Master Course Syllabus

For additional course information, including prerequisites, corequisites, and course fees, please refer to the Catalog: https://catalog.uvu.edu/

Semester: Spring
Year: 2025
Course Prefix: BIOL
Course and Section #: 3550, #003
Course Title: College Biology
Credits: 3

Course Description

BIOL 1610: Molecular Biology "Examines the structure, organization, replication, and expression of genomes. Explores the methods used for study of genome structure and function, including nucleotide and protein extractions, separations, and characterizations. Compares sequence data of genomes, transcriptomes, and proteomes. Examines primary literature in the field."

Course Attributes

This course has the following attributes:
☐ General Education Requirements
☐ Global/Intercultural Graduation Requirements
☐ Writing Enriched Graduation Requirements
☒ Discipline Core Requirements in Program
☐ Elective Core Requirements in Program
☐ Open Elective
Other: Prerequisite(s): BIOL 1610, CHEM 1110 or CHEM 1215, and University Advanced Standing. This is an Online Course with optional Livestream discussion sessions.

Instructor Information

Instructor Name: Ruhul Kuddus

Student Learning Outcomes

Upon completing this course, students would be able to
"1. Identify the underlying mechanisms of genome expression (i.e., transcription and translation).
2. Investigate the structure-function relationships of macromolecules.
3. Explain the methods of extraction, separation, characterization and manipulations of nucleic acids and proteins.
4. Interpret the sequence data of genomes, transcriptomes and proteomes.
5. Interpret published research reports on genomes, transcriptomes, proteomes, and regulation of genome expression."

Course Materials and Texts

Learning materials provided by the instructor are
(1) Lecture Excerpts as PDF files
(2) PowerPoint Lecture Outline

(2) Video Lectures (unedited) based on PowerPoint Lecture Outline
(3) Multiple-choice Items (MCI) questions for virtual classroom and online quizzes
(4) Answers and explanations of the MCIs (available before examinations)
(5) Assignments for AI-generated writing projects (AIWP).

Course Requirements

Course Assignments, Assessments, and Grading Policy
12 of 15 Virtual Classroom Quizzes (CRQs)- 12%
15 of 17 Online Quizzes (OLQs)- 30%
4 AI-Generated Writing Projects (AIWPs)- 8%
Two Midterm Examinations-30%
One Two-Part Final examination-20%
Extra credit opportunities-2%

Note: CRQs should be taken during the virtual class and can be taken twice. OLQs can be taken as homework and can be taken three times. Individual students or groups of 2-3 students can take CRQs and OLQs and submit the report on AIWP within the deadline. Midterms and final examinations are not group examinations and can only be taken once in one sitting within the deadline. All quizzes and examinations are open-book and open-note. Generative AI can be used in solving MCIs and writing AIWP reports, but not for taking the midterms and final examinations. All quizzes and examinations are online, but midterms and final examinations are remotely video-proctored, so students may not use phone or online help while taking the examinations. The examinations are cumulative; the final examination, part 2, involves writing a detailed critique of a recently published research article in molecular biology).
Course curriculum source: Derived from most recent editions of reputable textbooks on molecular biology

Required or Recommended Reading Assignments
Recommended Readings: Craig N, et al. Molecular Biology: Principles of Genome Function 3rd Ed., Oxford University Press (2021).

General Description of the Subject Matter of Each Lecture or Discussion
1. Molecular Biology: An Overview- A brief review of Medelain and Morganian genetics; definition of common terminologies; a brief review of discoveries that established the field of molecular biology; weak bonds and their roles in the structure of macromolecules, macromolecular interactions, and function.

2. Structure of Nucleic Acids- The common nitrogenous bases, nucleotides, and nucleosides; structure of A, B, and Z form of dsDNA; topological constraints od dsDNA and the roles of topoisomerases; melting of dsDNA; UV-absorption spectra of nucleic acids; DNA intercalating agents; unique nitrogenous bases found in RNAs; secondary and tertiary structures of folded RNAs; IRESs, aptamers, and riboswitches; and structure and activities of some ribozymes.

3. Protein structure- Chemical properties of different groups of amino acids used in protein synthesis; the phi, psi and peptide bonds and their roles in protein folding; the primary, secondary, and tertiary/quaternary structures of a protein; domain structure of eukaryotic proteins; and the common motifs found in DNA binding proteins.

4. DNA Techniques- DNA and RNA extraction and quantification; cDNA synthesis; primer designing, PCR and RT-PCR; size-fractionation of single- and double-stranded nucleic acids; type I, II, and III endonucleases; restriction-fragment length polymorphism and its applications; cloning vectors used for constructing genomic and cDNA libraries, subcloning and protein expression across species; screening of cloned DNA; solution hybridization, blotting techniques and gene chips; major DNA sequencing technologies; RNA-seq; whole genome sequencing and annotation; and some standard bioinformatic tools.

5. Protein Techniques- The concepts of translatome; protein extraction; the common separation technologies for protein isolation; protein assays for protein separation; expression and separation of tagged, flagged, and fusion polypeptides across species; size fractionation of proteins; two-dimensional separation of proteomes; protein identification by sequencing, mass spectroscopy, and western blotting; analysis of protein-DNA interactions; and assessing genome expression activities by chip-seq, and chip-chip assays.

6. Genome Structure- The structure, size, and gene density of the genome of different groups of genome creatures; the composition of the human genome; the structure of the centromeres and telomeres; structure of the mammalian genome at different phases of the cell cycle; structure of the nucleosomes and 10 and 30 nm chromatins; the nuclear matrix and structural domains of the nuclear genome; the structure of core histones; histone modifications ad their roles on chromatin compacting and relaxing; and removal and positioning of histones during transcription and genome replication.

7. Genome Replication- The origin-dependent replication of bacterial genome; the replisome and roles of the replisome components; structure of the processive DNA polymerases; how simultaneous replication of the leading and lagging strand is possible; removal and replacement RNA primers of the Okazaki fragments in bacteria and eukaryotic cells; repair and modification of the freshly replicated chromosomes; and replication of some RNA genomes.

8. DNA Recombination- Homologous recombination; conservative site-specific recombination by tyrosine and serine recombinases; using recombinases as tools for genome editing; lysogenic infection by lambda bacteriophage of E. coli; integration of retroviral DNA genome to the chromosomes; some DNA transposons and their transposition; using DNA transposons and transposases as tools for genome editing; endogenous retroviruses; retroviruses-like retrotransposons and how they transpose; LINES and SINES and how they transpose; how the cell regulate rate of transposition.

9. Genome Transcription- The structure of bacterial and eukaryotic RNA polymerases; structure of bacterial genes; structure of class I, II, and III genes of eukaryotes; transcription intuition in bacteria and eukarya (class II genes only); transcription termination in bacteria and eukarya (class II genes only); the roles of gene regulators in transcription intuition in mammalian genes; and capping and polyadenylation of eukaryotic mRNA transcripts.

10. RNA Grooming- Processing rRNA and tRNAs; splicing of eukaryotic mRNAs; structure of the GU-AG and CU-AC introns; chemistry of cis-splicing and the roles of snRNPs; chemistry of trans-splicing; group I and II introns and how they splice; different types of alternative splicing; roles of splice enhancers and silencers in alternative splicing; modifications of tRNAs; modifications of mRNAs in regulating genome expression; and the process of RNA editing.

11. Translation and Protein Grooming- The structure of prokaryotic and eukaryotic mRNAs; long open reading frames; structure of tRNA and tRNA charging; the initiator tRNA and how it is distinguished from elongation tRNAs; structure of rRNAs and ribosomes; the universality and beauty of the genetic code; codons, anticodons and the wobbling; translation initiation, peptidyl transferase activity, the translocation process, and transcription termination in bacteria; how fidelity of translation is ensured; transcription initiation in eukarya; examples of global and mRNA-specific regulation of translation; how the cell prevents translation of mutated mRNAs, and mechanisms of translation inhibition by some antibiotics.

12. Regulation of Transcription in Bacteria- The housekeeping and regulated genes; transcription regulators and how they exert their effects; insulators, silencers, and enhancers; the allosteric and recruitment process of regulating bacterial transcription; the lac operon and its transcriptional regulation; the ara operon and its transcriptional regulation; the genetic switch that controls the lytic and lysogenic infection and activation of the bacteriophage lambda; and transcriptional regulation by antitermination.

13. Regulation of Transcription in Eukarya- The epigenetic regulation gene expression revisited; the chromatin remodeling system; mediators and how they affect transcription initiation; other transcription regulators and how they contribute to transcription initiation; how insulators and locus control elements affect transcription; structure of the enhanceosomes; how cell signaling affects transcription; how a transcriptionally active gene is silenced; and the mechanism of gene imprinting.

14. Regulatory RNAs- Some anecdotal examples of RNA-mediated gene regulation in bacteria; riboswitches and how they affect transcription and translation; The CRISPR system and how it offers antiviral immunity to bacteria; CRISPR technology for genome editing; the siRNA, miRNAs, and piRNAs and their roles in inhibition of translation and transcription; RNAi and how plant use it to prevent viral infections; applications of RNAi in biotechnology and medicine; some long noncoding RNAs; and silencing of the extra X chromosomes in the female mammals.

The Final grade percentage is rounded to the nearest tenth and assigned the corresponding letter grade:
A = 90.0 -100%
A(-) =85.0 – 89.9%
B(+) = 80.0 - 84.9%
B = 75.0 - 79.9%
B(-) = 70.0 - 74.9%
C(+) = 65.0 - 69.9%
C = 60.0 - 64.9%
C(-) = 55.0 - 59.9%
D(+) = 50.0 - 54.9%
D = 45.0 – 44.9%
D(-)- = 40.0 - 44.9%
F = <39.9%

Required Course Syllabus Statements

Generative AI
Policy on Students using Generative Artificial Intelligence (AI) tools
This course does NOT allow students to use Generative AI tools such as ChatGPT, Google BARD, Dall-e, etc., in taking examinations 1, 2, and 3 Part I and Part II. This course allows students to use Generative AI tools for the following learning activities. A. Composing the writing project (AI-WPs). B. Solving multiple-choice items (MCIs) of online quizzes (OLQs) and classroom-type quizzes (CRQs). You do not need to report whether you used AI in solving these questions. C. Solving study guides for

Examinations 1, 2, and 3 Part I, to prepare for the examinations. You do not need to report whether you used AI to solve study guides.

Learning a subject such as biology is mastering the underlying principles, gaining the skills to apply the principles, and achieving the ability to be creative in the discipline and beyond. Mastering how to use Generative AI to study biology is not a goal of this course, but AI is a powerful tool that can enhance learning. The Center for Advanced Teaching of Temple University (teaching.temple.edu) suggests students make use of AI for the following applications: "(A) Brainstorming and refining your ideas; (B) Fine-tuning your research questions; (C) Finding information on your topic; (D) Drafting an outline to organize your thoughts; and (E) Checking grammar and style." Concurring with the policies suggested by the Center for Advanced Teaching of Temple University, the present course prohibits the following usage of AI: "(A) impersonating you in classroom contexts, such as by using the tool to compose discussion board prompts assigned to you or content that you put into a Zoom chat; (B) Completing group work that your group has assigned to you unless it is mutually agreed upon that you may utilize the tool; (C) Writing a draft of a writing assignment; and (D) Writing entire sentences, paragraphs or papers to complete class assignments." In addition, "You are responsible for the information you submit based on an AI query (for instance, that it does not violate intellectual property laws, or contain misinformation or unethical content). Your use of AI tools must be properly documented and cited to stay within university policies on academic honesty." Note: AI can make a mistake. Your writing reports will be scrutinized for correctness, and the final writing project will be graded accordingly.

Using Remote Testing Software

☐ This course does not use remote testing software.

☒ This course uses remote testing software. Remote test-takers may choose their remote testing locations. Please note, however, that the testing software used for this may conduct a brief scan of remote test-takers' immediate surroundings, may require use of a webcam while taking an exam, may require the microphone be on while taking an exam, or may require other practices to confirm academic honesty. Test-takers therefore shall have no expectation of privacy in their test-taking location during, or immediately preceding, remote testing. If a student strongly objects to using test-taking software, the student should contact the instructor at the beginning of the semester to determine whether alternative testing arrangements are feasible. Alternatives are not guaranteed.

Required University Syllabus Statements

Accommodations/Students with Disabilities

Students needing accommodations due to a permanent or temporary disability, pregnancy or pregnancy-related conditions may contact UVU Accessibility Services at accessibilityservices@uvu.edu or 801-863-8747.

Accessibility Services is located on the Orem Campus in BA 110.

Deaf/Hard of Hearing students requesting ASL interpreters or transcribers can contact Accessibility Services to set up accommodations. Deaf/Hard of Hearing services can be contacted at DHHservices@uvu.edu

DHH is located on the Orem Campus in BA 112.

Academic Integrity
At Utah Valley University, faculty and students operate in an atmosphere of mutual trust. Maintaining an atmosphere of academic integrity allows for free exchange of ideas and enables all members of the community to achieve their highest potential. Our goal is to foster an intellectual atmosphere that produces scholars of integrity and imaginative thought. In all academic work, the ideas and contributions of others must be appropriately acknowledged and UVU students are expected to produce their own original academic work.

Faculty and students share the responsibility of ensuring the honesty and fairness of the intellectual environment at UVU. Students have a responsibility to promote academic integrity at the university by not participating in or facilitating others' participation in any act of academic dishonesty. As members of the academic community, students must become familiar with their rights and responsibilities. In each course, they are responsible for knowing the requirements and restrictions regarding research and writing, assessments, collaborative work, the use of study aids, the appropriateness of assistance, and other issues. Likewise, instructors are responsible to clearly state expectations and model best practices.

Further information on what constitutes academic dishonesty is detailed in UVU Policy 541: *Student Code of Conduct*.

Equity and Title IX
Utah Valley University does not discriminate on the basis of race, color, religion, national origin, sex, sexual orientation, gender identity, gender expression, age (40 and over), disability, veteran status, pregnancy, childbirth, or pregnancy-related conditions, citizenship, genetic information, or other basis protected by applicable law, including Title IX and 34 C.F.R. Part 106, in employment, treatment, admission, access to educational programs and activities, or other University benefits or services. Inquiries about nondiscrimination at UVU may be directed to the U.S. Department of Education's Office for Civil Rights or UVU's Title IX Coordinator at 801-863-7999 – TitleIX@uvu.edu – 800 W University Pkwy, Orem, 84058, Suite BA 203.

Religious Accommodation
UVU values and acknowledges the array of worldviews, faiths, and religions represented in our student body, and as such provides supportive accommodations for students. Religious belief or conscience broadly includes religious, non-religious, theistic, or non-theistic moral or ethical beliefs as well as participation in religious holidays, observances, or activities. Accommodations may include scheduling or due-date modifications or make-up assignments for missed class work.
To seek a religious accommodation, a student must provide written notice to the instructor and the Director of Accessibility Services at accessibilityservices@uvu.edu. If the accommodation relates to a scheduling conflict, the notice should include the date, time, and brief description of the difficulty posed by the conflict. Such requests should be made as soon as the student is aware of the prospective scheduling conflict.

While religious expression is welcome throughout campus, UVU also has a specially dedicated space for meditation, prayer, reflection, or other forms of religious expression.

The End