BIO181 Biology and Biotechnology (3,0,3)

Schaefer School of Engineering & Science

Prerequisite(s) and Corequisite(s): None

COURSE DESCRIPTION

Biological principles and their physical and chemical aspects are explored at the cellular and molecular levels. Major emphasis is placed on cell structure (atoms & molecules), the processes of energy conversion by plant and animal cells (matter and energy), genetics (biological information) and evolution (biological changes), and applications to biotechnology.

STUDENT LEARNING OUTCOMES

Goals: To develop competencies in students to

1. Identify the key characteristics and functions of biological macromolecules and cell structures.
2. Explain the basic physiology of cell functions such as metabolism, respiration, mitosis, meiosis, and communication.
3. Correlate biological information from DNA to RNA to proteins in the context of explaining genetic inheritance and disorder and using biotechnology in medicine.

After successful completion of this course, students will be able to:

1. Identify the types of chemical bonds that are characteristically found in the major classes of biological macromolecules.
2. Identify the major organelles in the cell and describe their functions in cell physiology.
3. Describe the mechanism by which cells derive useful chemical energy; compare and contrast energy utilization with conversion of radiant energy to chemical energy during photosynthesis.
4. Recall the principles by which enzymes catalyze biochemical reactions.
5. Outline major complex cellular processes such as cell division, cell signaling, DNA replications, RNA transcription, and protein translation.
6. Define how cells that contain the same genome express different proteins.
7. Translate ideas about mutations in a single gene into concepts about dominant and recessive genetic disorders.
8. Interpret the generation of diversity during gamete formation and relate that concept to Mendelian genetics for individuals and populations.
9. Identify the major characteristics of the human genome.
10. Master the basic principles of the Theory of Evolution
11. Compare the structure and function of bacteria and viruses to eukaryotic cells.

COURSE FORMAT AND STRUCTURE

- Three 50-min lectures/week
    - Students are required to review chapter materials prior to class (see schedule)
    - Class consists of lectures, in-class activities, and plenty of time to review key concepts and problems.

COURSE MATERIALS

Your textbook for this class is available for free online!!! You can access it directly from canvas.
Biology 2e from OpenStax, Print ISBN 1947172514, Digital ISBN 1947172522:
https://openstax.org/details/books/biology-2e

COURSE REQUIREMENTS

1. Attendance and Participation:
   - Attendance and Participation in in-class activities/quizzes are MANDATORY.
   - Request to be excused will be granted ONLY in the following circumstances: sickness, athletic meets (official note required), deaths and wedding in the immediate family and other documented crises, call to court-imposed legal obligations (e.g., jury duty) and religious days.
     - NOTE: NOT VALID EXCUSES for ABSENCES include employment schedules, scheduled interviews or Career Center Co-op or Internship sessions, oversleeping, vacation travel, and athletic training/practice schedules.
     - When you miss a class for an excused absence, you will be assigned an "EX" in class indicating being excused from that assignment. Note with an excused absence, you do not need to submit the in-class assignments. However, you are strongly encouraged to review all assignments/class notes, which are posted on Canvas and see the instructor and/or course assistant to discuss what you missed and for help with the material.
     - NOTE: If you have 3 unexcused or excused absences in a row or have missed excessive number of classes we will submit an Early Warning Report to the Office of Undergraduate Academics.
2. Assignments:
   - Homework questions (multiple choice, matching quiz and fill-ins questions)
     - Assignments are administered through canvas and are DUE by 11:59 p.m. EST on the dates listed in the course schedule.
       - Deadlines are an unavoidable part of being a professional and this course is no exception. Course requirements must be completed and submitted on or before specified due date and delivery time deadline.
       - To encourage you to stay on schedule, due dates have been established for each assignment; 10% of the total points will be deducted for assignments received 1 day late; assignments received more than 1 day late will receive 0 points.
3. Exams:
   - Four 50-min exams
     - Exams will consist of multiple choice, matching quiz, and fill-ins questions. Materials for exams are taken from lecture, homework assignments and in-class activities. Please refer to the provided key concepts list as guide to study for the exams.
     - TAKE note of the exams' dates: NO make-up exam will be given without a valid excuse (refer to the above list of valid excuses)
       - Under no circumstances will make-up exams be given for student convenience. Students must contact the instructor prior to the exam to be excused (except in unforeseeable circumstances).
       - Makeup exams for the current semester will be offered ONLY the Monday following the scheduled dates, from 4:00-5:00 PM EST.

GRADING PROCEDURE

Grades will be based on: Attendance, Participation, Homework and Exams

- Attendance = 5%
- In class participation = 20%
- Homework = 25%
- Four 1-hour exams = 50% (12.5% each)
- EXTRA Credits: syllabus quiz and post-exam 1 self-reflection questionnaire (1 point total added to the final grade)

GRADING SCHEME

NO rounding off offered, do not ask, requests will go unanswered.

Grade	**Range**	
A	100%	to 93%
A-	<92.999%	to 90%
B+	<89.999%	to 87%
B	<86.999%	to 83%
B-	<82.999%	to 80%
C+	<79.999%	to 77%
C	<76.999%	to 73%
C-	<72.999%	to 70%
D+	<69.999	to 67%
D	<66.999%	to 60%
F	<59.999%	to 0%

EXAM CONDITIONS

The following procedures apply to exams for this course. As the instructor, I reserve the right to modify any conditions set forth below by printing revised Exam Conditions on the exam.

1. Students cannot use ANY of the following electronic devices during the exams. Note that the laptop is allowed ONLY if the exams are administered through canvas.

Device	**YES**	**NO**
Laptop	X (conditional)	
Cell phone		X
Tablet		X
Smart watch		X
Google glass		X

2. Students may use the following materials during quizzes and/or exams. Refer to the list.

Material	**YES**	**NO**
Handwritten notes	X	
Typed notes		X
Textbook		X
Other (e.g., Google, Chegg.com, etc.)		X

3. Students are NOT allowed to work with or talk to other students during exams.

COURSE SCHEDULE

NOTE: The instructor reserves the right to modify the schedule as necessary to assure the course objectives are met or exceeded. The student will be promptly informed of any such change.

Week	Topic	Reading
1	The Study and Organization of Life	Ch. 1 Ch. 20.1
1	The Chemistry of Life	Ch. 2
2	Biological Macromolecules	Ch. 3

3-4	Cell Structure
	• Visualization of the cells: Microscopy
	  o Light vs Electron Microscopes
	• Prokaryotic vs Eukaryotic cells
	  o 4 Common components: Plasma membrane, Cytoplasm, DNA, Ribosome
	  ▪ Plasma Membrane structure
	  o Description of bacterial cell components
	  o Tour of the eukaryotic cell
	  ▪ Basic description of all components, starting from the nucleus --> endoplasmic reticulum --> Golgi apparatus --> lysosomes and peroxisome --> cytoskeleton --> cell junctions
	• TRANSPORT through the plasma membrane.
	  o Passive
	  ▪ Simple diffusion, facilitate diffusion, osmosis.
	  o Active
	  ▪ Primary and Secondary
		Ch. 4
		
		Ch. 5 (1)
		Ch. 4
		
		Ch. 5 (2)

5	Metabolism and Enzyme
	• Definition and function of metabolism: Catabolic vs Anabolic pathways
	• Energy and Energy Transfer: the 2 laws of Thermodynamics
	• Activation Energy an Enzyme
	  o How Enzyme work
	  ▪ Substrate binding specificity
	  ▪ Helpers: Cofactors and Coenzymes
	  ▪ Factors affecting enzymatic activity (temp, pH, substrate conc.)
	  ▪ Inhibition
	  • Competitive, Noncompetitive, Allosteric, Feedback
		Ch. 6

Week	**Topic**	**Reading**

5-6	Cellular Respiration
	• How the energy is extracted from food: Redox reaction
	• The role of the Electron carriers
	• ATP: the energy currency of the cells
	  o Substrate-level phosphorylation vs chemiosmosis vs photophosphorylation
	• The 4 steps or Aerobic Respiration
	  o Glycolysis: overview (purpose and outcome)
	  o Pyruvate Oxidation: overview (purpose and outcome)
	  o Citric Acid Cycle: overview (purpose and outcome)
	  o Electron Transport Chain: (purpose and outcome)
	  ▪ Proton Motive Force and activation of ATP synthase
	• Fermentation
		Ch. 7

6	Photosynthesis	Ch. 8

6-7	Cell Division • Cell Cycle and Mitosis • Meiosis and Sexual Reproduction	 Ch. 10 Ch. 11
8	Mendelian Genetics	Ch. 12

9-10-11	The Central Dogma
	• DNA structure and Replication
	• Gene Expression: Transcription & Translation
	• Regulation of Gene Expression
	  ○ Prokaryotes (Operons)
	  ○ Eukaryotes
		
		Ch. 14
		Ch. 15
		Ch. 16

12-13	Biotechnology & Genomics	Ch. 17
14	Viruses Evolution	Ch. 21 Ch. 18

Academic Integrity

Undergraduate Honor System (100-400 level)

Enrollment into the undergraduate class of Stevens Institute of Technology signifies a student's commitment to the Honor System. Accordingly, the provisions of the Stevens Honor System apply to all undergraduate students in coursework and Honor Board proceedings. It is the responsibility of each student to become acquainted with and to uphold the ideals set forth in the Honor System Constitution. More information about the Honor System including the constitution, bylaws, investigative procedures, and the penalty matrix can be found online at http://web.stevens.edu/honor/

The following pledge shall be written in full and signed by every student on all submitted work (including, but not limited to, homework, projects, lab reports, code, quizzes and exams) that is assigned by the course instructor. No work shall be graded unless the pledge is written in full and signed.

"I pledge my honor that I have abided by the Stevens Honor System."

Reporting Honor System Violations

Students who believe a violation of the Honor System has been committed should report it within ten business days of the suspected violation. Students have the option to remain anonymous and can report violations online at www.stevens.edu/honor.

LEARNING ACCOMMODATIONS

Stevens Institute of Technology is dedicated to providing appropriate accommodations to students with documented disabilities. The Office of Disability Services (ODS) works with undergraduate and graduate students with learning disabilities, attention deficit-hyperactivity disorders, physical disabilities, sensory impairments, psychiatric disorders, and other such disabilities in order to help students achieve their academic and personal potential. They facilitate equal access to the educational programs and opportunities offered at Stevens and coordinate reasonable accommodations for eligible students.

These services are designed to encourage independence and self-advocacy with support from the ODS staff. The ODS staff will facilitate the provision of accommodations on a case-by-case basis.
For more information about Disability Services and the process to receive accommodations, visit https://www.stevens.edu/office-disability-services. If you have any questions please contact: Phillip Gehman, the Director of Disability Services Coordinator at Stevens Institute of Technology at pgehman@stevens.edu or by phone 201-216-3748.

Disability Services Confidentiality Policy
Student Disability Files are kept separate from academic files and are stored in a secure location within the Office of Disability Services. The Family Educational Rights Privacy Act (FERPA, 20 U.S.C. 1232g; 34CFR, Part 99) regulates disclosure of disability documentation and records maintained by Stevens Disability Services. According to this act, prior written consent by the student is required before our Disability Services office may release disability documentation or records to anyone. An exception is made in unusual circumstances, such as the case of health and safety emergencies.

INCLUSIVITY

Name and Pronoun Usage
As this course includes group work and class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect. This includes the ability for all students to have their chosen gender pronoun(s) and chosen name affirmed. If the class roster does not align with your name and/or pronouns, please inform the instructor of the necessary changes.

Inclusion Statement
Stevens Institute of Technology believes that diversity and inclusiveness are essential to excellence in academic discourse and innovation. In this class, the perspective of people of all races, ethnicities, gender expressions and gender identities, religions, sexual orientations, disabilities, socioeconomic backgrounds, and nationalities will be respected and viewed as a resource and benefit throughout the semester. Suggestions to further diversify class materials and assignments are encouraged. If any course meetings conflict with your religious events, please do not hesitate to reach out to your instructor to make alternative arrangements.
You are expected to treat your instructor and all other participants in the course with courtesy and respect. Disrespectful conduct and harassing statements will not be tolerated and may result in disciplinary actions.

MENTAL HEALTH RESOURCES

Part of being successful in the classroom involves a focus on your whole self, including your mental health. While you are at Stevens, there are many resources to promote and support mental health. The Office of Counseling and Psychological Services (CAPS) offers free and confidential services to all enrolled students who are struggling to cope with personal issues (e.g., difficulty adjusting to college or trouble managing stress) or psychological difficulties (e.g., anxiety and depression) and who can visit the office in person. CAPS is open from 9:00 am – 5:00 pm Mondays, Wednesdays, Thursdays and Fridays and from 9:00 am – 7:00 pm on Tuesdays during the Fall and Spring semesters; appointments are highly encouraged. For those students who cannot visit the Stevens campus for an in-person appointment, you can contact a local

mental health care provider for an in-person appointment, or if you are enrolled in the Stevens Student Health Insurance, you may call Care Connect for 24/7 mental health support at 1-888-857-5462.

EMERGENCY INFORMATION

In the event of an urgent or emergent concern about the safety of yourself or someone else in the Stevens community, please immediately call the Stevens Campus Police at 201-216-5105 or on their emergency line at 201-216-3911. These phone lines are staffed 24/7, year round. For students who do not reside near the campus and require emergency support, please contact your local emergency response providers at 911 or via your local police precinct. Other 24/7 national resources for students dealing with mental health crises include the National Suicide Prevention Lifeline (1-800-273-8255) and the Crisis Text Line (text "Home" to 741-741). If you are concerned about the wellbeing of another Stevens student, and the matter is not urgent or time sensitive, please email the CARE Team at care@stevens.edu. A member of the CARE Team will respond to your concern as soon as possible.