School of Molecular & Cellular Biology

# MCB 471, Fall 2024

Cell Structure and Dynamics, 3 Credit Hours

## Instructor/Instructional Team

Name: Haiting Ma (Assistant Professor, Department of Cell and Developmental Biology).
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Phone: 217-265-9891.

## Class Meeting Schedule

Scheduled Class Time: Tuesdays and Thursdays, 12:30 PM – 1:50 PM, 2055 Sidney Lu Mechanical Engineering Building
Office Hours: Thursdays, 4:00 PM – 5:00 PM, 583 Morrill Hall or on Zoom. Alternative office hours are available by appointment on Zoom.

## Course Overview and Description

This course covers the molecular basis of cellular organization focusing on how cells secrete, move, adhere, divide, communicate, and die. The material will emphasize critical analysis of experiments, current controversies, and hypothesis testing.

Cells are the basic functional unit for eukaryotic species. In contrast to introductory biology courses that traverse multiple domains of life, this advanced cell biology class focuses on mammalian cell structure, function, and diverse cell types that enable mammals to adapt to the changing environment. Since malfunctioning of the mechanisms that regulate normal physiology could backfire and often contribute to disease, relevant biomedical research topics will be part of this course. Although mammalian species harbor hundreds of distinct cell types, we hope to derive unifying principles in light of structure-function relationship, evolution, disease, and innovative strategies to treat disease.

## Course Format

In this course, we will discuss the topics by examining primary research papers that range from the classic to the most recent. Rather than solely focusing on learning knowledge from didactic lectures, this course offers the opportunity to experience how new knowledge is generated through evaluating the data from primary research papers, critiquing the stringency of how conclusions were drawn from the papers, and conducting thought experiments to push the boundary of knowledge frontier.

Based on hypothesis-driven papers, students will articulate their interpretations of the data, conclusions, impact, and future directions through both written and oral formats of communication. This course will familiarize students with basic sources of primary papers. Students are encouraged to practice deriving significant and novel hypotheses that are likely to be true based on current knowledge. Upon successfully finishing the course, students will

learn how to identify relevant primary research literature, critically evaluate experimental data, and reach their conclusions based on analyzing data.

The class will meet twice per week (Tuesdays and Thursdays) for about one hour and 20 minutes each class. Every week, two primary research papers will be required for students to read critically and thoroughly before paper discussion. Tuesday lectures will provide relevant information necessary for understanding the papers to go over on Thursdays. Preview of papers will be provided on Tuesdays as well. During classes on Thursdays, the students will critique the papers, focusing on two aspects: 1) overall evaluation of the results and impact of the papers. 2) detailed analysis of experimental design, methods utilized, controls, and key data points that allow authors to reach their conclusions. At the end of each session, two papers for the upcoming week will be previewed.

## Course Prerequisites, Requirements met

Students are recommended to have taken at least MCB 250 or MCB 252. Prerequisites may be waived with permission by the instructor. MCB 471 is an advanced MCB course that is appropriate for senior undergraduate students and graduate students. Basic to intermediate knowledge of molecular biology, cell biology, and biochemistry will be needed.

## Student Learning Outcomes

At the end of the course, through assignments, discussions, activities, and assessments, students will be able to:

- Explain basic cellular components, function, structure, regulations under normal physiology conditions, and how their dysregulations contribute to diseases.
- Extract the overarching questions and hypothesis and understand how the background motivated the authors to work on the questions and form the underlying hypotheses.
- Identify assumptions and critique the logic of the arguments in the papers, assess strengths and weaknesses of the arguments, and design follow-up studies.
- Explain experimental approaches commonly used to probe questions in cell biology.
- Identify key experiments and data (including design, controls, and statistical analyses).
- Consider alternative approaches and compare the advantages and disadvantages of different approaches.
- Learn how to rigorously and logically reach conclusions from data.

## Course Text/Materials Information

Research papers needed for the class will be provided on a course Canvas website. Cell biology textbooks including Molecular Biology of the Cell (Alberts et al., Garland Science, 4th edition or later) will be helpful. Students do NOT need to purchase textbooks to take this class.

## Course Website, Course Tools (Canvas, Moodle, LON-CAPA, Zoom, etc.)

A Canvas LMS (learning management system) site will be used to provide research papers needed for the class.

## Grading Information and Breakdown

This course is letter-graded. Student grades will be based on a total of 100 points. The following categories are approximate but should be very close to the final distribution.

| | |
|---|---|
| Presentation and class participation: | 15 points |
| Midterm written assignment: | 20 points |
| Final project report: | 25 points |
| Final project presentation: | 20 points |
| Final exam: | 20 points |
| Total: | 100 points. |

Class participation and presentation
Students assigned to present a paper will prepare a slide deck for a 30-minute presentation to discuss a research paper. An oral presentation rubric will be provided for students to prepare for their presentations and will be used by the instructor and by a randomly selected peer reviewer to assess the presentation (peer review provides 20% of the presentation scores). Asking relevant questions during the presentations and other ways to properly participate in the class could provide additional points for students. Students need to read papers beforehand and provide a brief point about what they like about the papers, one short criticism of the papers, and one question they had for the papers, at least one day before the paper presentations.

Midterm written assignment (due by September 24th, 2024, week 5)
An exercise to derive biological insights from available knowledge will be a long-term assignment from the beginning throughout the class. A midterm written assignment will provide students with the opportunity to write a hypothesis-driven research proposal based on the current literature. Students will write a summary of a research topic that is related to the course contents. The student should briefly describe the importance of the topic, current knowledge, and important open questions of the topic. Then based on primary literature and data, formulate a testable novel hypothesis to address some aspects of the open questions.

Written assignments should be within 1-2 single-spaced letter pages with margins of 0.5 inches on all sides. The main text font should be Arial 11, and the figure legend font size can be Arial 10.

Final project report and oral presentation
The instructor could provide feedback regarding whether the midterm assignment could be a suitable project for the final project. Based on the feedback, students will modify and develop their middle-term proposals through the rest of the course. For the final project report, students will have a 2–3-page addition to their midterm written assignment by elaborating details including the experimental design, possible outcomes, and explanation of the possible results. The final project report is due one day before the final oral presentation (see below).

Additionally, students will provide an oral presentation at the end of the course. Oral presentations will be scheduled around the end of the semester. The tentative schedule is December 3 and 5. The presentation is devoted to discussing proposed research to develop the hypotheses and research ideas of their written assignments. The slide deck should consist of about 7-10 slides with the following components: title slide (1 slide), background slides (1-2 slides), hypothesis from the written assignment with aims for proposals (1 slide), key experiments and the key control(s) in the designed study to develop the research proposal, expected results, interpretations, and alternative results and approaches should be included in the presentation (2-5 slides), and conclusions or possible future experiments for proposals

(1 slide). Based on the presentation slides, students will give a 7-8-minute presentation with a 2-3-minute question-and-answer session.

An oral presentation rubric will be provided for students to prepare for their presentations and will be used to evaluate the final presentation by the instructor and by a randomly selected peer reviewer (the peer reviewer provides 20% of the presentation scores).

Final exam
A closed-book exam composed of multiple-choice and short essay questions will be provided to gauge students' understanding of the knowledge and research approaches covered in this course.

Grade Scale
The grading will not be curved. The following grade scale will be used. After the final exam at the end of the semester, the instructor will analyze the course and reserve the right to decrease the range of each letter grade. Requests for changes to final grades will be granted only when there is evidence of miscalculation on the part of the instructor. Extraneous requests for bonus points beyond what is already offered will NOT be honored.

| Letter grade | Range |
|---|---|
| A+ | 98-100 |
| A | 92-98 |
| A- | 90-92 |
| B+ | 88-90 |
| B | 82-88 |
| B- | 80-82 |
| C+ | 78-80 |
| C | 72-78 |
| C- | 70-72 |
| D+ | 68-70 |
| D | 62-68 |
| D- | 60-62 |
| F | <60 |

## Tentative Course Calendar with Daily Schedule of Topics, Readings, and Assignment Due Dates

**Week 1 (Aug 26-Agu30):**
**Aug 27: Introduction to the class and scientific research.**
**Aug 29: Presentation of papers. Details of written assignment. Preview of papers of week 2.**

**Week 2 (Sep 2 – Sep 6):**
**Sep 3: Cellular membranes and membrane receptors.**
**Sep 5: Presentation of papers. Preview of papers of week 3.**

**Week 3 (Sep 9 – Sep 13):**
**Sep 10: Intracellular signal transduction, innate immune response, dsRNA sensing, detection of cytosolic DNA.**

**Sep 12: Presentation of papers. Preview of papers of week 4.**

**Week 4 (Sep 16- Sep 20):**
**Sep 17: Metabolites sensors and regulation of cell signaling.**
**Sep 19: Presentation of papers. Preview of papers of week 5.**

**Week 5 (Sep 23-27):**
**Sep 24: Intracellular trafficking and transportation.**
**Sep 26: Presentation of papers. Preview of papers of week 6.**
***Midterm written assignment due.***

**Week 6 (Sep 30 - Oct 4):**
**Sep 31: Nucleus and gene regulation.**
**Oct 2: Presentation of papers. Preview of papers of week 7.**

**Week 7 (Oct 7 - Oct 11):**
**Oct 8: Epigenetic controls. X-inactivation, genetic imprint.**
**Oct 10: Presentation of papers. Preview of papers of week 8.**

**Week 8 (Oct 14 - Oct 18):**
**Oct 15: Stem cells, reprogramming, and induced pluripotent stem cells (iPSCs).**
**Oct 17: Presentation of papers. Preview of papers of week 9.**

**Week 9 (Oct 21 - Oct 25):**
**Oct 22: Biogenesis and function of microRNA as a representative noncoding RNA.**
**Oct 24: Presentation of papers. Preview of papers of week 10.**

**Week 10 (Oct 28 - Nov1):**
**Oct 29: Immune checkpoint inhibition, chimeric antigen receptor (CAR)-T cells as programmable machines.**
**Oct 31: Presentation of papers. Preview of papers of week 11.**

**Week 11 (Nov 4 - Nov 8):**
**Nov 5: Cells in distress and disease.**
**Nov 7: Presentation of papers. Preview of papers of week 12.**

**Week 12 (Nov 11 - Nov 15):**
**Nov 12: Programmed cell death: types and mechanisms.**
**Nov 14: Presentation of papers. Overview of Presentation of the research project.**

**Week 13 (Nov 18- Nov 22):**
**Presentation of research projects.**
**Advanced methods in cell biology.**

**Week 14 (Dec 2-Dec6):**
**Frontiers of cell biology.**
**Presentation of research projects.**

**Week 15: Final exam.**

Attendance is mandatory and participation is a requirement for a passing grade.

## Policies

In this class, we strive to ensure that all students can efficiently learn the knowledge, skills, and critical thinking capacities needed for their future careers. A healthy and inclusive class environment is the most fundamental basis of the class. We respect many personal choices of students as long as they comply with the university policy and the class policy (see below), and are not interfering with other members of the class. To ensure a safe class environment, any disruptive behaviors will be requested to be addressed. Failing to address the requests may result in the concerned individual being asked to leave the classroom for the day. To uphold an academic integrity standard for all students, we also have the following class policy in addition to very basic

## Course Attendance Policy, Late Work, and Scheduling Conflicts

This class abides by the campus policy on attendance:
https://studentcode.illinois.edu/article1/part5/1-501

Excessive absence (more than once) may reduce the participation points unless there are valid reasons. If students cannot be present in class during their assignment presentation time due to unavoidable causes, the students are encouraged to contact the instructor as soon as possible to switch the date. A live Zoom presentation or a prerecorded Zoom presentation could also be an alternative.

The final reports could be acceptable within 3 days of the final presentation if students would like to include comments and feedback from the final presentation. Other forms of delayed assignments or deliverables could reduce the points of affected items.

Conflicts with exams may only be granted for one of the following conditions:

1) Students with three final exams scheduled within 24 hours as defined in Section 82.A.4) of Final Examinations of the Code of Policies and Regulations Applying to All Students.
2) Students who have two final exams scheduled at the same time. Final conflict exam requests should be made to the course with a larger enrollment. Course personnel can assist with information to determine which course this would be.
3) Students who have a verified personal problem, and who have received written permission to take a conflict final exam from a dean in their college.
4) Students who have DRES academic accommodations

## A Statement on Academic Integrity

This class abides by the student code on academic integrity:
https://studentcode.illinois.edu/article1/part4/1-401
The written assignments and presentations should be the original work of students. Proper citation should be included when others' work is cited.

Artificial intelligence (AI) platform-generated contents are largely based on language models. They are limited in generating genuinely creative hypotheses which should be the goal of the written assignment. Using AI to check for grammar errors may be appropriate. Any other use of AI in written assignments needs evaluation and approval from the instructor.

## Disability Resources and Educational Services (DRES) Accommodations:

We are committed to providing a learning environment where our students can succeed. If you require special accommodations, please contact the instructor and the Disability Resources and Educational Services (DRES) as soon as possible. To contact DRES, you may visit 1207 S. Oak Street, Champaign, call 217.333.4603, or email disability@illinois.edu. We will try to meet all accommodations once the process has started. Please note that accommodations are not retroactive to the beginning of the semester, but begin the day you contact your professor, instructor, or coordinator with a current letter of accommodation from DRES.

## Use of Course Materials

The course materials could be used for personal education use only. Posting or redistributing course material in any format on public platforms and social media is prohibited since some papers are copyright-protected.

Class presentations and audio captions could be recorded. The recorded materials are intellectual and copyrighted property of the University of Illinois Board of Trustees and may be made for personal use only. Posting of audio recordings or transcriptions on social or electronic media platforms is strictly prohibited.

Taking pictures or video recordings of any member of the class is strictly prohibited.

## Religious Observances and Practices:

- Students are required to submit the Request for Accommodation for Religious Observances Form (which can be found at www.odos.illinois.edu/.../Religious_Observance_Accommodation_Request_Form.docx) to their instructors and the Office of the Dean of Students requesting accommodation by the end of the second week of the course. Requests that are not submitted within this time frame may not be granted. Information about accommodations can be found in the Student Code: http://studentcode.illinois.edu/.

## University Information of Student Safety – Active Threats:

- **General Emergency Response Recommendations** (Emergency Response Guide):
- Security Threat. The Department of Homeland Security and the University of Illinois at Urbana-Champaign Office of Campus Emergency Planning recommend the following three responses to any emergency on campus: **RUN > HIDE > FIGHT**

- **Only follow these actions if safe to do so.** When in doubt, follow your instincts - you are your best advocate!

- **RUN** — Action is taken to leave an area for personal safety.
    - Take the time to learn the different ways to leave your building **before** there is an emergency.
    - Evacuations are mandatory for fire alarms and when directed by authorities! No exceptions!
    - Evacuate immediately. Pull a manual fire alarm to prompt a response for others to evacuate.

- Take critical personal items only (keys, purses, and outerwear) and close doors behind you.
- Assist those who need help, but carefully consider whether you may put yourself at risk.
- Look for **Exit** signs indicating potential egress/escape routes.
- If you are not able to evacuate, go to an Area of Rescue Assistance, as indicated on the front page of this plan.
- Evacuate to Evacuation Assembly Area, as indicated on the front page of this plan.
- Remain at Evacuation Assembly Area until additional instructions are given.
- Alert authorities to those who may need assistance.
- Do not re-enter the building until informed by emergency response personnel that it is safe to return.
- Active Threat**:** IF it is safe to do so, run out of the building. Get as far away as possible. Do NOT go to the Evacuation Assembly Area.

- **HIDE** – Action taken to seek immediate shelter indoors when emergency conditions do not warrant or allow evacuation.
  - Severe Weather:
    - If you are outside, proceed to the nearest protective building.
    - If sheltering in place due to severe weather, proceed to the identified Storm Refuge Area or the lowest, most interior area of the building away from windows or hazardous equipment or materials.
  - Active Threat**:**
    - Lock or barricade your area.
    - Get to a place where the threat cannot see you.
    - Place cell phones on silent.
    - Do not make any noise.
    - Do not come out until you receive an Illini-Alert advising you it is safe.
- **FIGHT** – Action taken as a last resort to increase your odds of survival.
  - Active Threat**:** If you cannot run away safely or hide, be prepared to fight with anything available to increase your odds of survival.

## Student Resources/Where to Go for Help:

**We Care at Illinois**

- For sexual misconduct support, response, and prevention visit: wecare.illinois.edu

*Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, etc. If you or someone you know has been harassed or assaulted, you can find the appropriate resources here: http://oiir.illinois.edu/sites/prod/files/SexualMisconduct_ResourceGuide.pdf*

**Safety and Emergency**

*University Police Department, Emergency, 9-911; Non-emergency, 217-333-8911*
University Fire Department Emergency, 9-911
Crisis Line, 217-359-4141

Emergency Dean, 300 Turner Student Services Bldg., 610 E. John St., 217-333-0050
Counseling Center, 110 Student Services Bldg., 610 E. John St., 217-333-3704
McKinley Health Center, General Information, 217-333-2701
McKinley Mental Health Center, 1109 S. Lincoln, 217-333-2705
Dean of Students, 300 Turner Students Services Bldg, 610 E. John St., 217-333-0050
Local Sexual Assault Center, RACES, 217-384-4444
Women's Resources Center, 703 South Wright Street, 2nd Floor, 217-333-3137
Rape Crisis 24-hour Hotline, 217-384-4444
Suicide & Psychological Emergency, Suicide Prevention Team, 217-333-3704
SafeRides (free nighttime campus ride program), 217-265-RIDE (265-7433)
SafeWalks (free walking escort service by Student Patrol), 217-333-1216

**Student Services and Advocacy**
Office of the Dean of Students, 300 Student Services Bldg., 610 E. John St., 217-333-0050

**Classroom Support, Teaching Skills, and Instructional Strategies**
Center for Innovation in Teaching & Learning, 249 Armory Building, 217-333-1462

**Counseling Services**
Counseling Center, 110 Student Services Bldg., 610 E. John St., 217-333-3704
McKinley Mental Health Center, 1109 S. Lincoln Ave., 217-333-2701
Psychological Services Center, 3rd Floor, 505 E. Green St., 217-333-0041

**Disability Services**
Disability Resources and Educational Services (DRES), 1207 S. Oak St., 217-333-1970

**Lesbian, Gay, Bisexual, Transgender Resource Center**
LGTB Resource Center, 323 Illini Union, 1401 W. Green St., 217-244-8863

**Veterans Services**
Veteran Student Support Services, Office of the Dean of Students, 610 E. John St., 217-333-0050
Center for Wounded Veterans in Higher Education, 908 W. Nevada St., 217-300-3515

**General Study Skills Assistance**
Office of Minority Student Affairs, 130 Student Services Bldg., 610 E. John St, 217-333-0054
Office of Minority Student Affairs Tutoring Services, 701 S. Gregory Dr., Suite 1, 217-333-7547
Writer's Workshop, 251 Undergraduate Library, 1402 W. Gregory Dr., 217-333-8796
**Additional academic assistance may be available through individual departments

**Health Resources**
Health Education, McKinley Health Center, 1109 S. Lincoln Ave., 217-333-2701
Alcohol & Other Drug Office, 2nd Floor Counseling Center, 610 E. John St., 217-333-7557
Sexual Health Educator, McKinley Health Center, 1109 S. Lincoln Ave., 217-333-2714
Dial-A-Nurse, McKinley Health Center (24-hour), 1109 S. Lincoln Ave., 217-333-2700
Health Resource Center, McKinley Health Center, 1109 S. Lincoln Ave., 217-333-6000
Health Resource Center, Room 40 Illini Union, 1401 W. Green St., 217-244-5994
McKinley Health Center, General Information, 1109 S. Lincoln Ave., 217-333-2701

**Sexual Harassment/Assault & Acts of Intolerance/Hate Crimes**
Office of the Dean of Students, 300 Students Services Bldg., 610 E. John St., 217-333-0050

## The Office of Diversity, Equity, and Access (ODEA):

- For non-academic support visit: diversity.illinois.edu
    - Discrimination & Harassment Prevention
    - Title IX
    - Accessibility & Accommodations
    - Inclusive Illinois