BALL STATE UNIVERSITY
DEPARTMENT OF BIOLOGY
SYLLABUS – Fall 2025

Course Number: **BIOT 490/590** **Credit Hours: 3**

Lecture Instructor: Dr. Douglas Bernstein
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Office: FSB 412
Lab: FSB 436
Office Hours: **By appointment**
Class Meets: **T** 1:00-2:50 **R** 1:00-2:50 FSB 348 For some lectures we may meet in a different classroom to accommodate the large number of students enrolled this semester.
WebEx Room: https://ballstate.webex.com/join/dabernstein

Please contact me with any questions or concerns you have regarding this course as soon as possible. The most effective means of contacting me quickly is via e-mail as I ***generally*** receive and can respond to queries within 24 hours. Feel free to stop by my office or Lab anytime, and if I am available I would be happy to talk with you. In addition, I will try to stay 10-15 minutes after class provided no other immediate obligations to answer questions.

I. TITLE: Introduction to Recombinant DNA and RNA Techniques

II. Course Objectives	**NACE Competencies**	**Assignments that achieve the course goals and workplace competencies**
Apply molecular biology techniques to manipulate DNA in silico, in vitro, and in vivo	Critical thinking/Problem Solving	Quizzes 30 x 3 Final Open Book Open Notes Dilution Problem Set and Training Tips Dilution Lab
Work independently to design and perform a research project	Leadership	Stay on Task Assignments (SOTA)
Gain proficiency in scientific writing	Written Communication	Final Lab Notebook, Scheduled Lab Notebook Check 1, Final Lab Report
Gain proficiency in oral scientific communication	Oral Communication	Attendance and Participation
Use critical thinking and teamwork to solve molecular biology problems	Teamwork and Collaboration	Stay on Task Assignments (SOTA)
Use bioinformatic tools to design molecular biology experiments that will ultimately edit a fungal pathogen's genome	Digital Technology	Benchling Lab Notebook, Primer Design for Guide and Repair Templates
Work independently on a semester long research project	Professionalism Work ethic	Most of the semester you will work independently
Gain an appreciation for how industry science is distinct from academic science	Career Management	Articulate work place competencies gained
Elucidate the societal impacts of genetic engineering	Global Fluency	Discussions of Science in the News in class

High Impact Practices: This course is designated as an high impact practice since it requires students perform authentic research to achieve the learning objectives described above.

Students will be expected to **explain relevant issues within in the context of the course**. This will be achieved formally through quizzes and exams and informally through daily conversations between the instructor and students with regards to the semester long research project being performed. In addition, **students will learn to apply high-impact skills to their field of study**. This will be achieved through working on a semester long research project in the class where students design and perform an experiment that leverages these skills.

TEXTS, RESOURCES AND MATERIALS:

There will be no required text for this class. Students will be expected to print and bring posted lecture notes and readings to class. As we will be doing lab work many of the days in class having your laptop out is probably a bad idea. As such, I recommend writing your notes. If something spills on your computer you are to blame, not anyone else in the class. I have put several textbooks on reserve in the science library in FSB. As this is an upper-level biology course textbooks, primary literature, as well as other online resources will all be important methods of obtaining information. The books on reserve are

Principles of Biochemistry (6th Edition) Lehninger, Nelson, and Cox
Molecular Cell Biology (8th Edition) Lodish, Berk, Kaiser, Kreiger, Bretscher, Ploegh, Amon, Martin
Molecular biology Principles and Practice (2nd Edition) Cox, Doudna, and O'Donnel

Things you will need: 1) Flash drive recommended 2) Something to take notes in, can be laptop or notebook 3) A laptop that can connect to Ball State WIFI is required, if you do not have a suitable laptop please come see me.

III. PREREQUISITES: Special Permission is Required

IV. COURSE RATIONALE AND INDEPENDENT RESEARCH PROJECT:

Introduction to Recombinant DNA and RNA Techniques will provide students with a broad overview of the current state of nucleic acid research. The majority of the course will guide students through the investigation of nucleic acid metabolism genes in fungi. Students will use cutting edge technologies to manipulate nucleic acids *in silico*, *in vitro* and *in vivo* and will gain an appreciation and understanding of how and why we as scientists manipulate nucleic acids. For the independent research portion of the course students will identify a gene of interest, develop a strategy to knockout said gene from an organism, and implement this strategy using techniques learned in the class.

V. Learning Outcome and Goals Introduction to Recombinant DNA and RNA Techniques

The goal of this course is to provide biology majors and other interested parties with an overview of the fundamental concepts of nucleic acid metabolism and how it is being leveraged in both fundamental and applied research. We will investigate a variety of molecular biology techniques and concepts essential to a wide variety of applications important for all molecular biology research. Students will learn by performing these experiments and interpreting the results. As a foundational course in the Biotech program this course also aims to prepare students for careers where they are expected to manipulate nucleic acids.

You will be expected to carry yourself in a professional manner at all times during this course and display a strong work ethic.

Student goals for the special lecture topics portion of the course:

- **Use leadership and oral communication to engage the speaker and class about the days topic to gain a better understanding of the current state nucleic acid research. Topics will include Utility of genome browsers**
- **Structure and function of canonical nucleic acids**
- **Function of Nucleic Acid modification and alternative nucleic acid structures**
- **How are people using genome editing to answer fundamental biological questions**
- **How/why would you perform a genome wide screen in a model organism**
- **Discuss potential societal impacts of genetic engineering.**

Student goals for the laboratory portion of the course:

- **Apply digital technology tools including BLAST, genome databases, and genome engineering software to a novel research problem.**
- **Display the ability to use bioinformatic tools to design molecular biology experiments that will ultimately edit a fungal pathogen's genome.**
- **Learn to use Benchling to maintain a clearly written lab notebook.**
- **Use critical thinking and teamwork to solve molecular biology problems in a digital environment.**
- **Use techniques such as ligation, primer annealing, phosphatase treatment, restriction digestion to clone a DNA fragment into a plasmid vector.**
- **Transform bacteria with plasmid and select for transformants using antibiotic selection.**
- **Purify plasmid and genomic DNA from bacteria.**

VI. Rough Tentative BIOT490/590 Schedule

This is a very tentative schedule as between the new building and Covid we have a lot of variables to deal with. If some of you make it through all of the work listed we will move on to generating mutants in fungi. Bold is lecture/discussion topics. Red is projects/assignments we are going to work on.

Week 1: Intro to the course and organization
Syllabus and Nucleic Acid Background Lecture
how to make solutions in a lab dilution problem sets
Week 2: **Genome Browsers/BLAST** (Genome Browser Assignment)
Week 3: **DNA RNA Techniques Lecture** Plasmid Annotation Assignment
Week 4: **CRISPR and genome editing Lecture** (Quiz 1)
Week 5: **Introduction to Benchling** Design PCR Primers for a gene of interest to clone into a plasmid
Week 6: Design PCR Primers for a gene of interest to clone into a plasmid
Week 7: **Genome wide Screens Lecture** Design guide RNAs and Repair Templates
Week 8: Design of guide RNAs and Repair Templates

Week 9: **DNA sequencing Lecture** (Quiz 2)
Week 10: Make Repair Templates and Transgenic *C. albicans*
Week 11: Make Repair Templates and Transgenic *C. albicans*
Week 12: **Nucleic Acid Modification Lecture**
Week 13: Make Repair Templates and Transgenic *C. albicans* (Quiz 3)
Week 14: Make Repair Templates and Transgenic *C. albicans*
Week 15 Make Repair Templates and Transgenic *C. albicans*, stay on task exercises, Work Place Competency Assignment Due during finals
Final Exam last day of Class. No assignments accepted after first day of finals.

VII. INSTRUCTIONAL ACTIVITIES:

This course will utilize several instructional techniques including lecture, group activities, and laboratory experimentation. Instruction may also include self- and peer-graded activities. ***Regular class participation and attendance is essential to all aspects of this course.***

- **Statement of Instructor Responsibilities** – Instructor has the responsibility to *facilitate* student learning. As an instructor, I am responsible for ensuring students are familiar with course objectives and grading procedures; creating an environment conducive to meeting course objectives; preparing lecture materials and conducting lecture within class time; providing challenging and intellectually stimulating lecture content; informing students of resources to aid in meeting course objectives; grading assignments and exams in a timely and equitable manner; being available for student consultation; and responding to student questions and concerns in a timely manner. As an instructor, I will address your concerns and questions professionally at all times.
- **Statement of Student Responsibilities** – Students have responsibility for the development of their education and are accountable for all choices and actions. As a student, you are responsible for reviewing, understanding, and abiding by course and university guidelines; attending class regularly for the full period; engaging in discu:ssions and activities; exhibiting non-disruptive classroom behavior; securing and turning off all electronic communications and entertainment devices during class (any use of a cell phone or other unauthorized electronic device may lead to an accusation of academic misconduct); refraining from use of laptops for any purpose other than class-related activities during class time; completing all coursework on time; taking scheduled exams; addressing conflicts or absences with the instructor as soon as possible in accordance with course policies; reviewing all graded material; registering disabilities with appropriate university office(s); notifying instructor of disabilities; and, *discussing any concerns or questions regarding the course with the course instructor as soon as possible.* Students should recognize that all coursework and interactions with instructors (whether verbal, e-mail, written, etc.) are professional activities and act accordingly.

VIII. RESOURCES:

All lecture notes will be provided on Canvas. While these may not be identical to the notes that are presented during class they will be close. It is required that the student's thoroughly go over all lecture material and come to class ready to participate and ask questions relevant to the lecture material. Ball State University has multiple resources available for aiding students in courses via individual and group tutoring, informal course study sessions, and specialized equipment. Contact BSU Student Services for additional information.

IX. GRADING PROCEDURES:

Assignments and Point Values:

Stay on Task Assignments (SOTA) due by end of the semester
working in groups or individually; 13x10 **(130 points)**
Dilution Problem Set Dilution Lab **50 points**
Genome Browser Assignment **50 points**
Benchling Exercise 1. Plasmid annotation assignment **50 points**
Benchling Exercise 2. Design PCR primers with restriction sites to amplify a gene of interest **50 points**
Benchling Exercise 3. Design Guide and Repair Templates for CRISPR **50 points**
Lab Notebook Final Project Transform C. albicans with plasmid and repair templates **50 points**
Final Exam **100 points**
Quizzes 30 x 3 **(90 points)**
Articulate workplace competencies gained **20 points**
Total **640**

Preliminary Grade Breakdown:

A = 94-100%	**C = 74-76.99%**
A- = 90-93.99%	**C- = 70-73.99%**
B+= 87-89.99%	**D+ = 67-69.99%**
B = 83-86.99%	**D = 63-66.99%**
B- = 80-82.99%	**D- = 60-62.99%**
C+= 77-79.99%	**F = 0-59.99%**

X. ATTENDANCE POLICY:

You are required to attend both lectures and laboratory on time. Regular attendance is essential to succeeding in this course. Students are solely responsible for materials covered during any absence and should contact the instructor regarding absence.

Missed Exams/Quizzes/Participation: The instructor must be notified **in advance** of the examination period if an exam is to be missed. Any make-ups are at the discretion of the instructor and on presentation of a documented excuse satisfactory to the course instructor. Please do not miss exams!

Late Assignments: A zero tolerance policy is in place for late assignments. No assignments will be accepted past the designated due date.

XI. LABORATORY EXPERIENCE:

Laboratory activities are crucial to this course.

XII. LABORATORY ATTIRE:

We will not always be doing lab work, but we will be in a lab so appropriate lab attire is recommended including no open toed shoes or loose-fitting clothes that might catch on something.

XIII. ACADEMIC HONESTY POLICY:

Honesty, trust, and personal responsibility are fundamental attributes of the university community. Academic dishonesty and other forms of academic misconduct threaten the foundation of an institution dedicated to the pursuit of knowledge and will not be tolerated. To maintain its credibility and reputation, and to equitably assign evaluations of scholastic and creative performance, Ball State University is committed to maintaining a climate that upholds and values the highest standards of academic integrity. Visit the VPAA's academic integrity website (Students tab) for resources on understanding academic integrity, citing sources properly, and avoiding inadvertent academic dishonesty. To learn about BSU's academic integrity expectations and students' rights, please read the University Student Academic Ethics Policy.

Academic integrity violations include giving or receiving an unfair academic advantage (cheating), presenting someone else's ideas or work as your own (plagiarism), and falsifying academic records. Unless otherwise indicated, you must work independently by yourself. Check with me if you are unsure whether something constitutes academic dishonesty. Examples of academic integrity include but are not limited to:

- Using resources not authorized by the faculty member (including devices, AI tools, hidden notes, and open books)
- Using commercial study websites to find answers to graded assignments (Chegg, Course Hero, StudyPool, OneClass, etc.).
- Without the instructor's written permission, giving away, buying, or selling graded assignments class notes, exams, study guides, or other course materials to other students or to third-party vendors (Course Hero, Chegg, 24HourAnswers, etc.).
- Working with another person on any assignment other than authorized group projects.
- Sharing or allowing others to access your files, whether done with permission or not.
- Reusing your own work from another semester, course, or section.
- Sharing answers with others during exams (passing notes, texting, whispering, gesturing)
- Discussing exam questions and answers with students who have not taken the exam.
- Soliciting others to complete work for you.

AI Use: For assignments done in class such as quizzes and exams the use of AI will not be permitted. For assignments to be done at home such as projects and presentations AI can be used to brainstorm and revise text. However, all assignments will have word, sentence, or time limits and failure to abide by these limits will result in lower grades. We will also discuss in this class how AI can be used in molecular biology and how it is currently being used. Understanding the underlying principles of molecular biology are critical to appropriate and successful leveraging of AI.

III. University Statement

We are committed to ensuring that all members of the community are welcome, through valuing the various experiences and worldviews represented at Ball State and among those we serve. We promote a culture of respect and civil discourse. If you need course adaptations or accommodations because of a disability, please contact the instructor of record as soon as possible. Ball State's Disability Services office coordinates services for students with disabilities; documentation of a disability needs to be on file in that office before any accommodations can be provided. Disability Services can be contacted at 765-285-5293 or dsd@bsu.edu.

Freedom of Expression: In this course, we are committed to fostering a learning environment that values intellectual diversity, encourages free expression, and promotes open inquiry. As members of the Ball State Community, we treat each person in the Ball State community with civility, courtesy, compassion, and dignity and respect and learn from differences in people, ideas, and opinions. Please review Ball State University's Statement on Freedom of Expression, the resources on Ball State's Freedom of Expression webpage, and Ball State's Beneficence Pledge.

Title IX: Ball State University is committed to providing a safe and inclusive learning environment for all students. If you or someone you know has experienced sexual harassment—including sexual assault, dating violence, domestic violence, or stalking, please know that you are not alone. The University offers support services and resources. For more information or to report an incident, please visit bsu.edu/titleix or contact the Title IX Coordinator at 765-285-1545 or at titleix@bsu.edu.

XIV. Course Withdrawals: You have until **10/27/25** to withdraw from this course. After that date, a late withdrawal is only allowed with permission and documentation of significant extenuating circumstances.

XV. Incompletes: An incomplete grade is only given when course work cannot be finished at the end of the semester, such as the final exam, for a documentable reason. All previous grades in the course are retained and a final course grade is given once the work is made-up. This is **NOT** a way to retake the class.

XVI. Tips for Success:

1) Don't miss class.
2) Come talk to me if you are having difficulty with some of the material.
3) Come prepared to discuss the days lecture or presentation!
4) Don't get frustrated if something does not work the first time, your grade will be based on your ability to determine why things worked or did not work not or what you could change to try to make it work in the future.
5) Work as a team but take responsibility for your work. Don't always wait for someone else to do something. Share your data with the other groups when appropriate. Collaborate don't copy.
6) Ask questions to me and your lab mates, no one knows everything.
7) Don't miss class. Excused absences for illness, family hardship, and hard school obligations are allowed with notes and you will be expected to make up the work.

Excuses not accepted – over sleeping, my car broke down, I had work, I forgot, I had other class stuff to do. Unexcused absences from class and lab will result in a loss of points from class participation and lab exercises at my discretion.