NUCLEIC ACID FUNCTION AND PROTEIN SYNTHESIS

CHEM 563

FALL 2021
SCHEDULE NUMBER 20875

COURSE INFORMATION

Class Days: MWF Aug 23 – Nov 3, 2021
Class Times: 1:00 – 1:50 pm PDT

Class location: P-144 or zoom:
https://SDSU.zoom.us/j/87560898936

Instructor: Manal Swairjo, PhD.
Office hours: Wednesdays 2-3 pm PDT & Thurs 12:45-1:45 pm PDT, or by appointment
mswairjo@sdsu.edu
Office hour location: Come in person to CSL-340 or find me at zoom link
https://SDSU.zoom.us/j/84870261915

COURSE OVERVIEW

Course description:
This is a course in advanced, selected topics in modern chemistry. The course may be repeated with new content. The content of this course focuses on the biochemistry of nucleic acids and protein synthesis, from structure to function to mechanisms. Topics include the structures and properties of nucleotides and nucleic acids, prokaryotic and eukaryotic DNA replication, nucleic acid purification and analysis, bacterial and eukaryotic transcription, posttranscriptional RNA processing, translation and the genetic code, prokaryotic and eukaryotic protein synthesis, protein synthesis targets of antibiotics, regulation of gene expression, DNA structure in cell cycle, and reverse transcription.

Student Learning Outcomes:
Students who complete this course will be able to
1) Illustrate and compare in molecular detail how prokaryotic versus eukaryotic cells replicate DNA.
2) Illustrate and compare in molecular detail how prokaryotic versus eukaryotic cells synthesize RNA.
3) Illustrate in molecular detail how living cells synthesize proteins.
4) Describe how eukaryotes process their newly synthesized RNA to the final functional RNA.
5) Compare how prokaryotes versus eukaryotes control/regulate the expression of genetic information.
6) List the common modes by which proteins interact with nucleic acids, and predict the structural and functional outcomes of these interactions.

Real Life Relevance:
This course will give you the fundamental knowledge needed to understand the Covid-19 pandemic. This course is an entry way to understanding modern medicine and biotechnology, and is an essential introduction of necessary knowledge for any career in these fields, including job placements in the biotechnology industry and health professions.

Relation to Other Courses:

This course builds on concepts introduced in General Biochemistry CHEM 560 (and CHEM 365), and builds toward more advanced concepts covered in CHEM 596 (Adv. Biochemistry of Nucleic Acids).

ENROLLMENT INFORMATION

Prerequisites:

CHEM 560 (General Biochemistry), or CHEM 365 (Biochemistry, Cell & Molecular Biology), or the equivalent (one semester of upper-level biochemistry). Credit for CHEM 563 is applicable to a master's degree with approval of the graduate adviser.

Adding/Dropping Procedures:

You can drop the class within the first 10 days of the semester (university policy), i.e. by September 1st 2021.

COURSE MATERIALS

Required Materials:

Textbook: Voet, Voet, and Pratt: "**Fundamentals of Biochemistry**", Wiley, 5th edition (2016). Most of you have used this textbook for CHEM 560.

Recommended Material: All other course material (Lecture Powerpoints, Zoom lecture recordings, quizzes and exams) will be posted on Canvas.

COURSE STRUCTURE AND CONDUCT

This online course is structured in three modules, each includes several lectures, quizzes and a non-cumulative exam. Synchronous lectures will be given in-person in the classroom and via Zoom on MWF 1:00-1:50 pm, with the exception of some Fridays (see Course Schedule below). The Zoom lectures will be recorded, and links to the lecture recordings will be posted on Canvas. All other course material (lecture powerpoints, and graded course activities/quizzes and exams) will be posted on Canvas and made live in their respective times. Although lecture powerpoints are posted in advance, some may be updated with minor changes the week they fall in, so make sure you view the latest for studying or to prepare for exam.

Technology Utilized in the Course:

Zoom, SDSU Canvas account, internet, MediaSite.

Down the line, I may recommend that you install on your computer the Pymol software (free student version, Schrodinger) https://pymol.org/edu/?q=educational/

COURSE ASSESSMENT AND GRADING

- There will be a few short activities/quizzes that will post with each course module on Canvas, totaling 8 such quizzes/activities for the whole course. For each module, you can complete the quizzes/activities from home any time during that module's instruction period. No time extensions will be provided except in the case of a verifiable long-term medical emergency.

- There will be three exams in this course, one after each module. **All exams will be offered on Canvas but they are to be taken in real time in person in the classroom, so YOU MUST BRING YOUR LAPTOP TO THE CLASSROOM AND USE IT TO TAKE THE EXAM**. **Rare exceptions are to my discretion.** All exams are open-book and open-notes. None of the exams is cumulative. Instructions for each exam will be made clear on Canvas. Note that any of this is subject to change depending on the Covid-19 pandemic situation and future guidelines. Do not worry, I will keep you abreast of any changes via Canvas announcements and will make things work. Just make sure you always have a laptop and internet connection as you did in the last two semesters.

Canvas Quizzes/activities 1-8: varying points depending on activity, totaling 80 points (40% of final grade).
Exams 1-3: 40 points each (each is 20% of final grade).
Total: 200 points.

Grading scale:

Percent Score	Grade
≥ 93.33	A
90 to < 93.33	A-
86.66 to < 90	B+
83.33 to < 86.66	B
80 to < 83.33	B-
76.66 to < 80	C+
73.33 to < 76.66	C
70 to < 73.33	C-
66.66 to < 70	D+
60 to < 66.66	D
< 60	F

Excused Absence Make-up Policies:
You are required to take exams on the scheduled dates. Make up exams are offered only with a documented medical emergency to be assessed at my discretion, AND a written excuse from the Office of Student Life.

ACADEMIC HONESTY

The University adheres to a strict policy regarding cheating and plagiarism. These activities will not be tolerated in this class. Become familiar with the policy and what constitutes plagiarism (http://studentaffairs.sdsu.edu/srr/cheating-plagiarism.html). Any cheating or plagiarism will result in failing this class and a disciplinary review by the University. These actions may lead to probation, suspension, or expulsion.

Examples of Plagiarism include but are not limited to:

- Using sources verbatim or paraphrasing without giving proper attribution (this can include phrases, sentences, paragraphs and/or pages of work)

- Copying and pasting work from an online or offline source directly and calling it your own
- Using information you find from an online or offline source without giving the author credit
- Replacing words or phrases from another source and inserting your own words or phrases
- Submitting a piece of work you did for one class to another class

For more information on plagiarism, consult the SDSU policy (http://www.sa.sdsu.edu/srr/conduct1.html).

TURNITIN

Students agree that by taking this course all required papers may be subject to submission for textual similarity review to Turnitin.com for the detection of plagiarism. All submitted papers will be included as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers. You may submit your papers in such a way that no identifying information about you is included. Another option is that you may request, in writing, that your papers not be submitted to www.turnitin.com. However, if you choose this option you will be required to provide documentation to substantiate that the papers are your original work and do not include any plagiarized material.

TECHNICAL SUPPORT FOR CANVAS

Student Canvas support: https://library.sdsu.edu/computers-technology

COURSE SCHEDULE

	Lecture	DATE	TOPIC	Reading (from 5th edition)
Module 1	0	Monday, August 23, 2021	Introduction, syllabus, if we have time we begin talking about discovery of the gene	
	1	Wednesday, August 25	Discovery of the "gene" classic experiments. Nucleotides, basic nucleic acid structure.	Ch 3 pp 42-53. Ch 24 pp 832-840.
	2	Friday, August 27	Review of Nucleic acids structures and functions	Ch 3 pp 42-53. Ch 24 pp 832-840.
	3	Monday, August 30	Forces stabilizing nucleic acid structures. Geometry of DNA. Age and size of DNA. The origins of life.	Ch 24 pp 848-856.
	4	Wednesday, September 1	Prokaryotic DNA replication, part 1	Ch 25 pp 880-897.
	5	Friday, September 3	Prokaryotic DNA replication, part 2	Ch 25 pp 880-897.

	no class. Labor Day holiday	Monday, September 6, 2021		
	6	Wednesday, September 8	DNA Supercoiling and Topoisomerases	Ch 24, pp 840-847.
	7	Friday, September 10	Eukaryotic DNA replication.	Ch 25 pp 898-902.
	Exam 1	**Monday, September 13**	**Exam on material covered in lectures 1-7**	
Module 2	8	Wednesday, September 15	Transcription in prokaryotes: bacterial RNA polymerase, promoters.	Ch 26 pp 938-948.
	9	Friday, September 17	Transcription in prokaryotes: initiation, elongation and termination.	Ch 26 pp 938-948.
	10	Monday, September 20	Transcription in eukaryotes: eukaryotic RNA polymerases and general transcription factors.	Ch 26 pp 948-961.
	11	Wednesday, September 22	Post-transcriptional processing of mRNA in eukaryotes: mRNA capping, poly-adenylation, splicing, alternative splicing.	Ch 26 pp 961-973
	no class	Friday, September 24		
	12	Monday, September 27	post-transcriptional processing of rRNA and tRNA.	Ch 26 pp 973-978.
	13	Wednesday, September 29	reverse transcription and other examples of viral replication, antiviral drugs.	Ch. 25 pp 900-901
	Exam 2	**Friday, October 1**	**Exam on material covered in lectures 8-13**	
Module 3	14	Monday, October 4	Translation, part 1: aminoacylation	Ch 27 pp 982-1004.

	15	Wednesday, October 6	Translation, part 2: The wobble hypothesis	Ch 27 pp 982-1004.
	16	Friday, October 8	Translation, part 3: ribosome structure.	Ch 27 pp 994-1004.
	17	Monday, October 11	Translation, part 4: Stages of ribosomal translation: initiation.	Ch 27 pp 1004-1024.
	18	Wednesday, October 13	Translation, part 5: Stages of ribosomal translation: elongation and termination.	Ch 27 pp 1004-1029.
	no class	Friday, October 15		
	19	Monday, October 18	Antibiotics that target translation. Posttranslational processing.	
	20	Wednesday, October 20	Gene regulation in prokaryotes: sigma factors, repressors & activators (lac operon story, helix-turn-helix DNA binding motif), riboswitches.	Ch 28 pp 1043-1048. Ch 24 pp 861-862. Ch 24 pp 1050-1052.
	no class	Friday, October 22		
	21	Monday, October 25	Gene regulation in eukaryotes, part 1: DNA binding domains in eukaryotic transcription factors.	Ch 28 pp 1063-1069. Ch 24 pp 864-867.
	22	Wednesday, October 27	Gene regulation in eukaryotes, part 2: Role of chromatin.	Ch 24 pp 868-873. Ch 28 pp 1052-1063. Ch 28 pp 1069-1075.
	no class	Friday, October 29		
		Monday, November 1	Review	
	Exam 3	**Wednesday, November 3**	**Exam on material covered in lectures 14-22**	

ESTIMATED TIME COMMITMENT

TABLE 1: MODULE AND ESTIMATED HOURS

Module	Estimated hours
1. nucleic acid structure and chemical properties, central dogma, molecular evolution.	4 lecture, 8 study hours
2. DNA replication	3 lecture, 6 study hours
2. transcription	6 lecture, 12 study hours
6. translation	4 lecture, 8 study hours
7. gene regulation	4 lecture, 8 study hours

STUDENTS WITH DISABILITIES

If you are a student with a disability and believe you will need accommodations for this class, it is your responsibility to contact Student Disability Services at (619) 594-6473. You can also learn more about the services provided by visiting the Student Disability Services website.

To avoid any delay in the receipt of your accommodations, you should contact Student Disability Services as soon as possible. Please note that accommodations are not retroactive, and that accommodations based upon disability cannot be provided until you have presented your instructor with an accommodation letter from Student Disability Services. Your cooperation is appreciated.

STUDENT SERVICES

A complete list of all academic support services is available on the Academic Success section of the SDSU Student Affairs website.

For help with improving your writing ability, the staff at the SDSU Writing Center is available in person and online.

Counseling and Psychological Services offers confidential counseling services by licensed psychologists, counselors, and social workers. More info can be found at their website or by contacting (619) 594-5220. You can also Live Chat with a counselor http://go.sdsu.edu/student_affairs/cps/therapist-consultation.aspx between 4:00pm and 10:00pm, or call San Diego Access and Crisis 24-hour Hotline at (888) 724-7240.

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