BIOL540 Biotechnology
Purdue University Fort Wayne
Summer II 2022: 6/27/22-8/5/22
Course Format: Online Asynchronous

Instructor
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Office location
SB382

Office Hours
TF 15:00 – 17:00

Class time and classroom
Lectures MWF 10:00 am-12:20 pm SB304

Prerequisites and recommendations
Prerequisites: BIOL 217 and 381
Recommendations: one semester of organic chemistry or permission of instructor.

Course Description

The first part of the course analyzes and describes the mechanisms that regulate the synthesis of DNA, RNA and proteins in organisms. Later, the course discusses biotechnological strategies that are used to manipulate DNA and RNA structure and function to affect gene expression and, consequently, protein synthesis. In the last part, the course is focussed in understanding DNA, RNA and protein engineering based-techniques that are used in the production of pharmaceutical proteins, including enzymes, hormones and vaccines, as well as bioactive simple molecules, such as lipids and carbohydrates.

Learning Outcomes

After completion of this course, students will be able to understand:

1. The mechanisms that regulate RNA, DNA and proteins synthesis in organisms.
2. The principles of RNA-based, recombinant DNA, immune, fermentation and protein engineering technologies that are involved in the production of pharmaceutical proteins and simple bioactive molecules, including lipid and carbohydrates
3. The biotechnological strategies involved in generating transgenic plants and animals that are used for the production of pharmaceuticals and other drugs.

Textbooks

Required: Biotechnology (Second ed.) by Clark, D. and Pazdernik; Academic Cell, 2015
Recommended: Molecular Biotechnology: Principles and Applications of Recombinant DNA (Fifth ed.) Glick, BR. and Patten, CL. ASM Press. 2017.

Course Materials

The course management is conducted through Brightspace software, which will be used to distribute course materials, display grades of assessments and communicate between instructors and students. Brightspace can be accessed at https://purdue.brightspace.com/d2l/login?logout=1. A brief introduction will be given in the first lecture session and further assistance can be scheduled.

Attendance

Attendance will be recorded due to COVID-19 Purdue University Fort Wayne regulations, and will be considered as an assessment criterion for calculating student grades in the course. Therefore, students are strongly advised and expected to attend all lectures of the course. Students will receive a participation grade that includes attendance to lectures and contribution towards the discussion of key papers on biotechnology. Consequently, absent students are not eligible to earn points in such tasks, unless the student has been previously excused. Additionally, the instructor continuously advises relevant topics of focus for students to perform successfully in exams and assignments.

Organization of the Course and of Course Materials Provided

The course includes lectures given by the instructor that follow the contents of the textbooks, Biotechnology by Clark and Pazdernik and Molecular Biotechnology: Principles and Applications of Recombinant DNA by Glick and Patten. Only selected chapters from these books will be included in the course. Each selected chapter of the books is presented in two class sessions, which is further discussed with specific research papers through student presentations and discussions. Prior to each lecture, students will find the daily lecture presentation in PowerPoint form in a folder on Brightspace. In addition, students working with a partner will produce a mini-review paper focused on a current topic of biotechnology, which coincides with the content of the course. When writing this mini-review paper, students are encouraged to explore and identify key scientific problems related with biotechnology that should be addressed for the benefit of this scientific field and applied sciences. Students will further focus on specific and critical topics of biotechnology through analysing primary literature to formulate a proposal to discover a novel drug. Such proposal will serve as an academic exercise that enables students to dissect specific biotechnological strategies and implement the proper methodologies which may lead to the discovery of a novel drug. The instructor will guide students to select specific drugs to investigate together with the proper methodologies involved in the validation of its effects. By conducting this academic exercise, students can directly beneficiate in their current work and/or in future career endeavours.

Assessment of the Course and Grades

Assessment	Points	
Proposal for producing a drug	250 points	250
Review paper	200 points	200
Presentation of research proposal for drug discovery	100 points	100
Participation Presentation of papers Discussion	 100 points 100 points	 100 100
Quizzes	50 points x 2 quizzes	100
Final exam	150	150
Total		1000

In-class Presentations: Each student will give PowerPoint presentations on a key research paper assigned by the instructor, which goes into further depth of lecture material. The student presenting the topic, together with the instructor are responsible for leading the discussion on the presented paper. Classmates are expected to fully understand the paper before the presentation in order to allow for a rich discussion. The presentations will be 25 minutes in length followed by a 15 minutes discussion. The presentations will be assessed by both the instructor and the rest of the class. The paper presentations for each student is worth 100 points whereas the participation of the other students in discussions during the course represents another 100 points. Specific guidelines for the presentation will be given in the second lecture and posted on Brightspace. Another important oral presentation in class will take place on the last week of the course, in which each student will present his/her formulated proposal for producing a drug.

Mini-Review: The mini-review articles are intended to provide information on newly emerging or rapidly progressing fields, in our case biotechnology. Ideally, two students will produce a mini-review article, although three-author or single-author reviews are accepted as well. Specific guidelines for writing the mini-review article will be presented in the second lecture of the course. The deadline for the mini-review submission is **July 18, 2022 22:00 hrs**. Five points will be deducted per day if the assignment is not turned in by its original due date.

Research proposal for discovery a novel drug: The writing of a research proposal for drug discovery encourages students to better understand research literature in biotechnology.

Students are expected to compilate and analyze the most recent literature in a specific compound or protein, which can be potentially used as a drug. In writing this proposal, the students are firstly required to identify a simple compound or protein that can be used as drug. Subsequently, students will find out a possible target for the drug to act. This target could be a metabolic or signalling pathway in specific tissue that is implicated in a human disease. Once the drug target has been identified, students need to propose a number of activities to conduct a process known as "target validation". In this step, students should select the most suitable techniques to determine if the drug has an effect on the disease, typically by using 'knockout' animals. These animals lack some genes that are important for the disease and, therefore, determine if the target is important for the development of the disease. Once the target has been identified and validated, students need to select techniques and strategies to test compounds or proteins with similar structure to the novel drug that is being tested. In this stage, known as "lead optimisation", the structure of the drug is tweaked to improve its potency. After completing such studies, a highly potent drugs, typically 5-250 compounds, can be selected and, then, used for preclinical studies. The research proposal should end at this stage by proposing some *in vitro* and *in vivo* experiments to test the efficiency of these drugs. A specific content and format are required in the writing of the research proposal, therefore students should follow specific guidelines, which will be presented by the instructor. Each student requires to write a research proposal. The deadline for the research proposal submission is **July 22, 2022 22:00 hrs** and the presentation of the research proposal will take place in the last weeks of the course.

Grades of the course: Grades will be calculated on cumulative points considering each course assessment and are awarded on the following scale:

Description	Letter Grade
Excellent - superior performance	**A**
Good - clearly above average	**B**
Satisfactory - basic understanding	**C**
Minimal Pass - marginal performance	**D**
Fail - unsatisfactory performance	**F**

A+ ≥ 97 %	**A** ≥ 93%	**A-** ≥ 90%
B+ ≥ 87%	**B** ≥ 83%	**B-** ≥ 80%
C+ ≥ 77%	**C** ≥ 73%	**C-** ≥ 70%
D+ ≥ 67%	**D** ≥ 63%	**D-** ≥ 60%
F ≤ 60%		

Students with Disabilities

Helping and assisting students with disabilities needs to be addressed immediately, in order to provide the necessary accommodations to ensure a positive learning environment and student success. If you have a disability which requires assistance, please contact Disability Access Center (DAC; Walb Union, room 113B, at 481-6658) in order to address your needs. DAC will provide you with a letter attesting to your needs for modification of your study environment. Please bring the letter provided by SSD to the course instructor in order to allow the necessary modifications. For more information, visit https://www.pfw.edu/dac

Adverse Weather

Classes are only cancelled in adverse serious weather conditions when PFW permits an official closing, otherwise instructors and students are expected to attend classes.

Academic Misconduct

Respect to peers and instructors in addition to following an ethic code is paramount at Purdue University and specifically BIOL540 Biotechnology course. Academic misconduct includes cheating, fabrication, facilitating academic dishonesty, plagiarism as well as disrespecting peers and academic staff. Although misconduct events are not desired, misconduct issues will be properly addressed in accordance to the Code of Student Rights, Responsibilities, and Conduct, available in the Undergraduate Programs Bulletin and at https://www.pfw.edu/committees/senate/code/. Please read the code to become familiar with the stated rules.

COVID-19 Guidelines in Classes

COVID-19 has significantly impacted the way in which we conduct ourselves in the classes of our courses. Purdue University Fort Wayne faculty has formulated basic guidelines to ensure that students and instructors work in a safe, productive and friendly environment during the progress of our courses throughout this pandemic. The following COVID-19 guidelines will help you conduct yourself in this course and tell you what you should do if your encounter COVID-19.

1. **Always wear a mask**. Everybody, including students, instructors and teaching assistants, are required to wear mask on campus. If you are not wearing a mask, you will be asked to leave the classroom. If you then grab a mask from the various source posts in our university (the Kettler, Walb and Library Information Desks), you will be allowed to come back to class. It is also required that you wear your mask properly – covering your nose and mouth. If you have a medical condition that may exempt you from wearing a mask, please contact the Services for Students with Disabilities office at http://www.pfw.edu/ssd/

2. **Move safely between classrooms.** The instructor will open the classroom 10 minutes before the class begins in order for students to enter the classroom and maintain social distancing protocols. Once a student enters the classroom, they must stay seated in their sitting spot to allow for social distancing while the other students enter the classroom. The instructor will end the class on time in order for students to leave the classroom in an orderly fashion and be on time for their next class.
3. **Don't attend class if you have symptoms.** Both instructors and students are expected to stay home if they show any COVID symptoms. Do not come to classes if you feel sick or if you believe you have been in contact with someone who tests positive to COVID-19.
4. **Report and self-isolate if you are COVID-19 positive or have come into contact with someone who has COVID-19**. Students and instructors are required to report and self-isolate if they are COVID-19 positive or have contact with someone tested positive, as informed by a contact tracer. Reporting and isolation should be conducted following public health recommendations according to the established Student Reporting, Quarantine & Isolation Protocol. Students and instructors that are confirmed as COVID-19 positive or having COVID-19 contact are encouraged to self-disclose their condition by informing the chair of the department, instructors, advisors or through online CARE Team referral process. The instructor will inform students if a student from their class has tested positive in order to follow public health recommendations.
5. **Course arrangements for self-isolators**. If a student is asked to be isolated, the instructor will continue teaching the course online to this student. In the event that the instructor is tested positive to COVID, the instructor will continue teaching the course online, if health permits.

Course Schedule – BIOL540 Biotechnology

Date	Topic	Learning outcome	Book Chapter
June 27	Introduction		
June 29	RNA, DNA and protein synthesis	Understand the principles of RNA, DNA and protein synthesis.	02 Clark and Pazdernik 02 Glick and Patten
July 1	Recombinant DNA technology	Understand techniques for isolation and modification of DNA as well as the strategies for gene expression in prokaryotes and eukaryotes.	03 Clark and Pazdernik 03 Glick and Patten
July 6	DNA Synthesis *In Vivo* and *In Vitro*	Understand strategies for biosynthesis and chemical synthesis of the DNA to affect gene expression.	04 Clark and Pazdernik 02 Glick and Patten
July 8	RNA-Based Technologies	Understand how RNA regulates various cell functions and how the manipulation of RNA structure and function can be used to protect the human body from virus or modify important enzymes.	05 Clark and Pazdernik
July 11	Immune Technology	Understand how the structure and function of antibodies can be manipulated to produce vaccines.	06 Clark and Pazdernik 07 Glick and Patten
July 13	Recombinant Proteins	Understand the main strategies to produce recombinant proteins	10 Clark and Pazdernik 03 Glick and Patten
July 15	Protein Engineering and Therapeutics	Understand the main strategies to modify recombinant proteins with pharmaceutical properties.	11 Clark and Pazdernik 03 and 05 Glick and Patten
July 18	Synthetic Biology (biofuels and lipids)	Understand the main strategies to modify metabolic pathways in organisms for the production of lipids and biofuels.	13 Clark and Pazdernik
July 20	Transgenic Plants and Plant Biotechnology	Understand the molecular strategies to modify plants for biotechnological purposes.	15 Clark and Pazdernik 11 Glick and Patten
July 22	Transgenic Animals and aquatic biotechnology	Understand the molecular strategies to modify animals for biotechnological purposes. Understand the use of aquatic organisms in various biotechnology applications	16 Clark and Pazdernik 12 Glick and Patten
July 25	Fermentation Technology	Understand microbial growth and fermentation system used for production of bioactive molecules	09 Glick and Patten Additional books

Date	Topic	Learning outcome	Book Chapter
July 25, 27, 29 August 1, 3, 5	Student presentations of research proposals		
Final Exam August 1 10:00- 11:00 am			