PCB 3109 – Cancer Biology

Contact Information

Instructor: David Oppenheimer, PhD

Phone Number: 352-273-0121

Office Hours: By appointment, via Zoom. Please send an email through Canvas to schedule an appointment.

Zoom link: https://ufl.zoom.us/j/6487840092?pwd=U0h2N0xYT0RqdjJ6U3F6YStHblZiQT09
Meeting ID: 648 784 0092
Passcode: 563289

Teaching Assistant: Basu Shambadeb
Department of Biology
E-mail: s.basu@ufl.edu
Zoom:
https://ufl.zoom.us/j/95610206074?pwd=WWo5c09xdUR3Um1TdlBlbWNCUUljdz09
Meeting ID: 956 1020 6074
Passcode: 255229

Course Information

Credits: 3

In this course, we will introduce the dysregulation of cellular processes in cancer cells including the mechanisms of action of anti-cancer drugs. By the end of this course, you will be able to explain the concepts and theories of cancer biology, as well as understand the basic methods used by cancer researchers. You will apply knowledge of basic cellular principles to solve problems in cell and cancer biology throughout the course.

Expectations

Each student is solely responsible for reading and following the instructions, guidelines, and schedules in this syllabus and on the course webpage, or announced in class. Not having read the information in this syllabus or in instructor announcements will not constitute an excuse for missing an assignment, exam, or other assessment. Please set your preferences in Canvas so that you receive timely notifications of course announcements and other information.

Course Objectives

By the end of this course, you will be able to:

- explain how mutations cause cancer.
- draw the structures of the major cellular macromolecules.
- identify the forces and bonds responsible for the four levels of protein structure.
- infer how mutations affect protein structure and function.
- explain how lipids act as signaling molecules.
- model a cellular membrane.
- illustrate the flow of lipid and protein through the endomembrane system.
- predict changes to membrane structure in cancer cells.
- explain how protein levels are controlled by the ubiquitin-proteosome system.
- illustrate the stages of the cell cycle and the locations of checkpoints.
- understand the relationship between loss of checkpoint control and cancer.
- predict the progression through the cell cycle of checkpoint-defective cells.
- compare and contrast oncogenes and tumor suppressor genes.
- compare the components of the major signaling pathways.
- predict the outcome of inappropriate activation of signaling pathways.
- define the role of the cytoskeleton in cancer development.
- outline the elements of the extracellular matrix and explain their role in tumor growth.
- summarize how metabolism in cancer cells is altered.
- elaborate on how altered cancer cell metabolism can be used for diagnosis.
- explain how cancer cells avoid apoptosis.
- design a strategy for cancer drug discovery using synthetic lethality.
- analyze protein structure in PyMOL.
- distinguish between a lead-driven and target-driven drug discovery approach.
- design an *in silico* anticancer drug screen.
- evaluate the results of a ligand-protein docking experiment.

Course Requirements

Required textbook

Becker's World of the Cell 9th Edition by Jeff Hardin, Gregory Paul Bertoni, and Lewis J. Kleinsmith. Pearson (Publisher)

You need to purchase Mastering Biology through UF All Access. With UF All Access you get access to Mastering Biology (homework and some activities), and an e-book version of the textbook. You are not required to purchase a physical copy of the textbook for this course.

For directions on how to purchase through UF All Access and access your textbook, read Registering for and Accessing MyLab and Mastering Biology.

Prerequisites

A grade of "C" or better in Integrated Principles of Biology I and II (BSC 2010, 2010L, 2011, 2011L).

In this course, we build upon the introduction to cell biology, biochemistry, and genetics that you received in BSC 2010, with a focus on structure-function relationships. Please review the material presented in BSC 2010, if a topic is unfamiliar to you.

Minimum technology requirements

The University of Florida expects students entering an online program to acquire computer hardware and software appropriate to his or her degree program. Most computers are capable of meeting the following general requirements. A student's computer configuration should include:

- Webcam
- Microphone
- Broadband connection to the Internet and related equipment (Cable/DSL modem)
- Microsoft Office Suite installed (provided by the university)

Individual colleges may have additional requirements or recommendations, which students should review prior to the start of their program.

You will be required to use PyMOL, a premier molecular visualization software package that allows you to view and manipulate protein structures. Static, 2D images of protein structures in textbooks are useful representations, but manipulation of 3D structures greatly facilitates the learning process, and provides a deeper understanding of how the atoms and functional groups interact with each other. Like most software, learning how to use PyMOL to do routine tasks takes time, and the PyMOL assignments are designed to help students achieve proficiency in these routine tasks in the shortest time possible.

PyMOL is available for student in this class through UF Apps (https://apps.ufl.edu/Citrix/UFAppsWeb/). Visit the UF Apps information page (https://info.apps.ufl.edu/) to get started. Submissions for PyMOL assignments must be made in either .pse or .png formats.

Visit the following pages for getting started with PyMOL:

1. PyMOL for Beginners - video 1: orientation (youtube.com/watch?v=wiKyOF-pGw4)
2. PyMOL for Beginners - video 2: labels (youtube.com/watch?v=nFY3EjBNPBQ)
3. PyMOL for Beginners - video 3: measurements (youtube.com/watch?v=lB-0WsZt8M8)
4. PyMOL for Beginners - video 4: H-bonds (youtube.com/watch?v=xUdETtfhens)
5. PyMOL - video 5: Working with Scenes (youtube.com/watch?v=0fIZh4NFOAo)

Minimum technical skills

To complete your tasks in this course, you will need a basic understanding of how to operate a computer, and how to use word processing software, as well as the stated programs above.

Microsoft Office programs are required for some of the assignments; these can be accessed by current UF and UFO students through GatorCloud. Submissions must be made either in an MS Office format (.docx, .ppt, etc.) or in a generally readable file format (.pdf, .jpg, .txt, etc.); proprietary file formats such as Pages, Keynote, etc. cannot be opened and will not count as an on-time submission.

Honorlock

Honorlock is an online proctoring service that allows students to take exams on-demand 24/7. There are no scheduling requirements or fees.

You will need a laptop or desktop computer with a webcam, a microphone, and a photo ID. The webcam and microphone can be either integrated or external USB devices.

Honorlock requires that you use the Google Chrome (Links to an external site.) browser; furthermore, the Honorlock extension (Links to an external site.) must be added to Chrome.

For further information, FAQs, and technical support, please visit Honorlock.

Zoom

Zoom is an easy to use video conferencing service available to all UF students, faculty, and staff that allows for meetings of up to 100 participants.

You can find resources and help using Zoom at https://ufl.zoom.us.

Course Website (Canvas)

Class material including the syllabus, discussion readings, problem sets, exam results, some lecture slides and other information related to the course will be posted on the course Canvas website (https://ufl.instructure.com/courses/513379). You are responsible for **all** announcements made in lecture and/or posted on the course website for this class. For help with Canvas, call the UF Computing Help Desk at 352-392-4357, or visit the Canvas support website: https://elearning.ufl.edu/student-help/.

Course Policies

Requirements for make-up exams, assignments, and other work in this course are consistent with university policies that can be found at catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

As this is an online class, you are responsible for observing all posted due dates, and are encouraged to be self-directed and take responsibility for your learning.

Course Communications

All email correspondence to course instructors should **originate from the Canvas inbox system**. If you are sending mail outside the Canvas inbox system, it must originate from your ufl.edu account, have your full name in the body of the email, and contain your course and section number in the subject line. Emails not meeting these requirements may not be recognized by our email filters, and thus may not be answered.

Netiquette and Communication Courtesy:

All members of the class are expected to follow rules of common courtesy in all email messages, threaded discussions, and chats. Please behave with courtesy towards your fellow students and the instructors. This is particularly important in discussion boards where you are voicing opinions and commenting on those of other students.

Grammar

Correct grammar, punctuation, spelling, capitalization, and paragraphing should be used in any college-level submission, including the discussion boards. (U SHLD NT US TXT SPEAK LKE IDK OR BFF THX ALSO DNT USE ALL CAPS.) The instructor will take note of spelling and grammar in all submissions and it will affect grading, even if it is not explicitly included on the rubric. If you need help with any aspect of your writing, please visit the UF Writing Studio .

Course Materials

All materials for this course, including but not limited to lectures, quizzes, and worksheets, are the intellectual property of the professor, textbook publisher, or UF and are provided solely for the personal use of the currently enrolled students. These materials may not be distributed to other students or repositories without express written permission, even after the conclusion of the course at the end of the semester. Doing so will be considered a violation of the UF Honor Code (see below).

Time Commitment

The UF College of Liberal Arts and Sciences assumes that each student will devote on average 3-4 hours per week per credit-hour to each course during the regular semester. Because BSC 2005 is 3 credits, each student should therefore expect to devote an average of 9-12 hours per week to this course in a 15-week semester. This time will not necessarily be evenly distributed; some weeks will have heavier workloads than others.

Attendance

Students are expected to complete all assigned work (quizzes, interactive, discussions, activities etc.) by the due date. Students with pre-planned travel/conflicting activities on the day of the deadline (including student athletes) are responsible for managing their time wisely and should plan to work ahead when needed so that they can submit their work before they leave. Excuses such as “we didn’t get back from (activity) when planned and I didn’t have time” or “my computer crashed half an hour before the deadline and tech support wasn’t open” will NOT be accepted as excuses for missed deadlines.

Unavoidable emergency circumstances (e.g. hospitalization or family emergencies) that prevent you from completing your work in a timely manner require you to obtain a letter from a medical professional or the Dean of Students office (https://care.dso.ufl.edu/instructor-notifications/) that specifies the time period for which you are excused from classwork, and submit it to your instructors as soon as possible (i.e. within a week, barring extreme circumstances like extended hospitalization).

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found in the online catalog at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx.

Course Technology

This course is facilitated 100% online through Canvas. You may access Canvas from UF’s e-Learning webpage: http://elearning.ufl.edu/ . Please contact the UF Help Desk, http://helpdesk.ufl.edu , if you have any technical difficulties with Canvas.

Assessments and Grading

I will make every effort to have each assignment graded and posted within one week of the due date. Some of the PyMOL assignments will take extra effort to grade, but we (my TA and I) will make every effort to complete the grading as soon as possible.

Course Assignment Percentages

Assignment	Percentage
Exams	50%
Assignments (quizzes and Mastering Assignments)	25%
PyMOL Projects	25%

Exams (50% of Grade)

Student mastery of the material in each module will be determined by performance on Exams. Exams count 50% toward the final grade in the course. Exams will be curved using the following formula: The scores from the top 10% of the scores will be averaged, and the difference from 100% will be added to everyone's exam score for that exam. There will be 7 Exams throughout the course covering the modules listed in Table 1, below.

Table 1: Exam Content

Exam	Modules Covered	# of Questions
1	1-4	43
2	5	28
3	6-7	23
4	8-9	31
5	10	14
6	11	17
7	12	13

Practice Exams

A "practice exam" is provided for each of the 7 Exams. These practice exams will have questions similar to the real Exam questions, but will not be counted toward the final grade. Unlimited attempts are allowed on the practice exams.

Exam Curves

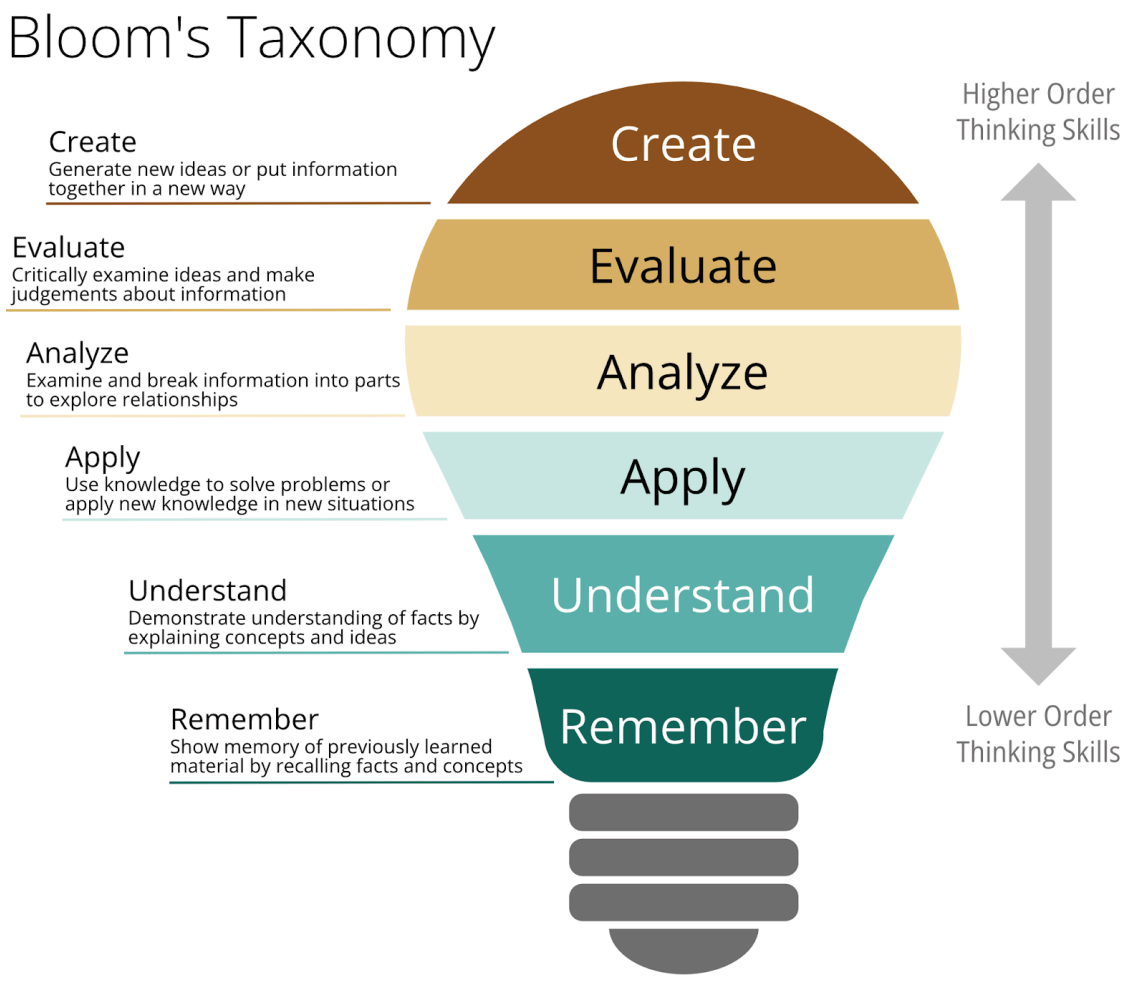
If necessary, exams MAY be curved using the following approach: The top 3% of the scores will be averaged, and the difference from 100 points will be added to each exam score.

Exam Format

Exam will be mostly multiple-choice questions, but there will be a few short-answer or "fill in the blank" questions. Question difficulty will include lower-level Bloom's Taxonomy questions, but students should also expect higher-level Bloom's Taxonomy questions. Students will be expected to analyze the concepts they are learning and apply knowledge to new situations. Bloom's Taxonomy levels are shown in the figure below.

Post-Exam Review

Exams will be available for review by appointment for one week following the posting of exam scores on Canvas; specific times for exam review will be announced following each exam. Exams will not be available for review after the semester has ended.



Make-up Exams

No make-up exams will be given without prior permission or documentation of illness. Exams are available for at least one week, so plan your schedules carefully.

Homework (7.72% of grade)

The homework consists of various tutorials and questions on textbook reading assignments where students will be asked to remember, understand, and apply the information they have learned in each module. Questions consist of multiple-choice, ranking, short answer, matching, and labeling diagrams and figures. Feedback is provided as you progress through the homework assignments, including hints. A summary of the Homework assignments is shown in Table 2 below.

Table 2: Summary of Homework Assignments

Module	# of Questions
M01	2
M02	14
M03	10
M04	1
M05	6
M06	13
M07	3
M08	29
M10	5
M11	6

Quizzes (17.28% of Grade)

Although mostly multiple choice, students can also expect some matching, short answer, and ranking questions. As with the Exams, students can expect some questions that require higher-level thinking skills beyond memorization of terms. The quiz questions are meant to be low-stakes questions so that students can practice answering questions similar to the questions on the exam as well as identify strengths and weaknesses in their mastery of the material in the assigned reading and lectures. Each correctly answered quiz question is worth 1 point, and wrong answers are awarded partial credit of up to 0.4 point. The correct answer is provided after the answer to the question has been submitted. Students are allowed to review the quiz questions and answers at any time during the course following the completion of the quiz. A summary of the number of questions on the quizzes for each module is shown in Table 3, below.

Table 3 Quiz questions per module

Module	# of Questions
M01	11
M02	33
M03	34
M04	8
M05	13
M06	10
M07	5
M08	7
M09	12
M10	16
M11	7
M12	3

Class Project (25% of Grade)

This course also includes a Class Project. The project is an *in silico* screen of small molecule compounds that bind to proteins typically overexpressed in various cancers. The goals of this activity is to provide a real world example of a popular method for identifying anti-cancer compounds and to introduce students to the use of computer-based analysis of protein structure and demonstrate its relevance to cancer research. Students will first learn how to use PyMOL, a premier molecular visualization program used by many researchers world-wide. Once students learn how to manipulate protein structures in PyMOL, they will choose an appropriate target for an anti-cancer compound from the RCSB Protein Structure Database, and define a target pocket to screen for binding of a small molecule. The screen of a compound database will be done using the resources provided by MTiOpenScreen, a webserver for virtual screening. Once potential anti-cancer compounds have been identified, students will create high-quality images of the top-scoring compound bound to the protein target. Along the way, students will use PyMOL to analyze one of the most common cancer-causing mutations in a key signaling protein.

This activity is presented in several parts, each with step-by-step instructions for how to achieve the desired outcomes.

Student Learning Outcomes

By the end of this activity, students will be able to:

- find a potential anti-cancer drug target in the protein database
- use PyMOL to open and manipulate protein structures
- compare mutant and wild-type proteins in PyMOL and highlight key structural differences
- create high-quality images of protein structures
- perform a computer-based drug screen of a target protein
- analyze drug screening results and create a representation of the drug molecule bound to its target

Course Grading Scale

Percent	Grade	Grade Points
90.0 – 100.0	A	4.00
87.0 – 89.9	A-	3.67
84.0 – 86.9	B+	3.33
81.0 – 83.9	B	3.00
79.0 – 80.9	B-	2.67
75.0 – 78.9	C+	2.33
72.0 – 74.9	C	2.00
69.0 – 71.9	C-	1.67
66.0 – 68.9	D+	1.33
63.0 – 65.9	D	1.00
60.0 – 62.9	D-	0.67
0 – 59.9	E	0.00

See the current UF grading policies for more information.

UF Policies

University Policy on Accommodating Students with Disabilities:

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, https://disability.ufl.edu/) by providing appropriate documentation. Once registered, students will receive an accommodation letter that must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Accessibility

The University of Florida is committed to providing everyone a welcoming and accessible campus. UF strives to ensure individuals with disabilities enjoy reasonable access to services and resources required by the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973 and other applicable federal and state regulations. To explore UF's accessibility standards and policies, visit the UF Accessibility Website.

University Policy on Academic Conduct:

UF students are bound by The Honor Pledge which states,

> *"We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity by abiding by the Honor Code."*

On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied:

> *On my honor, I have neither given nor received unauthorized aid in doing this assignment.*

The Honor Code (https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/) specifies the number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Any acts of cheating, plagiarism, or other forms of academic dishonesty will result in, at minimum, a 0 grade for the assignment, test, or quiz, and may include additional consequences up to and including a failing grade in the class. Sharing information about tests and quizzes with students who have not yet taken the exam or quiz, or posting on social media information about tests and quizzes that other students have not yet taken, is a serious act of academic

dishonesty. If you witness any instances of academic dishonesty in this class, please notify the instructor or contact the Student Honor Court (392-1631) or Cheating Hotline (392-6999). For additional information on Academic Honesty, please refer to the University of Florida Student Honor Code and Student Conduct Code at: https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

Software Use

All faculty, staff, and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Technology	Privacy Policy	Accessibility Policy/Statement
Instructure (Canvas)	Privacy Policy	Accessibility
Sonic Foundry (Mediasite Streaming Video Player)	Privacy Policy	Accessibility
Zoom	Privacy Policy	Accessibility
YouTube (Google)	Privacy Policy	Accessibility
Microsoft	Privacy Policy	Accessibility
Adobe	Privacy Policy	Accessibility

Getting Help

When you have a question about the course material, policies, or assignments, check the following sources first to see if it is already answered, **before** emailing your instructors or TA:

- Course Syllabus
- Canvas Announcements (this is the primary means that your instructors have to communicate with you in a timely manner)
- Canvas FAQ page
- Canvas Discussion Boards

If you still cannot find the answer to your questions:

- If it is a question that others might find useful to know the answer to as well, post it in the Canvas Discussion section.
- If it is regarding a technical problem, please contact the relevant tech support line (see below).
- If it is a question specific to you (e.g. account or grade specific), email your TA..

Technical Difficulties:

For issues with technical difficulties for Canvas, please contact the UF Help Desk at:

- http://helpdesk.ufl.edu
- (352) 392-HELP (4357)
- Walk-in: HUB 132

Any requests for make-ups due to technical issues should be accompanied by the ticket number received from the Help Desk when the problem was reported to them. The ticket number will document the time and date of the problem. You should e-mail your instructor within 24 hours of the technical difficulty if you wish to request a make-up.

Health and Wellness

College can be a very stressful time in a person's life. Resources are available on campus to help students meet academic goals and solve personal problems that may interfere with their academic performance. If you find that you are having difficulty emotionally or academically, there is substantial support available. See this guide "My CWC Plan" to help make a plan for resource use or contact one of the following services:

- **U Matter, We Care**: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit umatter.ufl.edu to refer or report a concern and a team member will reach out to the student in distress.
- **Counseling and Wellness Center:** Visit counseling.ufl.edu or call 352-392-1575 for information on crisis services as well as non-crisis services.
- **Student Health Care Center:** Call 352-392-1161 for 24/7 information to help you find the care you need, or visit shcc.ufl.edu.
- **University Police Department**: Visit police.ufl.edu or call 352-392-1111 (or 9-1-1 for emergencies).
- **UF Health Shands Emergency Room/Trauma Center:** For immediate medical care in Gainesville, call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; ufhealth.org/emergency-room-trauma-center.

Academic and Student Support

- **Career Connections Center:** 352-392-1601. Career assistance and counseling services career.ufl.edu/.
- **Library Support:** Various ways to receive assistance with respect to using the libraries or finding resources. cms.uflib.ufl.edu/ask
- **Teaching Center:** 352-392-2010 General study skills and tutoring: teachingcenter.ufl.edu/
- **Writing Studio:** 352-846-1138. Help brainstorming, formatting, and writing papers: writing.ufl.edu/writing-studio/

Course Evaluations

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

Tips for Success

Taking a course online can be a lot of fun! Here are some tips that will help you get the most of this course while taking full advantage of the online format:

- Schedule "class times" for yourself. It is important to do the coursework on time each week. You will receive a reduction in points for work that is turned in late!
- Read ALL of the material contained on this site. There is a lot of helpful information that can save you time and help you meet the objectives of the course.
- Print out the Course Schedule located in the Course Syllabus and check things off as you go.
- Take full advantage of the online discussion boards. Ask for help or clarification of the material if you need it.
- Do not wait to ask questions! Waiting to ask a question might cause you to miss a due date.
- Do your work well before the due dates. Sometimes things happen. If your computer goes down when you are trying to submit an assignment, you'll need time to troubleshoot the problem.
- To be extra safe, back up your work to an external hard drive, thumb drive or through a cloud service.

Lecture Schedule

Please check the Canvas course website for the most up-to-date lecture schedule.

Disclaimer

This syllabus represents the instructors' current plans and objectives. As we go through the semester, those plans may need to change to enhance the class's learning opportunity. Such changes, communicated clearly, are not unusual and should be expected.