



School of Molecular and Cellular Biology

MCB 493 CPP, Spring 2025

Cancer Pathophysiology, 3 Credit Hours

Instructor

Prof. Eric Bolton, Ph.D.

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Class Meeting Schedule

MCB 493 CPP lectures begin on Wednesday, January 22, 2025. The class meets every Monday, Wednesday, and Friday from 2:00-2:50 PM in room 2200 of the Sidney Lu Mechanical Engineering Building (2200 LUMEB), except on University-designated holidays. See the **MCB 493 CPP Lecture and Assessment Schedule** for additional information.

Course Description and Goals

Abnormalities that occur at the molecular and cellular level manifest as pathologies affecting the onset and progression of various forms of cancer. This course focuses on the pathophysiology of common human cancers and the genetic and environmental factors that influence malignant invasion and metastasis. The involvement of these biological factors in cancer development, diagnosis, prevention, and management will be examined throughout the course integrating basic science and clinical aspects central to oncology.

There is simply no way that we can discuss every form of cancer in one course. Thus, our intention is not to make this course all-encompassing; rather, we will try to present the material in a conceptual framework, providing a survey of the topic for breadth and specific examples to add depth. With this in mind, we have two main goals for the course:

1. Students learn fundamental concepts related to cancer pathophysiology onset and progression. Although it is important for students to have a good working knowledge of specific forms of cancer, it is even more important for students to understand the general principles related to cancer onset, progression, and management.
2. Students synthesize and apply information from a variety of disciplines (*e.g.*, biochemistry, molecular biology, cell biology, genetics, physiology, pathology, endocrinology, virology, immunology, etc.) to better understand the mechanisms of malignancy onset, progression, and management. Learning to synthesize material from multiple disciplines is central to oncology and the intellectual process.

Course Prerequisite

For undergraduates, MCB 252 (Cells, Tissues, and Development) and MCB 354 (Biochemistry and the Physical Basis of Life) or MCB 450 (Introductory Biochemistry) or instructor consent.

Student Learning Outcomes

At the end of the course, through lectures and case studies, discussions, and assessments, students will be able to:

1. Demonstrate an understanding of essential concepts of cancer onset and progression;
2. Describe how these essential concepts relate to the pathogenesis and management of common and important human cancers;
3. Demonstrate an understanding of the predisposing factors, causes, and pathophysiology and potential complications of such malignancies;
4. Correlate clinical features with pathologic signaling mechanisms of such malignancies;
5. Recognize and describe how knowledge of basic science and oncology can be used in the investigation, prevention, and management of various forms of cancer;
6. Synthesize and apply biological information from a variety of sources and disciplines.

Course Website

You will be able to download relevant course information and lecture slides from the MCB 493 CPP course website, which is hosted on the campus Canvas LMS server (Canvas@Illinois, <https://canvas.illinois.edu/>). If you are registered for MCB 493 CPP, you can log into the campus Canvas server using your campus NetID and password and access MCB 493 CPP course content.

Course Materials

The following items are required or recommended for MCB 493 CPP.

Recommended Lecture Slides

Download the lecture slides from the MCB 493 CPP course website and use them as you take notes during lecture. Address: <https://canvas.illinois.edu/>.

Recommended Textbooks

Niederhuber J. E., et al. (2020) Abeloff's Clinical Oncology. 6th ed. Elsevier. ISBN = 978-0323476744.

Lee R. J., et al. (2018) Case Studies in Cancer. 1st ed. W. W. Norton & Company. ISBN = 978-0393679519.

Rent or buy new/used copies of the textbooks from Amazon.com. Also, the UIUC Library has a licensed subscription to Science Direct, so you can freely access and download pdf copies of Abeloff's Clinical Oncology while logged into the campus network. Address: <https://www-sciencedirect-com.proxy2.library.illinois.edu/book/9780323476744/abeloffs-clinical-oncology>.

Other textbooks that you may want to consult for background information

Coleman W. B. and Tsongalis G. J. (2018) Molecular Pathology: The Molecular Basis of Human Disease. 2nd ed. Academic Press. ISBN = 978-0128027615.

Weinberg R. A. (2013) The Biology of Cancer, 2nd ed. W. W. Norton and Company. ISBN = 978-0815342199.

Course Grades

Student grades in MCB 493 CPP are based on a total of 500 points. There will be four 50-minute exams, each worth 125 points. Assessment scores will be posted in the MCB 493 CPP gradebook on the course website (Canvas@Illinois, <https://canvas.illinois.edu/>). Students are responsible for checking their scores in Canvas after each assessment and reporting any concerns to Prof. Bolton within 7 days of scores being posted.

4 Exams (125 points/exam) = 500 total points

The point totals contained in the following table represent the use of the plus/minus grading system coupled with a 4.0 grade point system, which has been assigned by the University for each letter grade. The grade you earn in the course will be based on the points that you earn. Effort is reflected in points earned. We will adhere to the MCB 493 CPP Standard Grade Scale when assigning grades to avoid capriciousness and to instill fairness and equity for all students.

MCB 493 CPP Standard Grade Scale

Letter Grade	Point Ranges	Grade Point Value
A+	500-460	4.000
A	459-442	4.000
A-	441-425	3.667
B+	424-409	3.333
B	408-392	3.000
B-	391-375	2.667
C+	374-359	2.333
C	358-342	2.000
C-	341-325	1.667
D+	324-309	1.333
D	308-292	1.000
D-	291-275	0.667
F	274-0	0.000

MCB 493 CPP Lecture and Assessment Schedule, 2025

Date	Day	Lecture Number and Topic
PART 1: Essential Concepts of Biology and Cancer		
Jan 22	Wed	Introduction to MCB 493 CPP; 1. Overview and Hallmarks of Cancer
Jan 24	Fri	1. Overview and Hallmarks of Cancer
Jan 27	Mon	2. Control of the Cell Cycle
Jan 29	Wed	2. Control of the Cell Cycle; 3. Pathophysiology of Cancer Cell Death
Jan 31	Fri	3. Pathophysiology of Cancer Cell Death
PART 2: Genesis of Cancer		
Feb 3	Mon	4. Environmental Factors
Feb 5	Wed	5. DNA Damage Response Pathways and Cancer
Feb 7	Fri	5. DNA Damage Response Pathways and Cancer; 6. Viruses and Human Cancer; Case study 12-1: cervical cancer and HPV
Feb 10	Mon	6. Viruses and Human Cancer; Case study 12-1: cervical cancer and HPV
Feb 12	Wed	Review
Feb 14	Fri	EXAM 1 (Lectures 1-6 and associated case study)
Feb 17	Mon	No lecture; Read the Cancer Genetics Overview PDQ
Feb 19	Wed	7. Genetic Factors: Hereditary Cancer Predisposition Syndromes
Feb 21	Fri	7. Genetic Factors: Hereditary Cancer Predisposition Syndromes; 8. Genetic and Epigenetic Alterations in Cancer; Case study 8-1: myelodysplastic syndromes and epigenetic therapy
Feb 24	Mon	8. Genetic and Epigenetic Alterations in Cancer; Case study 8-1: myelodysplastic syndromes and epigenetic therapy
PART 3: Advanced Concepts of Biology and Cancer		
Feb 26	Wed	8. Genetic and Epigenetic Alterations in Cancer; Case study 8-1: myelodysplastic syndromes and epigenetic therapy; 9. Intracellular Signaling; Case study: 4-4 metastatic melanoma and protein kinase inhibitors (PKIs)
Feb 28	Fri	9. Intracellular Signaling; Case study: 4-4 metastatic melanoma and protein kinase inhibitors (PKIs)
Mar 3	Mon	9. Intracellular Signaling; Case study: 4-4 metastatic melanoma and protein kinase inhibitors (PKIs); 10. Cancer Metabolism
Mar 5	Wed	10. Cancer Metabolism
Mar 7	Fri	11. Stem Cells and Cancer Stem Cells
Mar 10	Mon	11. Stem Cells and Cancer Stem Cells
Mar 12	Wed	Review
Mar 14	Fri	EXAM 2 (Lectures 7-11 and associated case studies)
Mar 15-23		Spring Break

Mar 24	Mon	12. Cancer Immunology
Mar 26	Wed	12. Cancer Immunology
Mar 28	Fri	13. Tumor Microenvironment and Metastases
Mar 31	Mon	13. Tumor Microenvironment and Metastases
Apr 2	Wed	13. Tumor Microenvironment and Metastases
PART 4: Clinical Features and Treatment of Cancer		
Apr 4	Fri	13. Tumor Microenvironment and Metastases 14. Cancer Biomarkers and Detection
Apr 7	Mon	14. Cancer Biomarkers and Detection 15. Cancer Treatment and Pharmacology; Case study 12-3: metastatic melanoma and immune checkpoint inhibitors
Apr 9	Wed	15. Cancer Treatment and Pharmacology; Case study 12-3: metastatic melanoma and immune checkpoint inhibitors
Apr 11	Fri	Review
Apr 14	Mon	EXAM 3 (Lectures 12-15 and associated case studies)
Apr 16	Wed	16. Lung Cancer; Case study 4-3: lung adenocarcinoma and PKIs
Apr 18	Fri	16. Lung Cancer; Case study 4-3: lung adenocarcinoma and PKIs 17. Breast Cancer; Case studies: 6-1 breast cancer and hormone therapy, 11-3 breast cancer and monoclonal antibodies
Apr 21	Mon	17. Breast Cancer; Case studies: 6-1 breast cancer and hormone therapy, 11-3 breast cancer and monoclonal antibodies
Apr 23	Wed	18. Prostate Cancer; Case study 6-2: prostate cancer and hormone therapy
Apr 25	Fri	18. Prostate Cancer; Case study 6-2: prostate cancer and hormone therapy 19. Colorectal Cancer; Case study 10-1: colorectal cancer and TME therapy
Apr 28	Mon	19. Colorectal Cancer; Case study 10-1: colorectal cancer and TME therapy
Apr 30	Wed	19. Colorectal Cancer; Case study 10-1: colorectal cancer and TME therapy 20. Myeloid and Lymphoid Cancers; Case studies: 4-1 chronic myelogenous leukemia and PKI, 4-2 chronic lymphocytic leukemia and PKI, 5-2 follicular lymphoma, 11-1 non-Hodgkin lymphoma and monoclonal antibodies, 11-2 Hodgkin lymphoma and monoclonal antibodies, 12-2 acute lymphoblastic leukemia and CAR T-cell therapy
May 2	Fri	20. Myeloid and Lymphoid Cancers; Case studies: 4-1 chronic myelogenous leukemia and PKI, 4-2 chronic lymphocytic leukemia and PKI, 5-2 follicular lymphoma, 11-1 non-Hodgkin lymphoma and monoclonal antibodies, 11-2 Hodgkin lymphoma and monoclonal antibodies, 12-2 acute lymphoblastic leukemia and CAR T-cell therapy
May 5	Mon	Review
May 7	Wed	EXAM 4 (Lectures 16-20 and associated case studies)

The lectures are divided into 4 parts according to distinct topics in cancer:

PART 1: Essential Concepts of Biology and Cancer (3 lectures)

PART 2: Genesis of Cancer (5 lectures and 2 case studies)

PART 3: Advanced Concepts of Biology and Cancer (5 lectures and 1 case study)

PART 4: Clinical Features and Treatment of Cancer (7 lectures and up to 12 case studies)

Students are expected to have read the Student Code, <https://studentcode.illinois.edu/>, and to act accordingly. Course faculty and staff are in charge of the orderly conduct of class meetings and may exclude a student who does not comply with a reasonable request. Course faculty and staff are not responsible for any student's personal belongings. In addition, regular class attendance is expected of all students at the University, <https://studentcode.illinois.edu/article1/part5/1-501/>. Attendance at every lecture (if possible) is crucial, as some lecture material is not described in the suggested readings that are listed in the lectures. For lecture attendance and absence policies, see **Attendance Policy and Absences**.

Assessment Information

There will be four 50-minute exams during regular class time (2:00-2:50 PM in 2200 LUMEB), each worth 125 points. The dates of the exams are listed below. Participation in all exams is crucial for completing the course.

Friday, February 14, 2:00-2:50 PM	Exam 1
Friday, March 14, 2:00-2:50 PM	Exam 2
Monday, April 14, 2:00-2:50 PM	Exam 3
Wednesday, May 7, 2:00-2:50 PM	Exam 4

The exams will cover material from the lectures and associated case studies and will be in the form of multiple-choice questions. The instructor may provide students with information regarding the content of a specific exam during a review session prior to an exam. Review sessions prior to the exams may be shortened or canceled to compensate for unforeseen circumstances (e.g., school closure, additional class time needed for lecture completion, etc.).

The exams in MCB 493 CPP are *not* “open note” or “open book” assessments, so put all notes and books away before you receive an exam in class. In addition, "cheat sheets", cell phones, headphones, ear buds, calculators, and non-essential electronic devices are prohibited. Also, each student must complete their own exam, and working together or communicating with others during an exam is *prohibited*. Visit the MCB 493 CPP course site for additional announcements concerning each assessment. For assessment attendance and absence policies, see **Attendance Policy and Absences**.

Adding the Course after the Semester Starts

We understand that the University has an add deadline 10 days into the semester. However, the University lets individual courses and/or programs determine their policies for late adds. We feel that students who choose to add a course late do so at their own discretion with knowledge that there may be points lost in the process.

Student Workload

Students are expected to commit approximately 6 hours each week to complete the instructional activities of the course, including synchronous engagements with the instructor, suggested readings, and assessment preparation.

Religious Observances and Practices

Students must request accommodations for religious observances from Prof. Bolton. This should be done early in the semester using the optional resource form on the Office of the Dean of Students website (<https://odos.illinois.edu/resources/students/religious-observances>). Information on accommodations is explained in the Student Code: <https://studentcode.illinois.edu/index.html>.

Disability Accommodations

To obtain disability-related academic adjustments and/or auxiliary aids, students must contact the course 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 (V/TTY), or e-mail a message to disability@illinois.edu. Please note that accommodations are not retroactive to the beginning of the semester; they begin the day you contact Prof. Bolton with a current letter of accommodation from DRES.

Attendance Policy and Absences

Regular class attendance is expected of all students at the University, <https://studentcode.illinois.edu/article1/part5/1-501/>. Attendance at every lecture (if possible) is crucial, as some lecture material is not described in the suggested readings that are listed in the lectures. Importantly, participation in all assessments is crucial for completing the course.

1. If you experience an *illness* that causes you to miss an assessment, you must submit confirmation of a visit with a medical practitioner within 24 hours of your absence. The confirmation cannot come from a relative, even if the relative is a medical practitioner.
2. The Student Assistance Center in the Office of the Dean of Students may provide informative letters to instructors due to a protracted illness of 3 or more days, certain emergencies, and the serious illness of immediate family members (parents, legal guardian, spouse/partner, siblings, children, or grandparents). These letters do not excuse you from class but merely provide information for the instructor to consider with regard to excusing the absence and permitting make-up work. Students must request an absence letter from the Office of the Dean of Students after the student has returned to class but not more than 10 business days after the last date of absence. The Office of the Dean of Students is located in the Turner Student Services Building, 610 E. John Street, Champaign, 217-333-0050, <http://odos.illinois.edu/>. Instructions for absence letter requests can be found on the Office of the Dean of Students website, <https://odos.illinois.edu/resources/students/absence-letters>.
3. Students with *foreseeable schedule conflicts* must provide written notification to Prof. Bolton at least 7 days before the assessment. A conflict exam may be given to students who find themselves in one of the following situations with documentation:
 - A regularly scheduled course for credit at the University that takes place during the scheduled assessment time
 - Scheduled activities of officially recognized groups such as athletic teams, performance groups, and the Urbana-Champaign Senate
 - Employment (if possible schedule your work shift around assessments)

- Religious observances that were documented with Prof. Bolton using the optional resource form on the Office of the Dean of Students website (<https://odos.illinois.edu/resources/students/religious-observances>)
 - Travel associated with a job, secondary school interviews (if possible schedule interviews around assessments), or scientific conferences (not general meetings)
 - Significant and compelling circumstances beyond a student's control, including medical treatment related to illness or injury; pregnancy; legal matters; serious illness, injury or death of a family member; citizenship or naturalization processes; or acts of nature which cause destruction to a primary residence or disrupt air travel.
 - Absences that will *not* be excused include family reunions, weddings, or serious illness of extended family member (aunt, uncle, niece, nephew, or cousin).
4. If you miss an exam due to serious *unforeseen circumstances*, you are required to contact Prof. Bolton within 24 hours of the absence. You will have 48 hours from the absence to submit documentation to Prof. Bolton. Your instructor will evaluate the documentation and decide if a conflict or prorated assessment is an option. Failure to follow this procedure will result in a *score of zero for the missed assessment*.
 5. **Whether it is an *illness*, a *foreseeable conflict*, or an *unforeseen emergency* that prevents you from taking a scheduled assessment, an explanation and supporting documentation of the illness/conflict *must* be submitted to Prof. Bolton by e-mail.** You must make these arrangements for each assessment, and your request for a conflict will not be carried forward to subsequent assessments. Conflict (i.e., makeup) or prorated assessments will only be given to students who have a well-documented reason approved by Prof. Bolton. Importantly, **only *one exam* may be prorated in a semester for any and all absences**. There may be instances when students 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.

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 assessments, presentations, and materials distributed or used in this course. Review these policies at the following websites:

<https://studentcode.illinois.edu/index.html>; <https://studentcode.illinois.edu/article1/part4/1-401/>.

The following policies support and reinforce these policies.

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. We require that all graded work be entirely your own, and that anything you write using the words of other writers be correctly attributed. Some specific points follow:

On exams and quizzes, the answers that your turn in for grading must be your own, formulated *during* the assessment 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, to ensure that it will be seen as your own. Failure to adhere to these standards, for any portion of an exam/quiz, may result in a grade of *zero for the entire exam/quiz, for all persons involved*. Use of a cell phone for any purpose during an exam/quiz, is prohibited. Use of any social or electronic media to share information, request information or make confidential information public is prohibited. Failure to adhere to these standards, for any portion of an exam/quiz, may result in a grade of *zero for the entire exam/quiz, for all persons involved*, or a more extreme penalty at the discretion of the instructor.

On 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*.

On assignments, if you use a statement taken directly from any book or other publication, including the course textbook, you must provide a citation. That is, you must put the text in quotes and put the author of the publication in parentheses after the quotation. Failure to do so will result in zero credit for that answer. Further, using only the words of another author as your entire answer or as the majority of your answer to any question is never sufficient to earn credit. If the majority of your work has been taken directly from a publication, you are likely to receive no credit for the work, since you would not be demonstrating knowledge beyond the ability to copy. Even if you quote another, your answer must be substantially your own words, drawn from your own understanding of the material. Failure to adhere to these standards may result in *zero credit for the entire assignment*.

Course Material

Students are encouraged to make audio recordings of course lectures and case studies. However, the recorded material is the intellectual and copyrighted property of the instructor and the University of Illinois 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 prohibited. Posting or redistributing of course material in any format is prohibited.

Emergency Response Recommendations (<https://police.illinois.edu/em/planning/emergency-response-guide/>)

The Department of Homeland Security and the University of Illinois at Urbana-Champaign Office of Campus Emergency Planning recommend the following three responses to an 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 > Hide > Fight

Emergencies can happen anywhere and at any time. It is important that we take a minute to prepare for a situation in which our safety or even our lives could depend on our ability to react quickly. When we're faced with almost any kind of emergency – like severe weather or if someone is trying to hurt you – we have three options: Run, hide or fight.



Run

Leaving the area quickly is the best option if it is safe to do so.

- ▶ Take time now to learn the different ways to leave your building.
- ▶ Leave personal items behind.
- ▶ Assist those who need help, but consider whether doing so puts yourself at risk.
- ▶ Alert authorities of the emergency when it is safe to do so.



Hide

When you can't or don't want to run, take shelter indoors.

- ▶ Take time now to learn different ways to seek shelter in your building.
- ▶ If severe weather is imminent, go to the nearest indoor storm refuge area.
- ▶ If someone is trying to hurt you and you can't evacuate, get to a place where you can't be seen, lock or barricade your area if possible, silence your phone, don't make any noise and don't come out until you receive an Illini-Alert indicating it is safe to do so.



Fight

As a last resort, you may need to fight to increase your chances of survival.

- ▶ Think about what kind of common items are in your area which you can use to defend yourself.
- ▶ Team up with others to fight if the situation allows.
- ▶ Mentally prepare yourself – you may be in a fight for your life.

Please be aware of people with disabilities who may need additional assistance in emergency situations.

Other resources

- ▶ police.illinois.edu/safe for more information on how to prepare for emergencies, including how to run, hide or fight and building floor plans that can show you safe areas.
- ▶ emergency.illinois.edu to sign up for Illini-Alert text messages.
- ▶ **Follow the University of Illinois Police Department** on Twitter and Facebook to get regular updates about campus safety.