

# Syllabus

## BIOL 448: Advanced Cell Biology

Section 001, Fall 2023

### Welcome!

This course will be an advanced exploration of the field of cellular and molecular biology through reading primary scientific literature related to the SARS CoV-2 virus, the cause of the COVID-19. We will first focus on commonly used laboratory techniques used in the field and then transition into a variety of cell and molecular topics. Throughout the semester students will critically evaluate primary literature, design experiments, and analyze and interpret data. Students will also complete a curriculum design project where they will develop an educational case study based on one of the primary literature articles that we discuss in class.

**Instructor:** Dr. Laura Ott

Learn more about me, to include how to meet with me in office hours and ways that we will communicate about class-related content, [HERE](https://uncch.instructure.com/courses/36108/pages/about-the-instructor) (<https://uncch.instructure.com/courses/36108/pages/about-the-instructor>).



**Meeting Time:** MWF, 9:05-9:55 AM

**Meeting Location:** Genome Sciences Building (GSB), Rm. 1374

*The instructor reserves the right to make changes to the syllabus including project due dates and test dates. These changes will be announced as early as possible.*

### Learning Objectives

At the conclusion of this class, students will be able to:

1. Describe how molecular mechanisms enable cellular functions
2. Relate genetic and chemical inputs to cellular function.
3. Predict how abnormalities in molecular and cellular processes correlate to disease.
4. Design, analyze, and interpret common laboratory techniques used in the cell and molecular biology field.

5. Critically analyze and interpret primary scientific literature that informs the field of cellular and molecular biology.
6. Propose experiments to test hypotheses.
7. Design an educational case study for introductory biology students that is based on primary literature.

In addition to these course-level learning objectives, each lesson will have specific **learning objectives**, which will be communicated on the [detailed course schedule](https://uncch.instructure.com/courses/36108/pages/class-schedule) (<https://uncch.instructure.com/courses/36108/pages/class-schedule>) for BIOL 448. These learning objectives will be how I will assess your learning in this class – when I write an exam question, it will directly relate to one of these learning objectives. Students should therefore use these learning objectives as a guide to their learning in this class (e.g., as a study guide).

## Course Structure

This course will be face-to-face, where students will devote much of class time to working in groups on practice problems, reading and interpreting primary scientific literature, and working on group projects. Before most class sessions, students will watch short, **pre-recorded videos** that covers lesson topics. Students can expect to watch 1-2 videos before each class period. The videos will be posted to the Canvas lesson page that is created for each lesson, with some videos being recordings made by the course instructor and others being created by others (e.g., YouTube videos). Students must be logged into Canvas using their ONYEN and ONYEN password. Videos will be posted at least 48 hours before class that is associated with that lesson.

This class is going to have a strong team focus, with students regularly working in instructor-assigned teams. This structure is being put into place because there is a wealth of evidence demonstrating that group-based learning promotes the outcomes for ALL students. Therefore, it is imperative that you attend class so that you can interact with your team – this is not only going to promote YOUR learning, but also the learning of your PEERS. Throughout the semester, teams will be able to reflect on their collective effectiveness and cohesion, while also providing constructive feedback to individual team members. Individuals who are found to repeatedly not contribute to their team's success may be required to work individually on assignments. Please keep in mind that many of the assignments in this class are designed for teams and will therefore require more advanced understanding, knowledge, and thinking that can come from team interactions, where individuals from diverse experiences and backgrounds can work together to promote each other's learning.

**Quizzes:** At the start of most class sessions, students will complete a quiz on the pre-recorded videos. The quiz will be taken twice – first students will take the quiz individually and then in instructor-assigned groups. Students' quiz scores will be an average of the individual and group quiz scores. These quizzes will be on Canvas and students **MUST** be present in class to earn credit for the quizzes. Flexibility: 20% of the quizzes will be dropped at the end of the semester to account for occasionally missing or arriving late to class.

**Assigned readings:** Periodically throughout the semester, students will be expected to read a primary literature article that focuses on a recent cell and molecular biology topic that is relevant to our understanding of the pathogenesis of the SARS CoV-2 pandemic (note that most of the papers are very current and were published in 2020). Students can expect questions about the assigned readings on the above-mentioned quizzes at the beginning of class sessions. To help guide students in reading the papers, **guided reading questions (GRQs)** will be posted to Canvas. In addition to answering the GRQs, when reading the papers students should be able to answer the following questions:

- What is the overarching question(s) of this paper and why is this question(s) important to ask?
- For each figure of the paper, students should be able to answer:
  1. What was the question(s) of the figure? It should be noted that in some instances (such as multi-panel figures) there may be more than one question.
  2. What method(s) were used and why were they appropriate? Students should pay close attention to controls that are used in the experiments.
  3. What were the results of the experiment and how did the results help to answer the overarching research question of the paper?
- What were the major conclusions of the paper and how did it contribute to our knowledge of the subject?
- What are future directions of this work – if you were to conduct a follow-up experiment, what would be your research question, hypothesis, and experimental approaches?

Note that there is NOT an assigned textbook for this class – all of the required primary articles (and occasional review articles) will be posted to Canvas for students to download and read.

**Student workdays:** Throughout the semester, student workdays will be built into the schedule. These will be dedicated class periods where teams can work on their educational case study assignments, group take home exams, and/or other course-related materials. There will not be a quiz on these student workdays.

## Assignments & Grading

Your grade in this class will be determined as follows:

<b>Quizzes</b> (20% of the lowest grades will be dropped)	15%
<b>Exam 1</b> , which will be the average of the group take-home and individual, in class exam.	20%
<b>Exam 2</b> , which will be the average of the group take-home and individual, in class exam.	20%

<b>Educational case study</b>	20%
<b>Cumulative final exam</b>	25%

Letter grades will not be assigned for individual assignments, just scores. Final letter grades will be based on the weighted scores on the assignments above for the entire semester. **Your grade will be based on your performance in class** and not on comparing your performance to peers. Grades will not round up (B=83, not 82.9). The grading scale is as follows: A = 93.0-100.0; A- = 90.0 = 92.9; B+ = 87.0-89.9; B = 83-86.9; B- = 80.0-82.9; C+ = 77.0-79.9; C = 73.0-76.9; C- = 70.0-72.9; D+ = 66.0-69.9; D = 60.0-65.9; F = 59.9 or below.

**Quizzes** will be based on accuracy, with students having a quiz for each class session where there is not an exam or a student workday. The quizzes will be made available on Canvas. The quizzes will assess students' mastery of content covered in the pre-lesson videos, the primary article(s) assigned for the lesson, and/or previous content covered in class. Each quiz will be taken twice; students will take the quiz individually first before taking it again in instructor-assigned teams. Quiz scores will be based on the average of the individual and team quiz scores. Students must be present at the start of class to earn quiz points for that day – students who are absent and/or late to class will not receive credit. *Flexibility:* to account for occasionally being late and/or absent from class, 20% of students' lowest quiz scores will be dropped at the end of the semester.

**Mid-Semester Exams:** There will be two mid-semester exams in this class, with each exam having two components that will be weighted equally.

**Group take-home component:** Students working in instructor-assigned teams will complete a take-home exam that will consist of short answer questions related to the class content. One document will be submitted per group, but an individual member can submit an individual answer to a question if they disagree with the rest of the group (to be included in the single document). Each student is responsible for contributing to each answer and students are encouraged to discuss any concerns regarding unequal contributions made individual team members with the instructor as soon as possible.

The take home exams must be typed and outside sources that are used should be appropriately cited. The take home exams are due at the beginning of the class period in which the in-class exam is listed in the class schedule. Groups will be given 14 days to complete the take home exam and it should be noted that material on the take home exam may be covered in the time between when the exam is posted and the exam is due. Begin working on them EARLY, as they are more time-consuming than they appear at first glance. **No late take home exams will be accepted;** any exam that is not turned in on time will receive a zero for the entire group.

Students can expect that the take home exams will have a focus on data interpretation, troubleshooting experiments, and experimental design. Further, the take home exams are designed to help students prepare for the individual in-class exam described below. *The use of generative artificial intelligence, such as ChatGPT, is strictly prohibited on these assignments, as the purpose of*

these assignments is to assess your knowledge and ability to construct answers to questions yourself.

**Individual in-class exam:** The in-class component of each exam is given on the due date of the corresponding take-home exam (refer to the course schedule). Students will take the in-class exam individually and the exam will consist primarily of true/false and multiple-choice exams, although there may be 1-2 short answer questions on each exam. These exams are closed-book, although students may have a single 8.5x11 piece of paper with notes written on one side prepared to use while taking the exam. Students must submit this prepared paper with their exam. Students will not be able to make up the individual in-class exam without appropriate documentation (e.g., doctor's note) that is emailed to the instructor in advance of the exam. Further, any planned absences (with documentation) on in-class exam dates require students to take the exam before their absence. The instructor will work with students with ARS approved accommodations on the scheduling and proctoring of their exam in accordance with their university-approved accommodations.


**Cumulative Final Exam:** The cumulative final exam will be taken individually and will cover all content covered in the class. The exam will primarily consist of true/false and multiple choice questions, but there may be no more than five short answer questions. Students can again have a single 8.5x11 piece of paper with notes written on both sides of the paper to use while taking the exam. Students must submit this prepared paper with their paper. Students must take the final exam during the university scheduled final exam period; students will need to obtain an excused absence from the Office of the Dean of Students to take a make-up final exam.









**Educational Case Study Project:** Students working in instructor-assigned teams will design a case study based on a primary literature article related to our understanding of SARS CoV-2, the virus that causes COVID-19. This case study should be designed such that it could be implemented in a single 50-minute class meeting for BIOL 101, BIOL 103, or BIOL 252. This will be a semester-long project, where students will submit components for feedback from either peers and/or the instructor. Refer to the Case Study project page on Canvas for details on this assignment, to include a grading rubric. Teams will present their case study to the rest of the class towards the end of the semester, where students in the audience will peer review the case study and provide constructive feedback before the final case study is due the final day of class. Well-designed case studies have the potential to be implemented in one of the above-mentioned introductory biology courses and/or published in a biology education research journal or database, with the students as co-authors. **No late case studies will be accepted**; any case study that is not turned in on time will receive a zero for the entire group. The use of generative AI, such as ChatGPT, is strictly prohibited on these assignments, as the purpose of this assignment is to assess your ability to construct information and communicate it to others.

## Course Policies & Resources

I value the perspectives of individuals from all backgrounds reflecting the diversity of our students. I broadly define diversity to include race, gender identity, national origin, ethnicity, religion, social class, age, sexual orientation, political background, and physical and learning ability. I strive to make this classroom an inclusive space for all students. Please let me know if there is anything I can do to improve, I appreciate suggestions.


### **Attendance Policy.**

**University Policy:** As stated in the University's [Class Attendance Policy](#)  (<https://catalog.unc.edu/policies-procedures/attendance-grading-examination/#text>), no right or privilege exists that permits a student to be absent from any class meetings, except for these University Approved Absences:

1. Authorized University activities: [University Approved Absence Office \(UAAO\) website](#)  (<https://uaao.unc.edu/sample-page/>), provides information and [FAQs for students](#)  (<https://uaao.unc.edu/faqs-for-students/>), and [FAQs for faculty](#)  (<https://uaao.unc.edu/sample-page/>), related to University Approved Absences
2. Disability/religious observance/pregnancy, as required by law and approved by [Accessibility Resources and Service](#)  (<https://ars.unc.edu/>) and/or the [Equal Opportunity and Compliance Office](#)  (<https://eoc.unc.edu/what-we-do/accommodations/>), (EOC)
3. Significant health condition and/or personal/family emergency as approved by the [Office of the Dean of Students](#)  (<https://odos.unc.edu/>), [Gender Violence Service Coordinators](#)  (<https://gvsc.unc.edu/>), and/or the [Equal Opportunity and Compliance Office](#)  (<https://eoc.unc.edu/what-we-do/accommodations/>), (EOC).

Instructors may work with students to meet attendance needs that do not fall within University approved absences. For situations when an absence is not University approved (e.g., a job interview, illness/ flu or club activity), instructors are encouraged to work directly with students to determine the best approach to missed classes and make-up assessment and assignments.

### **Honor Code**

All students are expected to follow the guidelines of the UNC Honor Code. In particular, students are expected to refrain from “lying, cheating, or stealing” in the academic context. If you are unsure about which actions violate the Honor Code, please see me or consult [studentconduct.unc.edu](#)  (<https://studentconduct.unc.edu/>).

### **Acceptable Use Policy.**

By attending the University of North Carolina at Chapel Hill, you agree to abide by the University of North Carolina at Chapel Hill policies related to the acceptable use of IT systems and services. The Acceptable Use Policy (AUP) sets the expectation that you will use the University's technology resources responsibly, consistent with the University's mission. In the context of a class, it's quite likely you will participate in online activities that could include personal information about you or your



peers, and the AUP addresses your obligations to protect the privacy of class participants. In addition, the AUP addresses matters of others' intellectual property, including copyright. These are only a couple of typical examples, so you should consult the full [Information Technology Acceptable Use Policy](https://policies.unc.edu/TDCClient/2833/Portal/KB/ArticleDet?ID=131247) [↗](https://policies.unc.edu/TDCClient/2833/Portal/KB/ArticleDet?ID=131247), which covers topics related to using digital resources, such as privacy, confidentiality, and intellectual property. Students should refer to the specific assignment regarding the use of generative AI, such as ChatGPT, which is based on [guidance](https://provost.unc.edu/student-generative-ai-usage-guidance/) [↗](https://provost.unc.edu/student-generative-ai-usage-guidance/) provided by the university. In general, generative AI is not permitted on assignments for this class.

Additionally, consult the [Safe Computing at UNC](https://safecomputing.unc.edu/) [↗](https://safecomputing.unc.edu/) website for information about data security policies, updates, and tips on keeping your identity, information, and devices safe.

### **Accessibility Resources and Service**

[Accessibility Resources and Service](https://ars.unc.edu/) [↗](https://ars.unc.edu/) (ARS – [ars@unc.edu](mailto:ars@unc.edu) [↗](mailto:ars@unc.edu)) receives requests for accommodations, and through the Student and Applicant Accommodations Policy determines eligibility and identifies reasonable accommodations for students with disabilities and/or chronic medical conditions to mitigate or remove the barriers experienced in accessing University courses, programs and activities.

ARS also offers its Testing Center resources to students and instructors to facilitate the implementation of testing accommodations.

Faculty and instructors with any concerns or questions about accommodations and/or their implementation, are invited to [reach out to ARS \(mailto:ars@unc.edu\)](mailto:ars@unc.edu) to discuss.

### **Counseling and Psychological Services**

UNC-Chapel Hill is strongly committed to addressing the mental health needs of a diverse student body. The [Heels Care Network](http://care.unc.edu) [↗](http://care.unc.edu) website is a place to access the many mental health resources at Carolina. CAPS is the primary mental health provider for students, offering timely access to consultation and connection to clinically appropriate services. Go to their website <https://caps.unc.edu/> [↗](https://caps.unc.edu/) or visit their facilities on the third floor of the Campus Health building for an initial evaluation to learn more. Students can also call CAPS 24/7 at 919-966-3658 for immediate assistance.

### **Title IX and Related Resources**

Any student who is impacted by discrimination, harassment, interpersonal (relationship) violence, sexual violence, sexual exploitation, or stalking is encouraged to seek resources on campus or in the community. Reports can be made online to the EOC at <https://eoc.unc.edu/report-an-incident/> [↗](https://eoc.unc.edu/report-an-incident/) or by contacting the University's Title IX Coordinator (Elizabeth Hall, [titleixcoordinator@unc.edu](mailto:titleixcoordinator@unc.edu) [↗](mailto:titleixcoordinator@unc.edu)) or the Report and

Response Coordinators in the Equal Opportunity and Compliance Office

([reportandresponse@unc.edu](mailto:reportandresponse@unc.edu) (<mailto:reportandresponse@unc.edu>)). Confidential resources include Counseling and Psychological Services and the Gender Violence Services Coordinators ([gvsc@unc.edu](mailto:gvsc@unc.edu) (<mailto:gvsc@unc.edu>)). Additional resources are available at [safe.unc.edu](https://safe.unc.edu) (<https://safe.unc.edu>).

### **Policy on Non-Discrimination**

The University is committed to providing an inclusive and welcoming environment for all members of our community and to ensuring that educational and employment decisions are based on individuals' abilities and qualifications. Consistent with this principle and applicable laws, the University's **Policy Statement on Non-Discrimination** (<https://eoc.unc.edu/our-policies/policy-statement-on-non-discrimination/>) offers access to its educational programs and activities as well as employment terms and conditions without respect to race, color, gender, national origin, age, religion, genetic information, disability, veteran's status, sexual orientation, gender identity or gender expression. Such a policy ensures that only relevant factors are considered, and that equitable and consistent standards of conduct and performance are applied.

If you are experiencing harassment or discrimination, you can seek assistance and file a report through the Report and Response Coordinators (email [reportandresponse@unc.edu](mailto:reportandresponse@unc.edu) (<mailto:reportandresponse@unc.edu>)) or see additional contact info at [safe.unc.edu](https://safe.unc.edu) (<https://safe.unc.edu>) or the Equal Opportunity and Compliance Office at <https://eoc.unc.edu/report-an-incident/> (<https://eoc.unc.edu/report-an-incident/>).

### **Undergraduate Testing Center**


The College of Arts and Sciences provides a secure, proctored environment in which exams can be taken. The center works with instructors to proctor exams for their undergraduate students who are not registered with ARS and who do not need testing accommodations as provided by ARS. In other words, the Center provides a proctored testing environment for students who are unable to take an exam at the normally scheduled time (with pre-arrangement by your instructor). For more information, visit <http://testingcenter.web.unc.edu/> (<http://testingcenter.web.unc.edu/>).

### **Learning Center**

Want to get the most out of this course or others this semester? Visit UNC's Learning Center at <http://learningcenter.unc.edu> (<http://learningcenter.unc.edu>) to make an appointment or register for an event. Their free, popular programs will help you optimize your academic performance. Try academic coaching, peer tutoring, STEM support, ADHD/LD services, workshops and study camps, or review tips and tools available on the website.

### **Writing Center**



For free feedback on any course writing projects, check out UNC's Writing Center. Writing Center coaches can assist with any writing project, including multimedia projects and application essays, at any stage of the writing process. You don't even need a draft to come visit. To schedule a 45-minute appointment, review quick tips, or request written feedback online, visit <http://writingcenter.unc.edu>  (<http://writingcenter.unc.edu>).

# Class Schedule

## Class Schedule

***This class schedule is subject to change, with any changes being made via Canvas announcements sent to your UNC email. Students are responsible for keeping track of these assignments and deadlines.***

***Students should refer to the specific lesson page under the Modules tab on the left for lesson-specific resources and materials.***

### ***UNIT 1: Molecular techniques and cell signaling***

DATE	LESSON	LEARNING OBJECTIVES	ASSIGNMENTS & ACTIVITIES
Aug. 21	0	<p><b>Course introduction and overview; team assignments.</b></p> <ul style="list-style-type: none"> <li>Describe the expectations for being prepared for class.</li> <li>Set goals for how your team will work effectively and cohesively.</li> </ul>	<p><b><u>In-class:</u></b> team contracts</p>
Aug. 23	1	<p><b>Reading primary literature and experimental design</b></p> <ul style="list-style-type: none"> <li>Identify approaches for reading primary scientific literature.</li> <li>Critically evaluate a figure from primary literature.</li> <li>Describe elements of research design and how they impact scientific findings or conclusions.</li> <li>Formulate a testable hypothesis.</li> <li>Design a controlled experiment.</li> </ul>	<p><b><u>Before class:</u></b> 1) watch pre-lesson video(s) for lesson 1 and 2) submit team contract to Canvas (due at 9:05 AM, ET on 8/23).</p> <p><b><u>In-class:</u></b> quiz 1</p>
Aug. 25	2	<p><b>Introduction to educational case study project.</b></p> <ul style="list-style-type: none"> <li>Describe aspects of Backward Design for Learning.</li> </ul>	<p><b><u>Before class:</u></b> watch pre-lesson video(s) for lesson 2</p> <p><b><u>In-class:</u></b> quiz 2</p>

		<ul style="list-style-type: none"> <li>• Write learning objectives that are aligned to Bloom's Taxonomy.</li> <li>• Associate assessment questions to specific learning objectives.</li> <li>• Compare different pedagogical approaches to learning.</li> </ul>	
Aug. 28		<p><b>Student work day</b> -- class time will be devoted to students working with their teams on their educational case studies or other assignments in class.</p>	-
Aug. 30	3	<p><b>Gene expression techniques, part 1</b></p> <ul style="list-style-type: none"> <li>• Create a conventional PCR reaction to amplify a gene.</li> <li>• Analyze and interpret PCR results.</li> <li>• Design conventional PCR primers to amplify a gene.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 3</p> <p><b>In-class:</b> quiz 3</p>
Sep. 1	4	<p><b>Gene expression techniques, part 2</b></p> <ul style="list-style-type: none"> <li>• Describe the process by which mRNA is isolated from a eukaryotic cell.</li> <li>• Explain the steps required to convert mRNA into cDNA.</li> <li>• Compare the technical aspects and applications of reverse transcription (RT-PCR) and quantitative real time PCR (qRT-PCR) methods.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 4</p> <p><b>In-class:</b> quiz 4</p> <p><b>After class:</b> Case study topic assignment due at 11:59 PM, ET on 9/1</p>
Sep. 4		No class -- Labor Day / UNC Well-Being Day.	-
Sep. 6	5	<p><b>Gene expression techniques, part 3</b></p> <ul style="list-style-type: none"> <li>• Describe the molecular mechanisms and applications of RNA interference (RNAi), to include differences between siRNA and shRNA.</li> <li>• Identify features of a mammalian expression plasmid.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 5</p> <p><b>In-class:</b> quiz 5</p>

		<ul style="list-style-type: none"> <li>Describe how to introduce vectors into mammalian cells via lipofection.</li> <li>Design an RNA experiment, to include controls.</li> <li>Evaluate the results of an RNAi experiment.</li> </ul>	
Sep. 8	6	<p><b>Immunotechniques, part 1</b></p> <ul style="list-style-type: none"> <li>Explain how a discontinuous SDS-PAGE is used to separate proteins based on size.</li> <li>Identify structural features of an antibody.</li> <li>Differentiate between monoclonal and polyclonal antibodies, to include their production.</li> <li>Compare applications of SDS-PAGE and Western blot.</li> <li>Compare direct vs. indirect antibody staining methods.</li> <li>Evaluate protein expression by Western blot.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 6</p> <p><b>In-class:</b> quiz 6</p> <p>-</p>
Sep. 11	7	<p><b>Paper discussion</b></p> <ul style="list-style-type: none"> <li>Critically evaluate primary scientific literature.</li> </ul>	<p><b>Before class:</b> read Varnaite, et al., 2020 (encouraged to use GRQs posted to lesson 7 page to help guide your reading).</p> <p><b>In-class:</b> quiz 7</p> <p><b>After class:</b> Group processing 1 due at 11:59 PM, ET on 9/11</p> <p>-</p>
Sep. 13	8	<p><b>Immunotechniques, part 2</b></p> <ul style="list-style-type: none"> <li>Compare and contrast direct and indirect ELISA methods.</li> <li>Analyze and interpret ELISA data.</li> <li>Compare competitive ELISA and lateral flow ELISA methods.</li> <li>Evaluate applications of ELISA.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 8</p> <p><b>In-class:</b> quiz 8</p> <p>-</p>

		<ul style="list-style-type: none"> <li>• Compare ELISPOT and immunofluorescence techniques.</li> </ul>	
Sep. 15	9	<p><b>Immunotechniques, part 3</b></p> <ul style="list-style-type: none"> <li>• Describe principles of flow cytometry in basic terms.</li> <li>• Evaluate the size and granularity of cells by comparing forward vs. side scatter.</li> <li>• Determine appropriate controls for a flow cytometry experiment.</li> <li>• Predict applications of flow cytometry.</li> <li>• Interpret flow cytometry data.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 9</p> <p><b>In-class:</b> quiz 9</p> <p>-</p>
Sep. 18		<p><b>Student work day</b> -- class time will be devoted to students working with their teams on their educational case studies or other assignments in class.</p>	-
Sep. 20	10	<p><b>Signal transduction, part 1</b></p> <ul style="list-style-type: none"> <li>• Predict the signaling pathway of an amino-acid vs. lipid hormone.</li> <li>• Define response element, kinase, and phosphatase.</li> <li>• Compare G protein coupled receptors and receptor tyrosine kinases.</li> <li>• Compare the function of toll-like receptors.</li> <li>• Predict anti-viral signaling events.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 10</p> <p><b>In-class:</b> quiz 10</p> <p><b>After class:</b> Take home exam 1 posted to Canvas</p>
Sep. 22	11	<p><b>Paper discussion</b></p> <ul style="list-style-type: none"> <li>• Evaluate primary literature associated with cell signaling experiments.</li> </ul>	<p><b>Before class:</b> read Wang and Liu, 2016 (encouraged to use GRQs posted to lesson 11 page to help guide your reading).</p> <p><b>In-class:</b> quiz 11</p>

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Sep. 25		No class -- UNC Wellbeing Day	-
Sep. 27	12	<p><b>Signal transduction, part 2</b></p> <ul style="list-style-type: none"> <li>Characterize the signaling events that occur in the mitogen-activated protein kinase (MAPK) and nuclear factor kappa B (NFkB) signaling pathways.</li> <li>Design a cell signaling experiment</li> <li>Evaluate how the MAPK and NFkB pathways are regulated.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 12</p> <p><b>In-class:</b> quiz 12</p> <p>-</p>
Sep. 29	13	<p><b>Signal transduction, part 3</b></p> <ul style="list-style-type: none"> <li>Discuss activation of receptor tyrosine kinases.</li> <li>Compare the three main pathways downstream of receptor tyrosine kinases: MAPK, JAK/STAT, PI3K/Akt.</li> <li>Predict the role of glucocorticoids on signaling through GPCRs and RTKs.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 13</p> <p><b>In-class:</b> quiz 13</p> <p><b>After class:</b> Case study learning objectives and assessment questions (due at 11:59 PM, ET on 9/29)</p>
Oct. 2		<p><b>Student work day</b> -- class time will be devoted to students working with their teams on their educational case studies or other assignments in class.</p>	-
Oct. 4		<p><b>Exam 1 (lessons 1-13)</b></p>	<p><b>Before class:</b> group take home exam due at 9:05 AM, ET on 10/6 via Canvas.</p> <p><b>In-class:</b> individual, in-class exam.</p> <p>-</p>

## **UNIT 2: Apoptosis, the cytoskeleton, intracellular trafficking, and immunity**

DATE	LESSON	LEARNING OBJECTIVES	ASSIGNMENTS & ACTIVITIES
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Oct. 6	14	<p><b>Apoptosis, part 1</b></p> <ul style="list-style-type: none"> <li>• Compare and contrast the intrinsic and extrinsic apoptosis pathways.</li> <li>• Predict the roles of Bcl-2 and Bax/Bak proteins on mediating apoptosis.</li> <li>• Compare pyroptosis, apoptosis, and necroptosis.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 14</p> <p><b>In-class:</b> quiz 14</p>
Oct. 9	15	<p><b>Paper discussion</b></p> <ul style="list-style-type: none"> <li>• Evaluate primary literature associated with apoptosis</li> </ul>	<p><b>Before class:</b> read Karki, et al., 2020 (encouraged to use GRQs posted to lesson 15 page to help guide your reading).</p> <p><b>In-class:</b> quiz 15</p> <p><b>After class:</b> group processing survey 2 due at 11:59 PM, ET 10/9</p>
Oct. 11	16	<p><b>Apoptosis, part 2</b></p> <ul style="list-style-type: none"> <li>• Compare how Annexin V, propidium iodide, and TUNEL can be used to evaluate apoptotic cells.</li> <li>• Design an experiment to evaluate whether a cell is undergoing apoptosis.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 16</p> <p><b>In-class:</b> quiz 16</p>
Oct. 13	17	<p><b>Autophagy</b></p> <ul style="list-style-type: none"> <li>• Differentiate between autophagy and apoptosis.</li> <li>• Describe the events that take place during autophagy.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 17</p> <p><b>In-class:</b> quiz 17</p> <p>-</p>
Oct. 16	18	<p><b>Cytoskeleton, part 1</b></p> <ul style="list-style-type: none"> <li>• Differentiate between pinocytosis and phagocytosis.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 18</p> <p><b>In-class:</b> quiz 18</p> <p>-</p>

		<ul style="list-style-type: none"> <li>• Describe actin and myosin interactions and their role in endocytosis.</li> <li>• Characterize the steps involved in receptor-mediated endocytosis.</li> <li>• Differentiate between early and late endosomes.</li> </ul>	
Oct. 18		<p><b>Student work day</b> -- class time will be devoted to students working with their teams on their educational case studies or other assignments in class.</p>	
Oct. 20		No class -- UNC Fall Break	-
Oct. 23	19	<p><b>Paper discussion</b></p> <ul style="list-style-type: none"> <li>• Evaluate primary literature investigating the role of the cytoskeleton on viral entry</li> </ul>	<p><b>Before class:</b> read Ou, et al., 2020 (encouraged to use GRQs posted to lesson 19 page to help guide your reading).</p> <p><b>In-class:</b> quiz 19</p>
Oct. 25	20	<p><b>Cytoskeleton, part 2</b></p> <ul style="list-style-type: none"> <li>• Compare and contrast microtubules, microfilaments, and intermediate filaments.</li> <li>• Describe how the polymerization of F-actin is regulated and the role of F-actin in cells.</li> <li>• Explain how microtubules are formed and their function in cells.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 20</p> <p><b>In-class:</b> quiz 20</p>
Oct. 27		<p><b>Student work day</b> -- class time will be devoted to students working with their teams on their educational case studies or other assignments in class.</p>	<p><b>After class:</b> 1) First draft of case study due at 11:59 PM, ET on 10/27 and 2) Take home exam 2 posted to Canvas</p>
Oct. 30	21	<p><b>Gene expression, part 5</b></p> <ul style="list-style-type: none"> <li>• Review factors that regulate the expression of a gene in eukaryotes.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 21</p> <p><b>In-class:</b> quiz 21</p>

		<ul style="list-style-type: none"> <li>Describe the molecular mechanisms of the COVID-19 mRNA vaccines.</li> <li>Compare the Moderna/Pfizer vaccines to Johnson &amp; Johnson</li> </ul>	
Nov. 1	22	<p><b>Paper discussion</b></p> <ul style="list-style-type: none"> <li>Evaluate primary literature investigating vaccine effectiveness.</li> </ul>	<p><b>Before class:</b> read Zhang, et al., 2020 (encouraged to use GRQs posted to lesson 22 page to help guide your reading).</p> <p><b>In-class:</b> quiz 22</p>
Nov. 3	23	<p><b>Intracellular trafficking, part 1</b></p> <ul style="list-style-type: none"> <li>Differentiate between cell-mediated and humoral immunity.</li> <li>Compare and contrast the role of antigen presentation on major histocompatibility complex (MHC) class I and II.</li> <li>Describe the molecular mechanisms of loading antigen on MHC class I and II.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 23</p> <p><b>In-class:</b> quiz 23</p> <p><b>After class:</b> Group processing survey 3 due at 11:59 PM, ET on 11/3</p>
Nov. 6	24	<p><b>Intracellular trafficking, part 2</b></p> <ul style="list-style-type: none"> <li>Predict the role of post-translational modifications on formation and function of MHC molecules.</li> <li>Design experiments to evaluate N-linked glycosylation.</li> <li>Determine if specific antigen epitopes are present on MHC molecules.</li> </ul>	<p><b>Before class:</b> watch pre-lesson video(s) for lesson 24</p> <p><b>In-class:</b> quiz 24</p>
Nov. 8		<p><b>Student work day</b> -- class time will be devoted to students working with their teams on their educational case studies or other assignments in class.</p>	

Nov. 10		<b>Exam 2 (lessons 14-24)</b>	<p><b><u>Before class:</u></b> group take home exam due at 9:05 AM, ET on 10/6 via Canvas.</p> <p><b><u>In-class:</u></b> individual, in-class exam.</p>

### Unit 3: Case Study Peer Review

DATE	LESSON	LEARNING OBJECTIVES	ASSIGNMENTS & ACTIVITIES
Nov. 13		<b>Student work day</b> -- class time will be devoted to students working with their teams on their educational case studies or other assignments in class.	<b>After class:</b> Second draft of case study due to Canvas (due at 11:59 PM, ET on 11/13)
Nov. 15		<b>Case study class presentation and peer review</b>	<b><u>In-class:</u></b> Submit completed rubric with peer review of team's case study before leaving class.
Nov. 17		<b>Case study class presentation and peer review</b>	<b><u>In-class:</u></b> Submit completed rubric with peer review of team's case study before leaving class.

Nov. 20		<b>Case study class presentation and peer review</b>	<b><u>In-class:</u></b> Submit completed rubric with peer review of team's case study before leaving class.
Nov. 22		No class -- Thanksgiving break	
Nov. 24		No class -- Thanksgiving break	
Nov. 27		<b>Case study class presentation and peer review</b>	<b><u>In-class:</u></b> Submit completed rubric with peer review of team's case study before leaving class.
Nov. 29		<b>Case study class presentation and peer review</b>	<b><u>In-class:</u></b> Submit completed rubric with peer review of team's case study before leaving class.

Dec. 1		<b>Case study class presentation and peer review</b>	<b><u>In-class:</u></b> Submit completed rubric with peer review of team's case study before leaving class.
Dec. 4		<b>Case study class presentation and peer review</b>	<b><u>In-class:</u></b> Submit completed rubric with peer review of team's case study before leaving class.
Dec. 6		<b>LDOC - class wrap-up and review</b>	<b><u>After class:</u></b> final case study due at 11:59 PM, 12/6
Dec. 12		<b>Comprehensive Final Exam, 4-7 PM in GSB-1374</b>	-