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# NUCLEIC ACID FUNCTION AND PROTEIN SYNTHESIS

## CHEM 563

FALL 2024  
SCHEDULE NUMBER 7310

### COURSE INFORMATION

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Class Days: MW Aug 26 – Dec 11, 2024

Class Times: 1:00 – 1:50 pm PDT

Class location: GMCS-314

Instructor: Manal Swairjo, PhD.

Office hours: Wednesdays 2:30-3:30 pm PDT, or by appointment [mswairjo@sdsu.edu](mailto:mswairjo@sdsu.edu)

Office hour location: Come in person to CSL-340 or find me on zoom link

<https://SDSU.zoom.us/j/89586686227>

### COURSE OVERVIEW

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#### 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. Credit for CHEM 563 is applicable to a master's degree with approval of the graduate adviser.

#### 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 and process RNA.
- 3) Illustrate in molecular detail how living cells synthesize proteins.
- 5) Compare how prokaryotes versus eukaryotes control/regulate the expression of genetic information.
- 6) Understand the contributions of scientists from varied backgrounds and examine how equity, access, and ethical considerations shape advancements in nucleic acid-based technologies.

#### Real Life Relevance:

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

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### Prerequisites:

CHEM 560 (General Biochemistry), or CHEM 365 (Biochemistry, Cell & Molecular Biology), or the equivalent (one semester of upper-level biochemistry).

### Adding/Dropping Procedures:

You can drop the class by September 9<sup>th</sup> 2024, the Schedule Adjustment Deadline set by the university.

## COURSE MATERIALS

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### Required Materials:

Textbook: Voet, Voet, and Pratt: “**Fundamentals of Biochemistry**”, Wiley, 5<sup>th</sup> 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

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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 on MW 1:00-1:50 pm (see Course Schedule below). The 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:

SDSU Canvas account, Respondus LockDown Browser, 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/>

Student Canvas support: <https://it.sdsu.edu/get-help>

## COURSE ASSESSMENT AND GRADING

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- 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 on your laptop. Important! You must have Respondus LockDown Browser working on your laptop, no exceptions. Do not use an iPad, Respondus does not work there. For help installing Respondus LockDown Browser on your laptop, talk to IT in the Love library. Make sure your laptop battery is fully charged before the exam, or bring your charger.**

All exams are open-book and open-notes. None of the exams is cumulative. Instructions for each exam will be made clear on Canvas.

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

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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

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Students agree that by taking this course all required papers may be subject to submission for textual similarity review to [Turnitin.com](http://www.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](http://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.

## COURSE SCHEDULE

	Lecture	DATE	TOPIC	Reading
				(from 5 <sup>th</sup> edition)
<b>Module 1</b>	0	Monday, Aug 26	Introduction, syllabus, if we have time we begin talking about discovery of the gene	
	1	Wednesday, Aug 28	Discovery of the "gene" classic experiments. Nucleotides, basic nucleic acid structure.	Ch 3 pp 42-53. Ch 24 pp 832-840.
	<b>No class. Labor Day Holiday</b>	Monday, Sept 2		
	2	Wednesday, Sept 4	Review of Nucleic acids structures and functions	Ch 3 pp 42-53. Ch 24 pp 832-840.
	3 <b>Last day to add/drop classes.</b>	Monday, Sept 9	Forces stabilizing nucleic acid structures. Geometry of DNA. Age and size of DNA. The origins of life.	Ch 24 pp 848-856.
	4	Wednesday, Sept 11	Prokaryotic DNA replication, part 1	Ch 25 pp 880-897.
	5	Monday, Sept 16	Prokaryotic DNA replication, part 2	Ch 25 pp 880-897.
	6	Wednesday, Sept 18	DNA Supercoiling and Topoisomerases	Ch 24, pp 840-847.
	7	Monday, Sept 23	Eukaryotic DNA replication.	Ch 25 pp 898-902.
	<b>Exam 1</b>	<b>Wednesday, Sept 25</b>	<b>Exam on material covered in lectures 1-7</b>	
<b>Module 2</b>	8	Monday, Sept 30	Transcription in prokaryotes: bacterial RNA polymerase, promoters.	Ch 26 pp 938-948.
	9	Wednesday, Oct 2	Transcription in prokaryotes: initiation, elongation and termination.	Ch 26 pp 938-948.
	10	Monday, Oct 7	Transcription in eukaryotes: eukaryotic RNA polymerases and general transcription factors.	Ch 26 pp 948-961.

	11	Wednesday, Oct 9	Post-transcriptional processing of mRNA in eukaryotes: mRNA capping, poly-adenylation, splicing, alternative splicing.	Ch 26 pp 961-973
	12	Monday, Oct 14	Post-transcriptional processing of rRNA and tRNA.	Ch 26 pp 973-978.
	13	Wednesday, Oct 16	Reverse transcription and other examples of viral replication, antiviral drugs.	Ch. 25 pp 900-901
	<b>Exam 2</b>	<b>Monday, Oct 21</b>	<b>Exam on material covered in lectures 8-13</b>	
<b>Module 3</b>	14	Wednesday, Oct 23	Translation, part 1: aminoacylation	Ch 27 pp 982-1004.
	15	Monday, Oct 28	Translation, part 2: The wobble hypothesis	Ch 27 pp 982-1004.
	16	Wednesday, Oct 30	Translation, part 3: ribosome structure.	Ch 27 pp 994-1004.
	17	Monday, Nov 4	Translation, part 4: Stages of ribosomal translation: initiation.	Ch 27 pp 1004-1024.
	18	Wednesday, Nov 6	Translation, part 5: Stages of ribosomal translation: elongation and termination.	Ch 27 pp 1004-1029.
	<b>No class. Veterans Day.</b>	Monday, Nov 11		
	19	Wednesday, Nov 13	Antibiotics that target translation. Posttranslational processing.	
	<b>No class. I will be at a conference.</b>	Monday, Nov 18		
	<b>No class. I will be at a conference.</b>	Wednesday, Nov 20		
	<b>No class. I will be at a conference.</b>	Monday, Nov 25		

	No class. Thanksgiving Holiday.	Wednesday, Nov 27		
20		Monday, Dec 2	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.
21		Wednesday, Dec 4	Gene regulation in eukaryotes, part 1: DNA binding domains in eukaryotic transcription factors.	Ch 28 pp 1063-1069. Ch 24 pp 864-867.
22		Monday, Dec 9	Gene regulation in eukaryotes, part 2: Role of chromatin.	Ch 24 pp 868-873. Ch 28 pp 1052-1063. Ch 28 pp 1069-1075.
	Last day of classes	Wednesday, Dec 11	Review	
	<b>Exam 3</b>	<b>Friday, Dec 13</b>	<b>Exam on material covered in lectures 14-22</b>	

## ESTIMATED TIME COMMITMENT

TABLE 1: MODULE AND ESTIMATED HOURS

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

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### Finding Help on Campus:

Need help finding help -- an advisor, tutoring, counselling, or emergency economic assistance? The SDSU Student Success Help Desk is here for you. Student assistants are available via Zoom Monday through Friday, 9:00 AM to 4:30 PM to help you find the office or service that can best assist with your particular questions or concerns.

- College of Arts and Letters Student Success Center: <https://cal.sdsu.edu/academics/student-success>
- College of Education Student Success Center: <https://education.sdsu.edu/oss>
- Center for Student Success in Engineering: <https://csse.sdsu.edu/advising/advising>
- College of Sciences Student Success Center: <https://cosuccess.sdsu.edu/>
- FCB Student Success Center: <https://business.sdsu.edu/undergrad/advising>
- CHHS Advisors: <https://chhs.sdsu.edu/academics/advising>
- SDSU Imperial Valley Student Success and Retention: <https://imperialvalley.sdsu.edu/about/departments/student-affairs/retention>
- PSFA Advisors: [https://psfa.sdsu.edu/resources/student\\_advisors](https://psfa.sdsu.edu/resources/student_advisors)
- Math & Science Learning Center: <https://mslc.sdsu.edu/>

### SDSU Economic Crisis Response Team:

If you or a friend are experiencing food or housing insecurity, technology concerns, or any unforeseen financial crisis, it is easy to get help! Visit <https://sacd.sdsu.edu/ecrt> for more information or to submit a request for assistance. SDSU's Economic Crisis Response Team (ECRT) aims to bridge the gap in resources for students experiencing immediate food, housing, or unforeseen financial crises that impacts student success. Using a holistic approach to well-being, ECRT supports students through crisis by leveraging a campus-wide collaboration that utilizes on and off-campus partnerships and provides direct referrals based on each student's unique circumstances. ECRT empowers students to identify and access long term, sustainable solutions in an effort to successfully graduate from SDSU. Within 24 to 72 hours of submitting a referral, students are contacted by the ECRT Coordinator and are quickly connected to the appropriate resources and services.

For students who need assistance accessing technology for their classes, visit our ECRT website <https://sacd.sdsu.edu/ecrt> to be connected with the SDSU library's technology checkout program. The technology checkout program is available to both SDSU and Imperial Valley students.

## CHANGES TO THE SYLLABUS

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This syllabus and the above schedule are subject to change if I deem it necessary. I will do my best to make these clear with announcements in class and on the Canvas website. Please pay attention to announcements made in class and lab. It is your responsibility to check on announcements made in your absence.

## COPYRIGHT POLICY

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SDSU respects the intellectual property of others and we ask our faculty & students to do the same.

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