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# ADVANCED BIOCHEMISTRY: EPITRANSCRIPTOMICS – CHEM 563B

SPRING 2025  
SCHEDULE NUMBER 11559

## COURSE INFORMATION

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Class Days: Tuesdays only, Jan 21 – May 8, 2025

Class Times: 9:30 – 10:30 am in person

Instructor: Manal Swairjo, PhD.

Office hours: Thurs 1-2pm, or by appointment

[mswairjo@sdsu.edu](mailto:mswairjo@sdsu.edu)

Office hour location: CSL-340

## COURSE OVERVIEW

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### Course description:

This course covers advanced topics in nucleic acids biochemistry and implications in human health and disease, including DNA processes of aging, DNA repair and cancer, DNA recombination and antibody generation, DNA modifications and bacterial RM system, genome editing and CRISPR/Cas technology, RNAi based technology, epitranscriptomics and tRNA based technology, nucleic acids based vaccines.

### Student Learning Outcomes:

Students who complete this course will be able to

- 1) Describe the fundamental principles of gene editing technology and discuss its ethical consequences.
- 2) Describe examples of epitranscriptomic human diseases and detail their molecular origins.
- 3) Distinguish RNAi, CRISPR/Cas and Restriction-Modification systems and their natural functions.
- 4) Speak fluently about viral and nucleic acid based vaccines.
- 5) Celebrate the women scientists behind the 21<sup>st</sup> century's most important discoveries in nucleic acid biochemistry: CRISPR/Cas and mRNA vaccines.

### Real Life Relevance:

Taking this course will help you understand some of the cutting edge biomedical technologies used in prevention, diagnosis and treatment of disease; and you will need this knowledge for any career in health professions or the pharmaceutical/biotechnology industry.

### Relation to Other Courses:

This course builds on concepts introduced in CHEM 563 (Nucleic Acid Function and Protein Synthesis).

## 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); and CHEM 563 or concurrently with it. Credit for 563b is applicable to a master's degree with approval of the graduate adviser.

- Adding/Dropping Procedures:

You can drop the class by 11:59 pm on February 3, 2025 (SDSU's schedule adjustment deadline).

## COURSE MATERIALS

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Required Materials: None.

Recommended Materials:

Textbook: Voet, Voet, and Pratt: “**Fundamentals of Biochemistry**”, 5<sup>th</sup> Edition, Wiley, 2016. Most of you have used this same text for CHEM 560.

Additional reading material from the primary literature, powerpoints, and videos will be provided on Canvas.

## COURSE STRUCTURE AND CONDUCT

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Style of the Course: Lecture, literature reading, classroom presentations and assignments.

Technology Utilized in the Course:

Canvas, internet access

Expectations:

You must do the assignments posted on Canvas by the deadlines indicated for them on Canvas.

## COURSE ASSESSMENT AND GRADING

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Undergraduate students: There will be 6 assignments (5 worth 16 points, 1 worth 20 points), a total of 100 points possible for the course.

Grading scale:

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:

This will be at my discretion and requires a valid medical excuse approved through the SDS office, emailed to me within 1 weeks after missing an assignment.

## COURSE SCHEDULE (ORDER OF TOPICS SUBJECT TO CHANGE)

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Lecture	DATE	TOPIC	Assignment due that week
1	1/21/2025	Introduction & syllabus. Telomeres and aging disease.	
2	1/28	DNA damage and repair.	
3	2/4	RNAi technology.	Assignment 1: RNA Interference, 16 points
4	2/11	Gene recombination - generation of antibodies.	

5	2/18	DNA recombination – transposition.	
6	2/25	Viral replication.	Assignment 2: Genetic Vaccines, 16 points
7	3/4	Nucleic acid technology to combat SARS-CoV2 (PCR tests, mRNA vaccines).	Assignment 3: Katalin Karikó, the woman behind the mRNA vaccine, 16 points.
8	3/11	Epitranscriptomics, the new RNA code.	Assignment 4: Mining/processing of RNA modification data. 20 points
9	3/18	Modomics Database.	
10	3/25	Epitranscriptomic sequencing technology.	
	4/1	No class. Spring Break	
11	4/8	RNA editing: ADAR and APOBEC enzymes, structure and mechanism.	Assignment 5: Role of tRNA modifications in human disease. (Review article. Present 5 slides on a posttranscriptional tRNA modification, its biosynthesis and role in health and disease, 16 points.
12	4/15	Posttranscriptional tRNA modifications - structures, functions.	
13	4/22	Biosynthesis of the modified nucleosides of tRNA – a few cool examples.	
14	4/29	Genome editing and CRISPR/Cas technology.	Assignment 6: NOVA CRISPR Documentary, 16 points.
15	5/6	DNA base modifications and restriction-modification systems. Metabolic cross talk between RNA and DNA modification.	

## ESTIMATED TIME COMMITMENT

Module	Estimated hours
DNA repair and recombination	6
Genome editing and RNAi technologies	3
Base editing and modification, epitranscriptomics technology	6
Genetic vaccine technologies	4.5

## ACADEMIC HONESTY

The University adheres to a strict [policy regarding cheating and plagiarism](http://studentaffairs.sdsu.edu/srr/cheating-plagiarism.html). 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 ChatGPT** or other artificial intelligence composition software to generate solutions to any course assignment including text and/or images for discussions and presentations.
- 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.

## TECHNICAL SUPPORT FOR CANVAS

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Student support for Blackboard is provided by the Library Computing Hub, located on the 2<sup>nd</sup> floor of Love Library. They can be reached at 619-594-3189 or [hub@mail.sdsu.edu](mailto:hub@mail.sdsu.edu)

## STUDENTS WITH DISABILITIES

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

To avoid any delay in the receipt of your accommodations, you should contact Student Abilities Success Center 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 Abilities Success Center. Your cooperation is appreciated.

## STUDENT SERVICES:

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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](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.

## COPYRIGHT POLICY

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