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# NUCLEIC ACID FUNCTION AND PROTEIN SYNTHESIS

## CHEM 563

FALL 2019  
SCHEDULE NUMBER 20850

### COURSE INFORMATION

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Class Days: MWF Aug 26 – Nov 4, 2019

Class Times: 1:00 – 1:50 pm

Class Location: P-244

Instructor: Manal Swairjo, PhD.

Office Hours Times: MW 2:30-4 pm, or email for  
appointment mswairjo@sdsu.edu

Office Hours Location: CSL 340

### 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 and function in cell cycle, reverse transcription, DNA damage and repair, DNA recombination.

#### Student Learning Outcomes:

Students who complete this course will be able to

- 1) describe in molecular detail how living cells synthesize DNA, RNA, and proteins.
- 2) explain and illustrate how nucleic acids interact with each other and with proteins, and predict the structural and functional outcomes of these interactions.
- 3) describe and illustrate the structural basis of the biochemical functions of nucleic acids and ribonucleoproteins.
- 4) describe and illustrate how the expression of genetic information is regulated at the molecular level.
- 5) describe the theory behind nucleic acid-based technologies.
- 6) describe in structural and functional detail some of the molecular abnormalities associated with cancer, aging, and genetic disease.

#### Real Life Relevance:

This course is an entry way to understanding modern medicine and biotechnology, and is essential 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 (Biochemistry of Nucleic Acids).

### ENROLLMENT INFORMATION

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Prerequisites:

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

## COURSE MATERIALS

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Required Materials:

Textbook: Voet, Voet, and Pratt: "**Fundamentals of Biochemistry**", Wiley, 4<sup>th</sup> edition (2012) or 5<sup>th</sup> edition (2016). Most of you have used this textbook for CHEM 560. **Purchasing and owning this textbook is absolutely required.**

Recommended Materials:

Additional handouts, review articles, and/or practice problems will be provided on Blackboard when necessary.

## COURSE STRUCTURE AND CONDUCT

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Style of the Course: Lecture

Technology Utilized in the Course:

Blackboard, Pymol software (free student version, Schrodinger). All students must download and install this free software on their laptops. It is required for class discussions and homework.

<https://pymol.org/edu/?q=educational/>

Expectations:

- 1) Regarding Powerpoints and your lecture notes, the Powerpoint slides will be available for download from SDSU Blackboard. Essentially all of the slides will be available as PDF files.
- 2) **Unless noted otherwise, you are responsible for learning everything presented in class, and for that you must read the textbook. There will be additional material presented in lecture that is not in the Powerpoints. Thus, attending the lecture is absolutely required!**
- 3) **There will be assigned homework. It will not be graded, but it will be taken into consideration - at my discretion - in assigning the final grade.**

## COURSE ASSESSMENT AND GRADING

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Exams: There will be a total of three exams of 100 points each, i.e. there are a total of 300 points possible for the course. The third exam will **not** be cumulative.

**The dates for the three exams are fixed at the beginning of the semester and will not change.**

**No calculators or electronic devices of any kind are allowed during the exams.**

**There may be multiple choice questions on the exams, and those will be answered on SCANTRON forms. Please bring a SCANTRON form No. 882-E to each exam.**

Grading scale:

270-300 points (90-100%):	A
240-269 points (80-90%):	B
210-239 points (70-80%):	C
180-209 points (60-70%):	D
<180 points (<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.

## TECHNICAL SUPPORT FOR BLACKBOARD

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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)

## COURSE SCHEDULE

	DATE	TOPIC	Reading (from 5 <sup>th</sup> edition)	Reading (from 4 <sup>th</sup> edition)
1	August 26	Nucleotides, nucleic acid structure  Overview of nucleic acid function, the Central Dogma, 3 types of RNA.	Ch 3 pp 42-50.  Ch 3 pp 50-53.	Ch 3 pp 40-48.  Ch 3 pp 48-51.
2	August 28	Forces stabilizing nucleic acid structures. Geometry of DNA. RNA enzymes and the RNA World. Size of DNA molecules.	Ch 24 pp 848-856.	Ch 24 pp 838-846.
3	August 30	Purification of nucleic acids.  Prokaryotic DNA replication.	Ch 24 pp 856-859.  Ch 25 pp 880-897.	Ch 24 pp 846-849.  Ch 25, pp 868-884.
	<b>September 2</b>	<b>Labor Day Holiday, campus closed, no class.</b>		
4	September 4	Prokaryotic DNA replication.	Ch 25 pp 880-897.	Ch 25, pp 868-884.
5	September 6	Recombinant DNA, restriction enzymes, plasmids, cloning.  PCR and DNA sequencing, molecular evolution and derivation of phylogenies from DNA sequences.	Ch 3 pp 54-56, 66-71.  Ch 3 pp 57-66.	Ch 3 pp 52-54.  Ch 3 pp 55-62.
6	September 9	DNA Supercoiling and Topoisomerases	Ch 24, pp 840-847.	Ch 24 pp 830-837.
7	September 11	Transcription in prokaryotes: bacterial RNA polymerase, promoters.	Ch 26 pp 938-948.	Ch 26 pp 919-929.
8	September 13	Transcription in prokaryotes: initiation, elongation and termination.	Ch 26 pp 938-948.	Ch 26 pp 919-929.
	<b>September 16</b>	<b>No class.</b>		
<b>9</b>	<b>September 18</b>	<b>Exam 1</b>		
10	September 20	Transcription in eukaryotes: eukaryotic RNA polymerases	Ch 26 pp 948-956.	Ch 26 pp 929-937.
11	September 23	Eukaryotic promoters, eukaryotic general transcription factors, preinitiation complex assembly.	Ch 26 pp 956-961.	Ch 26 pp 937-942.
12	September 25	Post-transcriptional RNA processing: eukaryotic mRNA capping, polyadenylation, and mRNA splicing.	Ch 26 pp 961-966	Ch 26 pp 942-947.
13	September 27	mRNA splicing; snRNPs.	Ch 26 pp 966-968.	Ch 26 pp 947-949.
14	September 30	Alternative splicing, RNA editing, transport of RNA to the cytoplasm.	Ch 26 pp 969-973.	Ch 26 pp 950-954.

15	October 2	rRNA processing; Group I and Group II self-splicing introns. tRNA processing.	Ch 26 pp 973-978.	Ch 26 pp 954-959.
16	October 4	Translation: the genetic code; tRNAs and aminoacylation	Ch 27 pp 982-994.	Ch 27 pp 962-974.
17	October 7	Translation: Codon-anticodon interactions, wobble, ribosomes.	Ch 27 pp 994-1004.	Ch 27 pp 974-984.
18	October 9	Polypeptide chain initiation, elongation, and termination.	Ch 27 pp 1004-1024.	Ch 27 pp 984-1004.
19	October 11	Protein synthesis inhibitors (antibiotics).  posttranslational processing.	Ch 27 pp 1020-1021.  Ch 27 pp 1025-1029.	Ch 27 pp 1000-1001.  Ch 27 pp 1004-1008.
<b>20</b>	<b>October 14</b>	<b>Exam 2</b>		
21	October 16	Regulation of prokaryotic gene expression: the lac operon and its repression and activation.  helix-turn-helix DNA-binding motif.  Riboswitches.	Ch 28 pp 1043-1048.  Ch 24 pp 861-862.  Ch 24 pp 1050-1052.	Ch 28 pp 1023-1028.  Ch 24 pp 851-852.  Ch 24 pp 1030-1032.
22	October 18	Regulation of eukaryotic gene expression: activators and repressors of transcription.  DNA binding domains in eukaryotic transcription factors.	Ch 28 pp 1063-1069.  Ch 24 pp 864-867.	Ch 28 pp 1043-1049.  Ch 24 pp 854-857.
23	October 21	Eukaryotic chromosomes and chromatin structure; histones, nucleosomes.	Ch 24 pp 868-873.	Ch 24 pp 858-863.
24	October 23	Role of Chromatin in eukaryotic gene regulation.  Posttranscriptional control of gene expression: RNA interference.	Ch 28 pp 1052-1063.  Ch 28 pp 1069-1075.	Ch 28 pp 1032-1043.  Ch 28 pp 1049-1055.
25	October 25	Cell cycle, cancer and apoptosis (programmed cell death).	Ch 28 pp 1080-1089.	Ch 28 pp 1059-1068.
26	October 28	Eukaryotic DNA replication.	Ch 25 pp 898-902.	Ch 25 pp 884-888.
27	October 30	Telomerase, aging and cancer.  DNA damage and repair.	Ch 25 pp 902-904.  Ch 25 pp 909-915.	Ch 25 pp 888-891.  Ch 25 pp 891-901.
28	November 1	DNA recombination.  Antibodies and DNA rearrangements for antibody production.	Ch 25 pp 916-924.  Ch 28 pp 1076-1079.	Ch 25 pp 902-911.  Ch 28 pp 1056-1059.
<b>29</b>	<b>November 4</b>	<b>Exam 3</b>		

## ESTIMATED TIME COMMITMENT

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TABLE 1: MODULE AND ESTIMATED HOURS

Module	Estimated hours
1. review of nucleic acid structure and chemical properties, central dogma, molecular evolution.	3
2. DNA replication, isolation and analysis methods	4
2. transcription	7
6. translation	4
7. gene regulation, DNA repair	8
9. exams	3

## 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 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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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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