BIOLOGY
111
Section 05
INTRODUCTION TO CELL & MOLECULAR BIOLOGY
College of Charleston, Department of Biology, Fall 2022

Lecture: MWF 10:00 am to 10:50 am in RITA 101
Instructor: Dr. Christopher (Chris) Freeman
E-Mail: freemancj@cofc.edu
Office Location: RITA 201
Office hours: M 4:15pm to 5:15pm
W 2pm to 5pm
https://calendly.com/freemancj/officehours
or email freemancj@cofc.edu to arrange a meeting by appointment
Office hours via Zoom

COURSE DESCRIPTION:
Introduction to Cell and Molecular Biology is a foundational Biology course that emphasizes:
• Critical thinking skills
• Structure and function in biological systems at both the molecular and cellular level
• Cellular pathways and the flow and exchange of information
• The link between interesting recent or important scientific research and the everyday lives of students and/or the functioning of biological systems

Key topics include:
• The scientific process
• Biochemistry
• Molecular biology
• Cell structure, function, and replication
• Respiration
• Photosynthesis
• Genetics
Completion of this course satisfies a General Education requirement and the lab BIOL111L is a co-requisite.
Course Information:

How will the class be given? The class is scheduled for in-person lectures. These lectures will remain in person unless instructor decides to shift to online synchronous due to deteriorating local conditions (high numbers of positive cases in class and/or high numbers of students in quarantine or isolation). The class will not be organized in a “Hybrid” mode where some students are in person and others are joining synchronously online. Lectures will be recorded, and these recordings will be uploaded at the end of each lecture; if you are unable to attend in person due to COVID-19 exposure or sickness, you will be able to watch the lecture asynchronously this way.

I have questions-how to I communicate with the instructor? Email me or join me for Office Hours by scheduling an appointment here: https://calendly.com/freemancj/officehours for a Zoom meeting. I will respond to emails within 24 hours (weekdays) or 48 hours (weekends).

How to stay up to date? Students should set notifications on OAKS so that they are informed when new materials or announcements are uploaded to OAKS. Students should also check OAKS daily for updates. It is imperative that you maintain a consistent presence in this class reading materials, taking OAKS quizzes, and staying on top of the assignments.

Need a study partner? The discussion board Course Lounge can be used for student-to-student interactions and is optimal for pre-exam study sessions.

How do I communicate with other students? Students will communicate with each other in person, via OAKS discussion boards, in breakout rooms on Zoom, and in GoogleDrive.

How should I act in online discussions with students? In these discussions, always we aware of your “Netiquette”: 1) Be kind and ethical. Avoid using sexist, racist, or offensive language in writing and speaking; be sensitive to and reflective about what others are saying, 2) Be aware of how your communication may be perceived; use appropriate levels of capitalization as USING ALL CAPITAL LETTERS is the online equivalent of yelling; be cautious with sarcasm, 3) think before you hit the post button, 4) be forgiving as anyone can make a mistake and respect disagreement, 5) help each other; realize that all students learn differently, 6) stay on topic (don't let a chat about class turn into a casual discussion among some students that derails the ability of other students to focus on course content), 7) only use appropriate abbreviations or acronyms as some students may not be familiar with them, and 8) keep the dialogue professional.

How should I act in class? Please come to class on time and do not spend class texting or using the Internet for activities not related to class. This is distracting to students that are learning the material or especially peers that are presenting. Please be respectful of others in your group and class. Sitting arrangements may be changed over the semester to stimulate collaborations and reduce distracting behavior. The use of cell phones may
also be restricted if needed.

Computers are allowed for note taking. Students should have personal laptops with Excel, Word, and PowerPoint for discussions.

Please be understanding of other students need for a quiet classroom and do not talk during class, tests, or quizzes. Please also refrain from potentially distracting activities in class.

Want to have a successful group for projects? Successful groups are those that set agreed upon deadlines, delegate tasks, identify meeting times and formats, and discuss progress and questions, etc. If problems arise, please see instructor immediately.

Do I need to come to class? You are expected to attend each meeting of the lecture unless you are unable due to a medical or other emergency. Please arrive on time prepared to conduct the work and stay for the entire duration. Attendance will be determined each day by in-class activities.

What if I miss class? Students are responsible for getting notes or any missed information from classmates and/or contacting the professor if they have questions due to a missed class. I’m happy to go over material with you. See below for more information about missed classes due to COVID-19.

Turning in assignments: Assignments must be turned in on time to obtain full credit. Assignments will lose 5\% of their grade each weekday they are late and cannot be turned in once they are graded and returned.

How am I doing in class? Grades will be uploaded to OAKS so students can track their progress!

What about COVID? I fully recognize that these are unprecedented times and that there will be unforeseen challenges that arise over the course of the semester. Therefore, it is my intention to be flexible with deadlines and class attendance if challenges arise for students due to COVID-19 exposure. I trust you to inform me directly (via email) and as soon as possible to notify me when you miss class and I trust that the reason you provide for an absence or delayed assignment is honest and truthful. In addition, to facilitate this:

1) I will drop the lowest two OAKS quiz grades for each student over the semester

2) Your grade will not suffer if you are unable to attend lecture and therefore miss in-class assignments for that day if you make up the assignment within a reasonable amount of time (within one week) and email it to me. This includes participation grades for lecture. If you miss lecture, you will receive a “0” for that day for participation, but you can get this point back if you email me answers to the questions I asked the class during my lecture within a week.
responsible for contacting me or a classmate about missed materials and catching up on missed assignments. If you miss lecture, you will need to download and watch the lecture recording asynchronously via OAKS. It is important to watch these ASAP so that you can review the material, contact me with questions, and make up any assignments. I’m happy to help you make this up so please contact me ASAP.

3) If an emergency arises and you miss lecture or an exam, please seek medical or other needed care first and then let me know (via email) as soon as you can.

4) I will use the FAST system for students that have excessive absences or appear to be struggling to facilitate the allocation of CofC resources to help them.

5) If you get COVID-19 or are exposed and need to isolate, we will adjust so that you can stay in the class.

What rules are in place due to COVID-19? Students are encouraged to wear a quality mask in class and maintain social distancing from each other and the instructor (as allowed). Masks should hug your face (not be open on the bottom) and cover both your nose and mouth.

What if I get COVID-19 or am exposed to it?


Isolation:

- **Any individuals who test positive** must isolate away from others for at least five days, regardless of vaccination status. CDC officials advise that individuals can end their isolation, if after five days they are fever-free for 24 hours without the use of medication and symptoms are improving. They still need to wear a high-quality mask such as a KN95 through day 10.

- Your isolation period is determined from the date of the positive COVID-19 test. Day 1 of isolation begins the day after the positive test date.

- **Anyone who has had close contact with a positive case** should wear a high-quality mask such as a KN95 for 10 days and should get tested after five days.

- All campus community members must self-report their positive tests using the self-report form located at the top of the Back on the Bricks website.
Face coverings/Masks:

- Masks are not currently required on campus unless one of the following applies:
  - You are on days 1-5 of isolation and have not yet left campus.
  - You are on days 6-10 of your isolation and have returned to campus.

- Those who are not vaccinated and/or those who wish to continue to wear high-quality, well-fitted masks such as a KN95 are encouraged to do so, especially in large indoor gatherings.

- The College has KN95 masks available for students, faculty and staff. **N-95 masks are available for free at several campus locations**

**Please note: any student (regardless of vaccination status) who tests positive for COVID-19 will need to isolate.**

If people suspect they have COVID-19, they can submit a notice through a self report form: [https://forms.office.com/Pages/ResponsePage.aspx?id=ONSF4rrbTEqUHFk7pCLErEe9xT6P1w5EgppC3mq25pxUNTFY1BWQkIYR1FYNUtSMUUNVEYxUjBJNC4u](https://forms.office.com/Pages/ResponsePage.aspx?id=ONSF4rrbTEqUHFk7pCLErEe9xT6P1w5EgppC3mq25pxUNTFY1BWQkIYR1FYNUtSMUUNVEYxUjBJNC4u)

Student submissions will go to Student Health Services. Alternatively, students can call Student Health Services at 843.953.5520.

*How will I evaluate the class?* Course evaluations will be completed in class towards the end of the semester

*How is the course organized?* Students can access course materials on OAKS. Our course is divided into four sections with multiple chapters within each section. Lectures and materials for each chapter will become available as the course progresses.

**EXAMS***: The *lecture* course will be divided into four sections based on topics. Each section will have an exam (**4 “midterm” exams**). Each exam will take an entire class period. I will drop your lowest exam grade in the class.

Exams may include multiple-choice and true/false questions, matching, or fill-in-the-blanks. **Many of these questions will require you to apply what we have talked about in class.**

Exam questions will be pulled from lecture slides, **notes**, activities, and the corresponding textbook material. There is a lot of information in this class, so I urge
students to: 1) attend lectures, 2) take detailed notes and 3) ask questions in class or office hours.

There will also be a comprehensive final exam at the end of the course.

*Make up exams can be administered under situations like a medical or family emergency. Missed exams should be made up as soon as possible.

**QUizzes:** A quiz will be uploaded to OAKS **each week and will be due by the start of class (10 am) each Monday.** Quizzes will include questions on material we have already covered (review) and material we are about to cover. These will be **open book and open note** and you will have ample time to start them. These quizzes are designed to facilitate reading ahead in the book, understanding the material, or reviewing the material in the book. There will be a window of time when these quizzes are open on OAKS and they will always end at the specific time and date that can be seen on the OAKS calendar. **Once the quiz is closed, they cannot be completed unless missed due to an excused absence. Please notify me of this ASAP and please make sure you check the calendar on OAKS and complete them before the deadline.**

Quizzes should be completed alone (please do not take them together or in groups).

These are an easy source of points (**~25% of your final grade**)!

**Assignments:**
We will have class activities to broadly review material we are going over and, in some cases, relate back to past material. These are a great opportunity to test your understanding, identify areas where you need to focus (or ask me questions), and **improve your grade (100/1100 final points in the class)!!**

We will also have assignments during class over the course of the semester to encourage active participation, collaboration, and discussion among students (Poll Everywhere questions, Think, Pair, Share; short writing assignments; reading articles; reviewing news stories, worksheets, and others).

This assignment grade is heavily weighted by participation (attending lectures, completion of questions and worksheets, and participation in discussions). This is an easy source of points in the class, but you need to participate in these activities and discussions to access these points.
How can you be successful in this class? You can be successful in this course if you:

- Log in to the course at least **four times each week**
- **Print out lecture slides (or download on iPad or computer)** before coming to class and take notes on what I’m saying
- **Activate OAKS notifications** to stay up to date with quizzes and assignments
- **Take OAKS quizzes**
- Set aside **at least four hours** of time outside of class for this course each week
- Review and complete OAKS **work** as needed
- **Complete** worksheets, assignments, and class activities
- Utilize **office hours**
- Study lecture slides and lectures for **exams**
- **Engage with your classmates** in and outside of class (use the course lounge)

**Course learning tools and links:**

*Zoom* will be used for office hours and synchronous lectures (as needed) because it allows instructor-student and student-student face-to-face interactions.

*OAKS Discussion boards* can be used to post and respond to course discussion questions that the instructor and students post.

*GoogleDrive* will be used for student collaborative work

*PollEverywhere* will be used to assess student understanding during lecture

These tools require accounts but are free to use.

If students encounter technical issues, please contact me, or review online tools and FAQ for each program.
**Required textbook and supplies:**
The textbook is free: Biology 2e Openstax*

Notebook or scrap paper for notes and activities in lecture.

PollEverywhere account (need to set up by Friday August 26th)

PollEverywhere questions will be from the following account:
PollEv.com.freemancj

Students may also need access to the following tools:
Zoom and Google Suite Applications

**TENTATIVE LECTURE SCHEDULE**

Remember to prepare for lecture by reading ahead in the assigned chapters in OpenStax Biology 2e (chapters shown in [] below).

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
</tr>
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<tbody>
<tr>
<td>24th August</td>
<td>Introduction, Syllabus, Biology, and Life [1].</td>
</tr>
<tr>
<td>26th August</td>
<td>Biology, Life, and Science [1].</td>
</tr>
<tr>
<td>29th August</td>
<td>Biology, Life, and Science [1].</td>
</tr>
<tr>
<td>31st August</td>
<td>Chemical bonds, thermodynamics, water [2].</td>
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<tr>
<td>2nd September</td>
<td>Chemical bonds, thermodynamics, water [2].</td>
</tr>
<tr>
<td>5th September</td>
<td>Chemical bonds, thermodynamics, water [2].</td>
</tr>
<tr>
<td>7th September</td>
<td>Proteins [3 and 3.4]</td>
</tr>
<tr>
<td>9th September</td>
<td>Proteins [3 and 3.4]</td>
</tr>
<tr>
<td>12th September</td>
<td>Exam #1</td>
</tr>
<tr>
<td>14th September</td>
<td>Nucleic acids [3 and 3.5]</td>
</tr>
<tr>
<td>16th September</td>
<td>Carbohydrates [3 and 3.2]</td>
</tr>
<tr>
<td>19th September</td>
<td>Carbohydrates [3 and 3.2]</td>
</tr>
<tr>
<td>21st September</td>
<td>Lipids and membranes [3 and 3.3]</td>
</tr>
<tr>
<td>23rd September</td>
<td>Passive and active transport [5]</td>
</tr>
<tr>
<td>26th September</td>
<td>Cell structure and metabolism [4 and 6]</td>
</tr>
<tr>
<td>28th September</td>
<td>Cell structure and metabolism [4 and 6]</td>
</tr>
<tr>
<td>30th September</td>
<td>Cell structure and metabolism [4 and 6]</td>
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<tr>
<td>3rd October</td>
<td>Exam #2</td>
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<tr>
<td>5th October</td>
<td>Respiration [7]</td>
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<tr>
<td>7th October</td>
<td>Respiration [7]</td>
</tr>
<tr>
<td>10th October</td>
<td>Photosynthesis [8]</td>
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<tr>
<td>12th October</td>
<td>Photosynthesis [8]</td>
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<tr>
<td>14th October</td>
<td>Cell to cell interactions [9]</td>
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<tr>
<td>17th October</td>
<td>Mitosis [10]</td>
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<tr>
<td>19th October</td>
<td>Mitosis [10]</td>
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<tr>
<td>21st October</td>
<td>Meiosis [11]</td>
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<tr>
<td>Date</td>
<td>Event</td>
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<tr>
<td>24th October</td>
<td>Meiosis [11]</td>
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<tr>
<td>26th October</td>
<td>Buffer/Makeup/Review Day</td>
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<tr>
<td>28th October</td>
<td>Exam #3</td>
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<tr>
<td>28th October</td>
<td>Last day to withdraw with a “W” as your grade</td>
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<tr>
<td>31st October</td>
<td>Mendel and the gene [12]</td>
</tr>
<tr>
<td>2nd November</td>
<td>Mendel and the gene [12]</td>
</tr>
<tr>
<td>4th November</td>
<td>Mendel and the gene [12]</td>
</tr>
<tr>
<td>7th November</td>
<td>NO CLASS-FALL BREAK</td>
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<tr>
<td>9th November</td>
<td>DNA synthesis and repair [14]</td>
</tr>
<tr>
<td>11th November</td>
<td>How genes work [15]</td>
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<tr>
<td>14th November</td>
<td>Transcription and Translation [15]</td>
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<tr>
<td>16th November</td>
<td>Transcription and Translation [15]</td>
</tr>
<tr>
<td>18th November</td>
<td>Transcription and Translation [15]</td>
</tr>
<tr>
<td>21st November</td>
<td>Gene expression in pro- and eukaryotes [16]</td>
</tr>
<tr>
<td>23rd November</td>
<td>NO CLASS-Thanksgiving break</td>
</tr>
<tr>
<td>25th November</td>
<td>NO CLASS-Thanksgiving break</td>
</tr>
<tr>
<td>28th November</td>
<td>Gene expression in pro- and eukaryotes [16]</td>
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<tr>
<td>30th November</td>
<td>Gene expression in pro- and eukaryotes [16]</td>
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<tr>
<td>2nd December</td>
<td>Exam #4</td>
</tr>
<tr>
<td>5th December</td>
<td>Last Day of Class-Final Review and Course Evaluations</td>
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<tr>
<td>6th December</td>
<td>READING DAY-no class. Extra credit due by 5pm</td>
</tr>
<tr>
<td>7th December</td>
<td>FINAL EXAM: Wednesday December 7th 08:00am to 10:00am Rita 101</td>
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SUPPLEMENTAL INSTRUCTION:
I strongly suggest that students attend at least one SI session per week. A supplemental Instruction (SI) leader will be assigned for this course (more details TBD). This leader is a student that will run active SI gatherings and study sessions to answer questions, review content, and help with problems. This is helpful and I encourage all students to participate. Students that attend these on a regular basis do better in the class by nearly a full letter grade.

SCIENCE TUTORING LABS:
http://csl.cofc.edu/labs/
http://csl.cofc.edu/labs/science-lab/index.php

Center for Student Learning: I encourage you to utilize the Center for Student Learning’s (CSL) academic support services for assistance in study strategies, speaking & writing skills, and course content. They offer tutoring, Supplemental Instruction, study skills appointments, and workshops. Students of all abilities have become more successful using these programs throughout their academic career and the services are available to you at no additional cost. For more information regarding these services please visit the CSL website at http://csl.cofc.edu or call (843)-953-5635.

ACCOMODATING DISABILITIES:
The college and professor will make any reasonable accommodations for students with documented disabilities. If students need these accommodations (outside class exams/extended time/etc…), they should see the Center for Disability Services/SNAP (located on the first floor of the Lightsey Center, Suite 104) and get a formal notice from SNAP to the professor as soon as possible so that we can make necessary arrangements. Let me know if you have questions.

NAME and PRONOUN PREFERENCE
I will gladly honor your request to address you by the name and gender pronouns of your choice. Please advise me of this early in the semester via your college-issued email account or during office hours so that I may make the appropriate notation on my class list.

FOOD and HOUSING INSECURITY
If you are housing or food insecure, there are programs through the College that may help. Students can contact Mark Antoine at antoinemp@cofc.edu or visit the Dean of Students in the 3rd floor of the Stern Center.

WEATHER CLOSING
If the College of Charleston closes and members of the community are evacuated due to inclement weather, students are responsible for taking course materials with them in order to continue with course assignments consistent with instructions provided by faculty. In cases of extended periods of institution-wide closure where students have relocated, instructors may articulate a plan that allows for supplemental academic engagement despite these circumstances.
CONTINUITY of LEARNING (for hybrid classes with face-to-face meetings)
Due to social distancing requirements, this class may include a variety of online and technology enhanced components to reinforce continuity of learning for all enrolled students. Before the drop/add deadline, students should decide whether the course plan on the syllabus matches their own circumstances (see information for this class in syllabus).

RECORDING of CLASSES (via ZOOM)
Class sessions may be recorded via both voice and video recording. By attending and remaining in this class, the student consents to being recorded. Recorded class sessions are for instructional use only and may not be shared with anyone who is not enrolled in the class.

HONOR CODE AND ACADEMIC INTEGRITY:
Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code. Academic integrity is essential at the College of Charleston and to the practice of science. You will therefore be held to a high standard of integrity in this course. Any Honor Code violations that occur will be handled as outlined in the Student Handbook. Please be absolutely sure that you understand what the Honor Code requires of you:
http://studentaffairs.cofc.edu/honor-system/
http://studentaffairs.cofc.edu/honor-system/studenthandbook/

If you have any questions or concerns about Honor Code expectations or about how to avoid violations, please consult with the instructor.

Plagiarism: Plagiarism is any use of words or ideas produced by another person without proper attribution and includes failing to paraphrase adequately or to cite sources properly. The Honor Code forbids plagiarism, both intentional and unintentional. Please consult the instructor if you have any questions or concerns about how to use and cite sources to avoid plagiarism.

Collaboration: Many of your discussion projects will involve working with other students. Nevertheless, the work you submit must be completed independently and must represent your own independent ideas, unless the instructor specifically requires a joint product (rare). Please be sure that you understand the distinction between collaborating and copying and ask me if you have any doubts. Identical copies of figures or text count as copying so please turn in your own work. Suspicions of unauthorized collaboration will be dealt with according to the Honor Code.

Re-using work: Please be aware that using work that you or anyone else has done for this or any other class or project, either in whole or in part is a violation of the Honor Code, even if the work is revised. Reuse or revision will result in reporting to the Dean.
Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students. A student found responsible by the Honor Board for academic dishonesty will receive a XXF in the course, indicating failure of the course due to academic dishonesty. This status indicator will appear on the student’s transcript for two years after which the student may petition for the XX to be expunged. The F is permanent.

**GRADING BREAKDOWN:**
- **Exams:** 600 Points (4 midterms (lowest dropped); 200 points each)
- **Final Exam:** 200 Points
- **Quizzes:** 250 Points
- **In Class Assignments:** 50 Points

**Total= 1100 points**

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<thead>
<tr>
<th>Percentage</th>
<th>Grade</th>
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<tbody>
<tr>
<td>≥93%</td>
<td>A</td>
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<tr>
<td>90-92</td>
<td>A-</td>
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<tr>
<td>87-89</td>
<td>B+</td>
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<tr>
<td>83-86</td>
<td>B</td>
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<tr>
<td>80-82</td>
<td>B-</td>
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<td>70-72</td>
<td>C-</td>
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<td>D</td>
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<tr>
<td>60-62</td>
<td>D-</td>
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<td>≤59</td>
<td>F</td>
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</table>

I do not curve grades on exams, assignments, or final scores in the class, but there are opportunities (other tests, quizzes, and assignments) to make up points if you do poorly on a single test or assignment. If, at the very end of the semester, your final grade is near (<0.5 points) a letter grade threshold, I will round up. As an example, if you have a 79.6, I will round up to an 80 and you will have a B- in the class. In comparison, if you have a 79.5 or below, your grade will remain a C+. This cutoff system is the only way that I can maintain a consistent treatment of grades across students, so there will be no exceptions.

† Each project will be graded as a portfolio, including the final products and all work leading up to those products (e.g., worksheets, quizzes, participation).
EXTRA CREDIT:
Extra credit options are of minor point value. They are available for a maximum of 20 points. This will equate 1.5% added to your final grade. Some extra credit questions may also occasionally appear on the exams for a couple of extra points. Note that your time is better spent studying the material than doing extra credit.

Option #1 (10 points each): Read a peer-reviewed, published scientific article on a subject that interests you. Write a one page (double spaced) summary of the article. For full credit, make sure to outline why the authors did the research, what their hypotheses or predictions were, the methods they used to test their hypotheses, and their results and conclusions. Also make sure to mention why you were interested in the article and attach a copy of the article to your summary to receive full credit. The article and summary must be uploaded by 5 pm on December 6th.

Option #2 (10 points each): Go to: http://www.iucnredlist.org and find an organism that is of interest to you. Write a one page (double spaced) summary of the organism and why it is of interest to you. For full credit, only include an organism that has been evaluated by the IUCN and discuss what its status is, how that status was determined, what the major threats to its survival are, where it is found and its current/historical range, how many of the species are left in the world, its common and scientific name, and what, if anything is being done to protect it. This must be uploaded by 5 pm on December 6th.

Option #3 (10 points each): Watch a TED Talk: https://www.ted.com/talks on some sort of Biological Science/Conservation Biology/Ecology/Biodiversity/Chemistry subject and write a one page (double spaced) summary of it. For full credit, include a link to the talk, discuss who gave it, why they decided to give it and/or why they were the best person to talk about the subject, give a summary of the main take home messages, how it relates to a subject we talked about in class, and why it is important to be discussing right now. This must be uploaded by 5 pm on December 6th.

Option #4 (4 points each): Go to a department (http://biology.cofc.edu/departmental-seminars/) or Grice Marine Laboratory (http://gricemarinelab.cofc.edu/research/marine-science-seminar/index.php) seminar. To receive credit you must hand in a typed 5 sentence summary of the seminar that you participated in which also includes a description of what you learned from this seminar. This must be uploaded by 5 pm on December 6th.

*Note that this syllabus or an assignment is subject to change over the course of the semester
OFFICIAL BIOL 111/L – 112/L COURSE LEARNING GOALS AND OBJECTIVES

This general education science sequence provides a background for understanding and evaluating contemporary topics in biology. Students develop a foundational understanding of core concepts to use and on which to expand in upper level courses. They also develop the critical competencies that form the bases for the practice of science and use of scientific knowledge.

Core Concepts

This 2-semester course sequence in general biology addresses fundamental principles in biology to prepare students for sophomore and upper level courses in biology:

- **EVOLUTION**: The diversity of life evolved over time by processes of mutation, selection, and genetic change. The theory of evolution by natural selection allows scientists to understand patterns, processes, and relationships that characterize the diversity of life.
- **STRUCTURE AND FUNCTION**: Basic units of structure define the function of all living things. Structural complexity, together with the information it provides, is built upon combinations of subunits that drive increasingly diverse and dynamic physiological responses in living organisms. Fundamental structural units and molecular and cellular processes are conserved through evolution and yield the extraordinary diversity of biological systems seen today.
- **INFORMATION FLOW, EXCHANGE, AND STORAGE**: The growth and behavior of organisms are activated through the expression of genetic information at different levels of biological organization and depend on specific interactions and information transfer.
- **PATHWAYS AND TRANSFORMATIONS OF ENERGY AND MATTER**: Biological systems grow and change by processes based upon chemical transformation pathways and are governed by the laws of thermodynamic and will be explored to understand how living systems operate, how they maintain orderly structure and function, and how physical and chemical processes underlie processes at the cellular level (i.e. metabolic pathways, membrane dynamics), organismal level (i.e. homeostasis) and ecosystem level (i.e. nutrient cycling).
- **SYSTEMS**: Living systems are interconnected and interacting and biological phenomena are the result of emergent properties at all levels of organization, from molecules to ecosystems to social systems. The course will explore the dynamic interactions of components at one level of biological organization to the functional properties that emerge at higher organizational levels.

The specific topics covered in each course include:

**Biology 111 & Biology 111L**
- Chemical and physical properties of life
- Cell form & function
- Energetics, metabolism, and photosynthesis
- The cell cycle
  - Mitosis and cell reproduction
- Meiosis and sexual reproduction
• Mendelian genetics / Patterns of inheritance
• Human Inheritance
• The molecular basis of inheritance
• DNA and protein production
• Regulation of gene expression
• Some aspects of biotechnology

Biology 112 & Biol 112 L
• The development of evolutionary thinking
• Basic evolutionary processes
• Comparative plant form & function
• Comparative animal form & function

Core Competencies

• Nature of Scientific Knowledge
  ○ Understand the intellectual standards used by scientists to establish the validity of knowledge, evidence, and decisions about hypothesis & theory acceptance. These standards include: 1) science relies on external and naturalistic observations, and not internal convictions; 2) scientific knowledge is based on the testing of hypotheses and theories, which are under constant scrutiny and subject to revision based on new observations; 3) the validity of scientifically generated knowledge is established by the community of scientists through peer review and open publication of work.
  ○ Understand that new ideas in science are limited by the context in which they are conceived; are often rejected by the scientific establishment; sometimes spring from unexpected findings; and usually grow slowly, through contributions from many investigators.
  ○ Understand that science operates in a world defined by the laws of chemistry and physics.
  ○ Understand the differences and relationships among scientific theories, hypotheses, facts, laws, & opinions.
  ○ Understand the differences between science and technology, but also their interrelations.
  ○ Understand the dynamic (tentative) nature of science.

• Scientific Methods of Discovery
  ○ Understand the methods scientists use to learn about the natural world (observing; questioning; formulating testable deductive hypotheses; controlled experimentation when possible; observing a wide range of natural occurrences and discerning (inducing) patterns).
  ○ Apply physical/natural principles to analyze and solve problems.

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1 This learning goal will be measured as part of the general education assessment. The specific learning outcome to be measured is: Students can apply
physical/natural principles to analyze and solve problems.

- **Develop a Scientific Attitude**
  - Develop habits of mind that foster interdisciplinary and integrative thinking (within biology; between biology and other sciences; between science and other disciplines).
  - Develop an appreciation for the scientific attitude - a basic curiosity about nature and how it works.

- **Develop scientific analysis and communication skills**
  - Develop quantitative reasoning skills (quantitatively expressing the results of scientific investigations, or patterns in nature and using knowledge of biological concepts to explain quantitatively-expressed data or patterns).
  - Understand the probabilistic nature of science and the use/application of inferential statistics to test hypotheses.
  - Develop scientific information literacy (library, internet, databases etc…); find and evaluate the validity of science-related information.
  - Communicate scientific knowledge, arguments, and ideas in a variety of different contexts (scientific, social, cultural), utilizing a variety of different media (scientific articles, policy statements, editorials, oral presentations etc.).
  - Develop cooperative problem-solving skills (working effectively in teams), but also habits of mind and skills that foster autonomous learning.

- **Develop an appreciation for the impact of science on society.**
  - Develop an appreciation of humans as a part of the biosphere and the impact of biological science on contemporary societal/environmental concerns.
  - Knowledge of the history of the biological sciences and the influences of politics, culture, religion, race, and gender on the scientific endeavor.

2 This learning goal will be measured as part of the general education assessment. The specific learning outcome to be measured is: *Students can demonstrate an understanding of the impact that science has on society.*

**Signature assignments for measuring learning outcomes**

**Learning Outcome 1:** Students apply physical/natural principles to analyze and solve problems.

This learning outcome is assessed using the poster (or scientific article) generated in Biology 112 lab as part of the multi-week student-directed independent research project. In this project students use data they collect (or has been collected in actual research investigations) to test an hypothesis of their choosing. These projects may be themed, with all student groups addressing different aspects of a larger question, emphasizing the interdependence of various research groups needed to address complicated problems. This multi-week project begins the class identifying what questions need to be addresses in the larger problem. Individual student groups then become experts in
these areas of the larger problem. The smaller research teams develop a hypothesis, and write a research proposal to test their hypothesis. Students collect (or use already collected data), summarize and statistically analyze the data, and draw conclusions.

**Learning Outcome #2** - Students demonstrate an understanding of the impact that science has on society.

Biology 112 lab Students produce a written document based on one of the case-based labs (examples - policy statement, article, stake-holder professional letter or poster) that requires them to research and apply biological knowledge or evidence to defend or critique a proposed solution to a biology-related societal issue. Although the choice of the specific issue or proposed solution is course-section specific, some examples of potential issues include

- exploring environmental/health impacts of genetically modified organisms
- the use of performance enhancing drugs in sports
- the development of antibiotic resistance in disease organisms

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2 This learning goal will be measured as part of the general education assessment. The specific learning outcome to be measured is: *Students can demonstrate an understanding of the impact that science has on society*