AM May 19)*

**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 #6: Discussion forum (open 12:01 PM May 19 to 11:59 PM May 22)*

**Week 4: -May 23-29 (3 modules + midterm #2)****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

*Task #7: Discussion forum (Open 12:01 AM May 23 to 11:59 AM May 26)*

**Midterm #2**

- Covers modules 6-12. Write from noon Sun. May 26 to noon Mon. May 27.

**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 #8: Discussion forum (Open 12:01 PM May 26 to 11:59 PM May 29)*

**Week 5: May 30-June 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 19<sup>th</sup> 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

*Task #9: Discussion forum (Open 12:01 AM May 30 to 11:59 AM June 2)*

**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 #10: Discussion forum (Open 12:01 PM June 2 to 11:59 PM June 5)*

**Week 6: June 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

*Task #11: Discussion forum (Open 12:01 AM June 6 to 11:59 AM June 9)*

**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 #12: Video assignment: What have I learned? (Open 12:01 PM June 9 to 11:59 PM June 12)*

**Exams** (dates indicated above and in Calendar)

There are 3 exams during the course: 2 midterms and one final exam. These cover the lecture ranges as indicated above. They are written online at any time during a one-day period and are designed to be 1 h long. I will forward other details in the video lectures and in Announcements as the dates approach.

The final exam is not cumulative and covers material between midterm #2 and the end of the course. However, any material that students had difficulty answering on the midterm test may be included on the final. I will let you know what this material is in advance.

**Statement on academic dishonesty**

The full version of [Lakehead University's policy on academic dishonesty](#) is available for you to read. This policy makes up part of the [Code of Student Behaviour and Disciplinary Procedures](#). All students in this course should read the Code and become familiar with it.

In summary, 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 the University.

For the purposes of this course, there are in particular two places where cheating may occur:

- (a) using written or electronic notes or conferring with another person in a test or examination, and
- (b) 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. Rest assured that the course instructors will take **every precaution** to ensure that potential cheaters are caught and subjected to the appropriate penalty.