



School of Molecular & Cellular Biology

BIOP 401, Fall 2021

Introduction to Biophysics, 3 Credit Hours

Instructor

Prof. Nicholas Wu
Office Location: Burrill Hall 331
Phone: (217) 300-9239
Email: nicwu@illinois.edu

Class Meeting Schedule

Scheduled Class Time: MW 03:00-03:50 pm (Online via Zoom)

Office Hours & Discussion sessions

Instructor:

Prof. Nicholas Wu
nicwu@illinois.edu
Office hours: Monday, 05:00 - 06:00 pm, Zoom

Teaching Assistants:

Ali Rasouli
rasouli2@illinois.edu
Discussion: Friday, 02:00-02:50pm, Zoom

Timothy Tan
tctan3@illinois.edu
Discussion: Friday, 03:00-03:50pm, Zoom

Course Outline

Part I: Thermodynamics and statistical mechanics
Part II: Structure and stability of biomacromolecules
Part III: Molecular interactions and kinetics

MIDTERM EXAM 1: Covering Lectures 1 - 9
MIDTERM EXAM 2: Covering Lectures 10 - 18
FINAL EXAM: Covering Lectures 19 - 26

Course Prerequisites

Prerequisite: MCB 354 or MCB 450, or equivalent, or consent of instructor.

Student Learning Outcomes

At the end of the course, students will be able to:

- Solve basic biophysical problems
- Identify and formulate biophysical questions
- Interpret data from biophysical experiments

Reference Textbooks

Provided on the class website:

- Physical Biochemistry by Prof Robert Gennis (UIUC) - Selected chapters of the draft textbook.
- Cell Biology by Numbers by R. Milo, R. Phillips, N. Orme - draft.
- Bionumbers - searchable website: <https://bionumbers.hms.harvard.edu/search.aspx>

Access via UIUC VPN or library:

- Baron Peters, Reaction rate theory and rate events, 2017, UIUC Access (VPN): <https://www.sciencedirect.com/book/9780444563491/reaction-rate-theory-and-rare-events-simulations>
- Clayden, Organic chemistry, 2012 Chapters 3, 13, 18. UIUC Access (VPN): <https://ebookcentral.proquest.com/lib/uiuc/detail.action?docID=1591368>
- Mouritsen & Bagatolli, Life as a matter of fat: lipids in a membrane biophysics perspective, 2016. UIUC Access (VPN): <https://link.springer.com.proxy2.library.illinois.edu/book/10.1007%2F978-3-319-22614-9>
- M. Scott Shell, Thermodynamics and statistical mechanics: an integrated approach, 2016. UIUC Access (VPN): https://i-share-uui.primo.exlibrisgroup.com/permalink/01CARLI_UIU/q1ojeg/alma99803975812205899

Not freely available and are not required to buy:

- Dill and Bromberg, Molecular driving forces, 2003, 2010
- Phillips, Kondev, Theriot, Garcia, Physical biology of the cell, 2nd Edition, 2013
- Kuriyan, Konforti, Wemmer, The molecules of life, 2013

Course Website

Course Website: <https://learn.illinois.edu/course/view.php?id=60969>

(Login with NetID and password)

Grading Information and Breakdown

Grading will use the usual scale, with + and - grades, e.g., A+, A, A-, B+, etc.

Six Problem Sets (Total: 25%)

- Problem set answers due on Wednesday or as indicated in class.
- NO LATE homework without valid excuse.

Three Exams (25% each)

- Two in-class midterms
- One final exam

Tentative Course Calendar

Date	Day	Topics	Homework Due
8/23/21	Monday	Lecture 1: What is biophysics?	
8/25/21	Wednesday	Lecture 2: Introduction to thermodynamics	
8/27/21	Friday	Discussion	
8/30/21	Monday	Lecture 3: Entropy	
9/1/21	Wednesday	Lecture 4: Enthalpy	
9/3/21	Friday	Discussion	
9/6/21	Monday	No class (Labor Day)	
9/8/21	Wednesday	Lecture 5: Boltzmann distribution	HW1
9/10/21	Friday	Discussion	
9/13/21	Monday	Lecture 6: Free Energy	
9/15/21	Wednesday	Lecture 7: Biochemical reaction	
9/17/21	Friday	Discussion	
9/20/21	Monday	Lecture 8: Stability of biomolecules	
9/22/21	Wednesday	Lecture 9: Lipids	HW2
9/24/21	Friday	Discussion	
9/27/21	Monday	Exam 1 (covering lectures 1-9)	
9/29/21	Wednesday	Lecture 10: Proteins I	
10/1/21	Friday	Discussion	
10/4/21	Monday	Lecture 11: Proteins II	
10/6/21	Wednesday	Lecture 12: Proteins III	
10/8/21	Friday	Discussion	
10/11/21	Monday	Lecture 13: Proteins IV	
10/13/21	Wednesday	Lecture 14: Electrostatics1	HW3
10/15/21	Friday	Discussion	
10/18/21	Monday	Lecture 15: Electrostatics2-Phase	
10/20/21	Wednesday	Lecture 16: Osmolarity	
10/22/21	Friday	Discussion	
10/25/21	Monday	Lecture 17: DNA/RNA I	
10/27/21	Wednesday	Lecture 18: DNA/RNA II	HW4
10/29/21	Friday	Discussion	
11/1/21	Monday	Exam 2 (covering lectures 10-18)	
11/3/21	Wednesday	Lecture 19: Diffusion	
11/5/21	Friday	Discussion	
11/8/21	Monday	Lecture 20: Binding Kinetics I	
11/10/21	Wednesday	Lecture 21: Binding Kinetics II	
11/12/21	Friday	Discussion	
11/15/21	Monday	Lecture 22: Binding Kinetics III	
11/17/21	Wednesday	Lecture 23: Allostery	HW5
11/19/21	Friday	Discussion	
11/22/21	Monday	TBD	
11/24/21	Wednesday	TBD	
11/26/21	Friday	No Discussion (Thanksgiving)	
11/29/21	Monday	Lecture 24: Enzyme Kinetics	
12/1/21	Wednesday	Lecture 25: Protein Folding Kinetics	
12/3/21	Friday	Discussion	
12/6/21	Monday	Lecture 26: Protein Fitness Landscape	
12/8/21	Wednesday	TBD	HW6

Course Policies

For non-academic campus assistance and support:

- See Office of Diversity, Equity and Access (ODEA) information at the end of this document.

Student Advocacy Resources:

- For student-centered advocacy programs and services visit:
<https://mcb.illinois.edu/undergrad/advising/resources>.

Contacting MCB Course Personnel:

- MCB course personnel are more than happy to assist students.
- Emails to instructors, TAs, or course coordinators will only be answered if they come from an @illinois.edu account. We will only use this account in order to protect your educational information and profile. As a student, please remember that when you email a staff member, it is important to include all pertinent information so that we can assist you in the most efficient and effective manner possible. This information includes:
 - The course rubric in the subject line
 - Your full first and last name
 - Your NetID (the first part of your illinois.edu email account)
 - Your UIN (9 digit number that can be found on your ICard)
 - The course that you are concerned about (the course personnel often work with multiple courses)
 - Your section letter/number
 - The previous email "thread" or previous communicated information pertinent to the situation
- Your cooperation will help us respond much more quickly to your concerns.

Religious Observances and Practices:

- Students are required to submit the Request for Accommodation for Religious Observances Form (which can be found at <https://odos.illinois.edu/community-of-care/resources/students/religious-observances/>) 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/>.

DRES Accommodations:

- We are committed to providing a learning environment where our students can succeed. If you require special accommodations, please contact us 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.
- If a student believes that they need DRES accommodations, they should contact DRES at disability@illinois.edu.

Class Absences:

- Regular class attendance is expected of all students at the University. (http://odos.illinois.edu/studentAssistance/absence/revised_code.asp)
- If you are going to miss a class, please email me and let me know the reason.
- Attendance will be taken at random times.
- Attendance and participation will be of importance in assessment of borderline grades.

Exam Absences:

- If you must miss an exam due to unforeseen circumstances, you are required to contact your instructor or course coordinator within 24 hours of the absence. You will then have 48 hours from the absence in which to submit documentation to your instructor or course coordinator. You must also submit an online Absence Form if one is available on your course website. Course personnel will evaluate documentation and decide whether or not there will be an option to compensate for the missed exam through either a make-up exam or proration. Failure to follow this procedure will result in a zero for the exam.
- If you find yourself ill, you must submit confirmation of a visit with a medical practitioner within 24 hours of your absence. The confirmation cannot be provided by a relative, even if the relative is a practitioner.
- If you must miss an exam for a conference or job, graduate or professional school interviews, the exam may be prorated. A best effort should be made to schedule these events around exams. You will need to be mindful that only one exam may be prorated in a semester for any and all absences. All will require documentation.
- There will be instances when the student must make an individual choice about their ability to perform on an exam and will need to accept any and all consequences for that choice.
- If the absence is a result of a protracted illness of 3 days or more, you should follow the procedure for obtaining a letter from the Office of the Dean of Students. The request may be made once the student returns to class but not more than 10 business days after the last date of absence.

Exam Conflicts:

- If you have a regularly scheduled University course that conflicts with the exam, you should complete the online Conflict Exam Request Form on the course website. This request must be made by 5:00 pm not less than 3 business days prior to the exam. Requests made after 5:00 pm and less than 3 business days prior to the exam will not be granted. See course policies for a specific deadline for your course.
- Work schedules should be adjusted, if at all possible, in order to eliminate a conflict with scheduled exams. Please plan accordingly at the beginning of the semester. If eliminating a conflict is not possible, the student should complete the online Conflict Exam Request Form on the course website. This request must be made by 5:00 pm not less than 3 business days prior to the exam. Requests made after 5:00 pm and less than 3 business days prior to the exam will not be granted.
- Students that are formally participating in officially recognized groups, such as athletic teams and performing groups, with a conflict should request a conflict exam by 5:00 pm not less than 3 days prior to the exam via the online Conflict Request Form. Formal participation does not include general meetings of RSOs or any other recognized groups. Documentation of the event will be required prior to scheduling

the conflict exam. Requests made after 5:00 pm and less than 3 business days prior to the exam will not be granted.

- Students with DRES accommodations should also submit the online Conflict Request Form by 5:00 pm no later than 3 business days prior to the exam. Requests made after 5:00 pm and less than 3 business days prior to the exam will not be granted.

Final Exam Absence:

- If you must miss a final exam due to unforeseen circumstances, you are required to contact your instructor or course coordinator within 24 hours of the absence. You must also contact the Dean of your college. Finally, you must submit an online Absence Form if one is available on your course website. You will receive an ABS (absent) in the course if you miss the final exam. This ABS will result in an F in the course unless action is taken. The Dean can approve the change of the ABS to an Incomplete, which then allows a limited window of time for you to complete the final exam and earn a grade in the course.
- There will be instances when the student must make an individual choice about their ability to perform on an exam and will need to accept any and all consequences for that choice.
- If the absence is a result of a protracted illness, you should follow the procedure for obtaining a letter from the Office of the Dean of Students. The request may be made once the student recovers but not more than 10 business days after the date of absence.
- Information about final exams can be found in the Student Code: <http://studentcode.illinois.edu/>.

Final Exam Conflict:

- Conflict final exams may only be granted for any one of the following situations:
 - Students with three final exams scheduled within a 24 hour period as defined in Section 82.A.4). Final Examinations of the *Code of Policies and Regulations Applying to All Students* which can be found at: www.illinois.edu/admin/manual/code/
 - Students who have two final exams scheduled at the same time. Final conflict exam requests should be made to the course with larger enrollment. Course personnel can assist with information to determine which course this would be.
 - 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.
 - Students who have DRES academic accommodations.
- Students that find themselves in any of the above situations should complete the online Conflict Final Exam Request Form which can be found on the course website. This request must be made by 5:00 pm on the last day of class in order for the request to be granted. Any requests made after this time may not be granted. If a conflict final exam is granted, it may be scheduled at any time during the final examination period and is at the discretion of the instructor or course coordinator.

Academic Integrity:

- The Code of Policies and Regulations Applying to All Students will be applied in all instances of academic misconduct committed by students. This applies to all exams, presentations, assignments and materials distributed or used in this course. You can review these policies at the following website:

<http://admin.illinois.edu/policy/code/index.html> and specifically here:
<http://studentcode.illinois.edu/article1/part4/1-401/>

- Science cannot exist without honesty. The faculty and staff in MCB require students, as scientists-in-the-making, to hold the highest standards of scientific and academic conduct. Any form of cheating on any graded work in courses is unacceptable.
- On exams, the answers that you turn in for grading must be your own, formulated during the exam from your own understanding of the material and without any supporting information, be it written, verbal or electronic. Copying the work of another student, or allowing another to copy your work, or copying work from any other source, is unacceptable. Since we cannot always monitor you as you complete your work, we must rely upon appearance of your work from which to judge. If the work you submit resembles that of another student or another source too closely, we may conclude that it was not your original work. Always make a conscious effort to complete your work on your own and to protect it from the view of others, in order to ensure that it will be seen as your own. Failure to adhere to these standards for any portion of an exam may result in a grade of zero for the entire exam or quiz for all persons involved.
- Texting, or the use of a cell phone or any other device for any purpose, during an exam is prohibited. Doing so may earn you a zero or a more extreme penalty on the quiz or exam at the discretion of the instructor.
- Use of any social or electronic media to share information, request information or make confidential information public is prohibited. Any use of this type may earn you a zero on the exam or a more extreme penalty at the discretion of the instructor.
- On written or electronic assignments, the answers that you turn in for grading must be written in your own words, formulated from your own understanding of the material. While you may be working with other students in the course, you must formulate and submit your own answers. Copying or paraphrasing the work of another student, or allowing another to copy or paraphrase your work, is unacceptable. Since we cannot monitor you as you complete your work, we have only the appearance of your work from which to judge. If the work you submit resembles that of another student too closely, we may conclude that it was not your original work. Always make a conscious effort to complete your work on your own and to protect it from the view of others, in order to ensure that it will be seen as your own. You must also make a conscious effort to protect your passwords and accounts. Failure to adhere to these standards may result in a grade of zero for the entire assignment for all persons involved.

Electronic Media/Device Use:

- Use of any social or electronic media to share course information, request course information or make confidential course information public is prohibited. Any use of this type may earn you a zero on an assignment or exam or a more extreme penalty at the discretion of the instructor.
- Any violation of the social media policy **on your account** may result in a zero on an assignment or exam or a more extreme penalty at the discretion of the instructor.
- Any social media sites created in relation to MCB courses must grant access to course personnel upon request. Failure to provide access will result in a failing grade in the course for the group/site's administrator(s).
- No electronic devices, including smart watches, are allowed at exams.

Course Material:

- Students are welcome and encouraged to make audio recordings of course lectures.

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- The material recorded is intellectual and copyrighted property of the University of Illinois Board of Trustees and may be made for personal use only.
 - Video recordings of any kind are strictly prohibited.
 - Posting of audio recordings or transcriptions on social or electronic media platforms is strictly prohibited.
 - Posting or redistributing of course material in any format is strictly prohibited.

University Information of Student Safety - Active Threats:

- 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 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 manual fire alarm to prompt a response for others to evacuate.
 - Take critical personal items only (keys, purse, 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 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 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 to 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.

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- Active Threat: If you cannot run away safely or hide, be prepared to fight with anything available to increase your odds for survival.

Student Resources/Where to go for Help:

We Care at Illinois

- For sexual misconduct support, response and prevention visit:
<https://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: <https://diversity.illinois.edu/>
 - Discrimination & Harassment Prevention
 - Title IX
 - Accessibility & Accommodations
 - Inclusive Illinois