

IB 270: THE EVOLUTION OF MOLECULES & CELLS

FALL 2024

Lecture time: MWF 11.00 - 11.50am (Natural History Building 4014)

Lab time: Th 1.00pm – 5.00pm (Natural History Building 4016)

Required Text: Genomes 4 by T.A. Brown (full-text pdf available free through UIUC Library)

Prerequisite courses: IB 150 or MCB 150.

COURSE OVERVIEW

Life on earth is characterized by a mind-boggling organismal diversity. Surprisingly, the same core molecules (DNA, RNA, proteins, carbohydrates, and lipids) are used to construct all this diversity. This first course in the IB Honors Program, IB270: The Evolution of Molecules and Cells, explores how these fundamental building blocks shape and delves into the technological advances that have helped us uncover, study, and manipulate these processes. Through lectures, readings, and discussions, you will be exposed to diverse research areas including molecular biology, genetics, genomics, bioinformatics, and systems biology. Your Discovery Projects in lab will let you put concepts and experimental approaches into practice to ask how genotypes influence phenotypes. Throughout the semester, we will also touch on the historical and societal context of these concepts and research.

Learning Objectives

- o Understand and execute the scientific process, from hypothesis generation, to experimental design, to data collection, to interpretation and presentation.
- o Critically read and evaluate primary literature on a range of topics.
- o Hone writing skills for popular and scientific audiences.
- o Apply knowledge of molecular processes to design and complete an original research project.
- o Describe the molecular and cellular processes responsible for regulating biological systems, and how these systems vary across organisms.
- o Understand how underlying genetic and molecular processes have evolved, and how they in turn influence evolutionary outcomes.
- o Appreciate how rapid technological advances in your lifetime have fundamentally re-shaped biological research.
- o Integrate an understanding of diverse topics to build a systems-biology perspective of fundamental biological processes.
- o Discuss the history of the field and modern-day context of biological research, in particular genome sequencing and editing.

COURSE SCHEDULE

week of	Lecture	Topic	Reading	Lab & Assignments
Week 1 Aug. 26	Monday	Central Dogma: DNA, RNA, and proteins	Ch. 1	<u>LAB</u> Orientation, Pipetting, Worms <u>Assignment 1:</u> Wormbase
	Wednesday			
	Friday			
Week 2 Sep. 2	Monday	NO CLASS - LABOR DAY		<u>LAB</u> Worm mini-lab <u>Assignment 2:</u> DataClassroomU #1
	Wednesday	Studying Nucleic Acids	Ch. 2, 18.1	
	Friday			
Week 3 Sep. 9	Monday	Studying Genomes 1: mapping and sequencing	Ch. 3, 4.1, 4.2	<u>LAB</u> DNA extraction, PCR <u>Assignment 3:</u> DataClassroomU #2
	Wednesday			
	Friday	Paper Discussion		
Week 4 Sep. 16	Monday	Studying Genomes 2: assembly and annotation	Ch. 4.3, 4.4, 5, 6	<u>LAB</u> PCR gel, RNA extraction <u>Assignment 4:</u> Project Proposal Project Proposal DUE Sep. 22
	Wednesday			
	Friday	Paper Discussion		
Week 5 Sep. 23	Monday	Studying Genomes 3: types of genomes	Ch. 7, 8.1, 8.2, 9.1	<u>LAB</u> qPCR, worm methods, project prep <u>Assignment 5:</u> Prokaryotic genomes
	Wednesday			
	Friday	Paper Discussion		
Week 6 Sep. 30	Monday	Genome Expression 1: DNA modification	Ch. 10, 11	<u>LAB</u> qPCR analysis, project prep <u>Assignment 6:</u> qPCR analysis
	Wednesday			
	Friday	Paper Discussion		
Week 7 Oct. 7	Monday	Genome Expression 2: transcriptomes	Ch. 12	<u>LAB</u> BLAST, primer design, project prep <u>Assignment 7:</u> Cancer Genome Atlas
	Wednesday			
	Friday	EXAM 1		
Week 8 Oct. 14	Monday	Genome Expression 3: proteomes, metabolomes	Ch. 13	<u>LAB</u> DISCOVERY Project <u>Assignment 8:</u> Central Dogma Methods Draft DUE Oct. 20
	Wednesday			

	Friday	Paper Discussion		
Week 9 Oct. 21	Monday	Genome Evolution 1: generating variation	Ch. 18.2, 18.3, 18.4	<u>LAB</u> DISCOVERY Project <u>Assignment 9:</u> DataClassroomU #3
	Wednesday			
	Friday	Paper Discussion		
Week 10 Oct. 28	Monday	Genome Evolution 2: changing size and complexity	Ch. 14	<u>LAB</u> DISCOVERY Project <u>Assignment 10:</u> Introduction Draft Introduction Draft Due Nov. 3
	Wednesday			
	Friday	Paper Discussion		
Week 11 Nov. 4	Monday	Genes in Cells & Organisms 1: environmental responses, development	Ch. 8.3 Readings	<u>LAB</u> DISCOVERY Project <u>Assignment 11:</u> Article Extras
	Wednesday			
	Friday	EXAM 2		
Week 12 Nov. 11	Monday	Genes in Cells & Organisms 2: cooperation and coevolution	Readings	<u>LAB</u> DISCOVERY Project <u>Assignment 12:</u> Article Spotlight Results Draft DUE Nov. 17
	Wednesday			
	Friday	Paper Discussion		
Week 13 Nov. 18	Monday	Genes in Cells & Organisms 3: microbiomes	Readings	<u>LAB</u> DISCOVERY Project PEER REVIEW <u>Assignment 13:</u> Phinch App FULL DRAFT DUE Nov. 24
	Wednesday			
	Friday	Paper Discussion		
Nov. 25	Nov. 25	FALL BREAK		
Week 14 Dec. 2	Monday	Manipulating the Genome	Readings	<u>LAB</u> DISCOVERY PRESENTATIONS <u>Assignment 14:</u> Genetics & Society
	Wednesday	Ethics and Genomics		
	Friday	EXAM 3		
Week 15 Dec. 9	Monday	Genetics & Society Discussion	Readings	<u>Assignment 15:</u> Self-reflection DISCOVERY Final Draft DUE Dec. 15
	Wednesday	Genetics & Society Discussion		
Week 16 Dec. 16	Dec. 16	FINALS WEEK		

CONTACT INFORMATION

Instructor: Dr. Rose Marks

Office location: Morrill Hall 171

Email: ramarks@illinois.edu

One-on-one support: Thursdays after lab (~5pm – 6pm, NHB 4014), Friday 10am – 11am (NHB 4014), or by appointment

About Me: I am faculty in the Department of Plant Biology at UIUC. My research explores how plants have evolved to survive in some of the most extreme environments on earth. I'm particularly interested in "resurrection plants", which are a special type of plants that can survive complete desiccation. My research investigates the ecological and genetic processes that impact their desiccation tolerance and combines field and lab work. To learn more and see some pictures of the awesome plants we work with, visit roseamarks.com. I grew up in New Hampshire, got my BA at the University of Montana, my PhD at the University of Kentucky, and spent time as a postdoc in South Africa and Michigan. In between, I worked on farms, in restaurants, and bakeries. In addition to science, my favorite things include rock climbing, gardening, and baked goods (making and consuming).

Teaching Philosophy: My teaching philosophy is centered around the idea that learning should be both practical and accessible to all. In the classroom, my first priority is to create a space where all students feel safe to ask questions, voice ideas, and learn from one another. Beyond this foundation of respect, my focus is on teaching students *how* to approach problems, synthesize, and communicate complex ideas. I strive to create an engaging environment by using hands-on activities, encouraging discussion, and allowing students to test their own ideas through independent course-based research projects. While the subject matter is important, my ultimate goal is to help students gain the confidence and skills required to investigate any question.

Teaching Assistant: Kithmee De Silva

Office location: Natural History Building 4016

Email: kithmee2@illinois.edu

One-on-one support: If you would like to request group office hours or one-on-one support, please send me an email. Mentioning the topics or questions you hope to discuss will help me prepare better.

About Me: I am a third year Plant Biology PhD student in the Brooks lab. My research involves untangling gene regulatory networks to decipher how plants sense and harmoniously integrate light, nitrogen, and carbon signals to orchestrate the mesmerizing dance of photosynthesis using the dicot model plant, *Arabidopsis*. Outside of work, I love to cook, read, paint and explore places and cuisines.

COURSE STRUCTURE & ACTIVITIES

This is a 5 credit (!) course with both a lecture and a lab. Typically, each credit is ~3 hours of work a week, so you should plan on spending ~15 hours per week on this class. Note that actual time commitments will vary week to week, as well as your motivation, needs, and study habits. All course material for both the lecture and the lab will be posted on Canvas where you

will also submit most of your assignments, so make sure you familiarize yourself with the course site and check it often.

Lecture

We will have a pretty traditional lecture style, with lots of opportunities for questions, active learning, and discussion. Coming to class ready to take notes, participate, and engage with your classmates and instructors will maximize your gains during lecture. The general structure will be similar most weeks. You will have lectures, an assignment, and a discussion section. In addition, you will have review and practice questions in class and through the course website. More detailed information about course activities and grading is below.

Lectures, Readings, and Resources

Lectures are designed to give an overview of the topic and provide an opportunity for you to ask questions. In-class lectures will be supported by readings, additional resources on the course website, and study guides. Study guides list key topics and provide practice questions that are a mixture of multiple choice, true/false, and short answer questions. Study guides aren't graded – they are meant as a study tool to help prepare you for the exams.

Discussion Section

Most weeks we will have a discussion section covering reading(s) on a specific topic. Participation in discussions will consist of three parts: (1) reading and commenting on the reading through Perusall, (2) attending and participating in the discussion section, (3) leading one of the discussion sections. Each reading/topic will be posted on Perusall with an overview on the course website. Perusall is a 'social e-reader' that lets you read, comment, and respond to the questions and comments of others. You can use Perusall through a web browser or their app. It's free, but you'll need to create an account and use our course access code: MARKS-7LYBX

The goal of using Perusall is to jump-start discussion and deeper thinking about the material (and to help me know what things sparked your interest and/or confused you). I'll post a few questions to get you started, but in general, active Perusall engagement includes: responses to any assignment-specific prompts, defining terms you looked up to help classmates who read the paper later, asking questions to clarify content, proposing answers to other students' questions, highlighting places where evidence is unclear or weak, and drawing connections between prior knowledge and the new information provided. Unsatisfactory engagement reflects a lack of thoughtful engagement with content, e.g. commenting on only one paragraph or section or displaying only cursory attempts to understand material, simple restatement of what is written, lacking detail/justification. Critical reading is time-consuming, so please plan at least two hours per paper. Comments are due the night before so we can read each other's comments before in-class discussion.

Assignments

There will be one assignment per week. The content and structure of the assignments will have a range of formats, but might include paragraph style answers, drawing diagrams, data interpretation, questions associated with completion of an on-line activity, computational exercises, and/or reflection. Unless otherwise noted, assignments will be available through and submitted via the course canvas website (due Sundays unless noted otherwise).

Lab

You will have a four-hour lab session each week. You MUST come to lab prepared and ready to stay the entire time. Being prepared means completing pre-class assignments and wearing

appropriate attire. Sometimes you will also have follow-up activities/assignments to complete after lab. For the first few weeks the lab will vary week-to-week as you learn a range of techniques, but once you get going on your Discovery Projects you'll be working very independently.

Discovery Projects are really the highlight of IB270! Using *C. elegans* nematode worms as a model system, you will work in groups of 2-3 to complete an independent project. You will go from background research, to hypothesis generation, to experimental design and implementation, to data collection, to data analysis, and finally to presentation in both a written and oral formats. Your projects are original research and you will probably find it both exciting and a bit unnerving to be completing a big project where no one knows what the outcome will be! **NOTE:** Completing your Discovery Projects will include coming to regularly scheduled lab times as well as coming in outside of regular lab sessions to monitor your worms and collect data!

Participation & Attendance

Participation is an essential component of your commitment to the course and the honors program. Given the structure of the class, it is impossible to do well in the class without attending and participating. Attendance is required. Labs are always mandatory, but each student is permitted to miss 2 lectures without an excuse. Absences beyond that must be excused or participation points will be impacted. I hope you won't see 'participation' as just another box to check, but rather as an additional opportunity for learning and a meaningful way of building and engaging in our course community!

COMMUNITY STANDARDS

We will develop these together on the first day of class. Come prepared to share your ideas!

Some examples to get you started:

- o Support each other in learning.
- o Be respectful of differences in background and experience.
- o Let classmates finish points, raising hands as a placeholder.
- o Invite others to speak.
- o Listen actively.
- o Distinguish whether you are stating your opinion or a fact.
- o Tell your own story rather than others (unless requested).
- o When space is needed, ask for time or take a break from the room.
- o Be open to discussion.
- o Think before you speak and use considerate language.
- o Assume others have good intentions.

ASSESSMENT INFORMATION

Exams, assignments, Perusall discussions, your Discovery project pieces, your final Discovery Project paper, your Discovery Project Presentation, community participation, and self assessment will be standard graded using points/percentages. The entire class will consist of 300 points.

Grade composition (percent of total)

Component	Number	Points per Item	Description	Total Points	Percent of total
Exams	3	20 points	3 exams, worth 20 points each	60 points	20%
Assignments	15	4 points	15 assignments, worth 4 points each	60 points	20%
Perusall Discussions	9	4 points	Participate in 9 discussions (4 points each) and lead one discussion (9 points)	45 points	15%
Discovery Project Pieces	6	5-10 points	Project Proposal: 10 points	45 points	15%
			Methods Draft: 5 points		
			Introduction Draft: 5 points		
			Results Draft: 5 points		
			Peer Review: 10 points		
			Full Draft: 10 points		
Discovery Project FINAL paper	1	45 points	Final Paper: 45 points	45 points	15%
Discovery Project Presentation	1	15 points	Presentation: 15 points	15 points	5%
Community Participation	ongoing	15 points	15 points for overall participation	15 points	5%
Self-Assessment	1	15 points	Self-assessment: 15 points	15 points	5%
TOTAL				300 points	100%

Grade percentage assignments

A+ = 98-100; A = 93-97, A- = 90-92, B+ = 88-89, B = 83-87, etc.

You will receive an automatic 0% on an assignment if you are caught cheating/plagiarizing! Completing assignments for others or having others complete your assignments is also considered cheating (by both parties).

GUIDELINES & EXPECTATIONS FOR COMMUNICATION

Come to class and office hours to get your questions answered. Your instructors are here to help you! Outside of class, the Canvas Q&A forum is your first line of defense for all course related questions. Please post general questions about the course logistics and course materials here. This way you are mostly likely to get your questions answered as quickly as possible and others can benefit by being part of the discussion. Note that your instructors may move questions from email to the Q&A forum for this same reason. Questions of a private/personal nature should be sent to your instructors via email or discussed in person.

We will always do our best to respond to email in a timely fashion. This means that we will get back to you within 24 hours or less Monday – Friday, 9am-6pm CST. Be aware that response times for emails sent late at night or on the weekends may be longer.

Assessment Feedback Turnaround Time

Please reference your Canvas grade book frequently to ensure your assessments are being submitted properly and that you are earning credit for your work. We recommend keeping all graded assignments until the end of the course in case of discrepancies. Please allow 1 week for exam, assignment, and draft grading.

TIPS FOR SUCCESS

- o Communicate, communicate, communicate. We are here to help and want you all to succeed and be well. The best way to ensure this is to communicate early and often about anything that you're worried about or struggling with.
- o Log in to Canvas frequently to manage announcements, activities, and messages. If you let things pile up for three to four days, you might be overwhelmed. You should start working on new module content right away as it is posted.
- o Stay on track. We've built in deadlines to help, but also recommend making a schedule for yourself to work through the material. This will help you manage your time better.
- o Take good notes! Even though the lecture slides are provided, taking notes is key. [Did you know taking notes by hand may be better than typing?](#)
- o Use the lecture materials as a guide for what you need to know. Lectures are geared toward the material your instructors think is most important.
- o Focus! When you're studying, try to minimize distractions and do focused work for a chunk of time. Then take a mental break (check your phone, check the fridge, check in with a friend). Do NOT do both at the same time.
- o Find a study buddy! Explaining things to others is one of the best ways to learn!
- o Come to office hours! This is a great way to get your questions answered, learn by listening in on others' questions, and get to know your instructors.

ACADEMIC INTEGRITY

Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the [Academic Integrity Policy](#). Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

INCLUSIVITY

Exclusionary, offensive or harmful speech (such as racism, sexism, homophobia, transphobia, etc.) will not be tolerated and in some cases subject to University harassment procedures. We

are all responsible for creating a positive and safe environment that provides everyone equal respect and comfort. I expect each of you to help establish and maintain an environment where you and your peers can contribute without fear of ridicule or intolerant or offensive language.

SUPPORT RESOURCES & SUPPORTING OTHERS

As members of the Illinois community, we each have a responsibility to express care and concern for one another. If you come across a classmate whose behavior concerns you, whether in regards to their well-being or yours, we encourage you to refer this behavior to the Student Assistance Center (1-217-333-0050) or odos.illinois.edu/community-of-care/referral/.

As a Community of Care, we want to support you in your overall wellness. We know that students sometimes face challenges that can impact academic performance (examples include mental health concerns, food insecurity, homelessness, personal emergencies). Should you find that you are managing such a challenge and that it is interfering with your coursework, you are encouraged to contact the Student Assistance Center (SAC) in the Office of the Dean of Students for support and referrals to campus and/or community resources. The SAC has a Dean on Duty available to see students who walk in, call, or email the office during business hours. For mental health emergencies, you can call 911 or contact the Counseling Center.

ACCOMODATIONS

To obtain disability-related academic adjustments and/or auxiliary aids, you must contact your instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak St., Champaign, call 333-4603, e-mail disability@illinois.edu or go to the DRES website. NOTE: all DRES accommodations are from the date the letter is issued and cannot be applied retroactively!

For accommodations related to Religious Observances, please see:

<https://odos.illinois.edu/community-of-care/resources/students/religious-observances/>.

This links to the Community of Care's Request for Accommodation for Religious Observances form that should be completed for those students seeking religious accommodations.

SEXUAL MISCONDUCT POLICY AND REPORTING

The University of Illinois is committed to combating sexual misconduct. Faculty and staff members are required to report any instances of sexual misconduct to the University's Title IX and Disability Office. In turn, an individual with the Title IX and Disability Office will provide information about rights and options, including accommodations, support services, the campus disciplinary process, and law enforcement options.

A list of the designated University employees who, as counselors, confidential advisors, and medical professionals, do not have this reporting responsibility and can maintain confidentiality, can be found here: <https://wecare.illinois.edu/resources/students/#confidential>
Other information about resources and reporting is available here: wecare.illinois.edu

FAMILY EDUCATIONAL RIGHTS AND PRIVACY ACT (FERPA)

Any student who has suppressed their directory information pursuant to Family Educational Rights and Privacy Act (FERPA) should self-identify to the instructor to ensure protection of the

privacy of their attendance in this course. <https://registrar.illinois.edu/academic-records/ferpa/> for more information on FERPA.

EMERGENCIES

Emergency response recommendations can be found at the following website: <http://police.illinois.edu/emergencypreparedness/>. I encourage you to review this website and the campus building floor plans website within the first 10 days of class. <http://police.illinois.edu/emergency-preparedness/buildingemergency-action-plans/>.