Course Title: IST 340 DNA Technology

Instructor: Dr. Elizabeth Murray

Professor, Integrated Science and Technology  
241G Byrd Biotechnology Science Center (office)  
BBSC 211 or 330 (lab)  
304-696-3746 (lab)  
304-696-3515 (office)  
murraye@marshall.edu

Office Hours:

I strongly encourage students to meet me during office hours (M-F after class) or contact me via e-mail. I will be in BBSC Lab Area most MWF in mornings before class so give me a shout. Here is my schedule.

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<th>Time</th>
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Course Description: This course is designed for science majors who are interested in pursuing a career in the rapidly expanding biotechnology industry. The class will include a lot of reading and some online lectures with PowerPoints. These lectures cover theoretical background of biotechnology methods and their application. The laboratory covers DNA and Protein purification and manipulation techniques. Issues including bioethics, biosafety, and the use of genetically modified organisms will also be incorporated into the course content. The lab has a new fermenter which I hope we can use in the latter part of the semester to grow microorganisms.

Credit Hours: 4

Prerequisites: IST 241 (Introduction to DNA Cloning) or permission of instructor.

Recommended Texts:


This book is not required but is EXCELLENT. I am also linking Dr. Metzenberg’s excellent webpage
http://escience.ws/b572/syllabus.html and have posted most relevant pages in the Blackboard page for background reading for those choosing not to purchase his book.

*Biotechnology DNA to Protein A Laboratory Project.* (2003) Teresa Thiel, Shirley Bissen and Eilene Lyons McGraw Hill ISBN 007241664-5  This book is pretty expensive for what it is, but never-the-less it is the book I have based a lot of the course upon, with lots of modifications over the year.

In Blackboard I have downloaded a series of relevant protocols from Current Protocols in Molecular Biology.  These will provide a lot of background methods.  We will follow protocols adapted from these and from Thiel *et al.* which will be given out before lab on Blackboard or handed out in class.  Additional handouts from companies, technical articles, worksheets and laboratory notes based on this project will be in Blackboard. On-line Internet resources, including biotechnology company websites, technical information, tutorials and simulations will be provided in Blackboard and on the course website.

**Computer:** Access to a Pentium computer with WebCT, Internet, and current Marshall Microsoft Windows packages.

**Desired Learner Outcomes/Objectives:**

Student will review and expand their knowledge of biotechnology concepts.

- Organization and regulation of prokaryote and eukaryote genes
- DNA replication
- RNA transcription
- Protein Translation
- Bioinformatics
- Recombinant DNA in both prokaryotes and eukaryotes
- Vectors and Enzymes used in DNA Cloning
- PCR
- DNA Sequencing
- Enzyme assays
- Antibody applications and Western Blotting
- Protein purification
- Fermentation

Students will learn practical, hands on methods used in the lab:

- Identify novel soil bacteria producing alpha amylase, isolate and purify strain from single colony.
- Explore the idea of Metagenomics- purifying DNA from organisms which have not been isolated in the lab.
- Use Bioinformatics to explore sequence and structure of the alpha amylase in genome and protein databases.
- Perform PCR nonradioactive labeling, Southern Blots and DNA Mapping to locate the alpha amylase gene.
- Plasmid Mapping of recombinant DNA clones
- Clone the alpha amylase gene from prokaryotes into antibiotic resistant plasmids and transform them into bacteria.
• Plate recombinant bacteria purify recombinant DNA molecules and analyze recombinant DNA molecules using gel electrophoresis
• Examine enzyme activity of alpha amylase
• Examine the alpha amylase proteins with Western blotting

Grading Policy:

Course will be graded by 1000 points.
• A= \leq 900 points
• B= \leq 800 points
• C= \leq 700 points
• D= \leq 600 points
• F= \leq 500 points

Evaluation/Measurement of Learner Outcomes:

Exams: 200 pts.

Learners will be expected to read and understand the Blackboard content. This will be assessed during a midterm exam (100 pts) and a comprehensive final exam (100 points). These exams will each have a review and a study guide. The goal is to link the lab concepts to the theory of molecular biology. They are either short problems or multiple choice/true false questions. The final will be given on the final day.

Reading the scientific literature: 300 pts.

I believe it is fundamentally important to learn to critically read and discuss the scientific literature. I have a well crafted assignment with two parts- a short team presentation in class and a short review paper you write independent of your team, due 1 week after the class presentation. There will be three sets of papers- one on DNA purification, one on cloning alpha amylases and one on metagenomics- purification of DNA from soil or water organisms without isolation of specific organisms. I will select and assign the paper to the teams. The class presentation is a team grade of 50 points per paper and the individual paper is 50 points.

Lab: 500 pts

Lab will be evaluated in the following manner:

1. Prompt attendance and team participation (50 pts). You can’t learn much if you aren’t here, and it is not feasible to make up labs. If you are a regular attender and work with your team to clean up your work station and keep organized, you will get all 50 points. However, if you skip >3 labs without a University excuse, your grade in lab will drop by one letter. If you skip >6 labs, it will drop by two letters and so on. I keep attendance. The data and experiments will be performed by a mixture of teams and individuals- you may purify your own DNA and then run it on a team gel, for example. The analysis of data will be individually performed, unless I specify otherwise.
2. **Lab notebook and data analysis (300 pts).** After we perform labs, I will have the results turned in individually as labeled figures for a laboratory report. **You need to produce quality data- so some experiments may be performed twice.** I will spot check your laboratory notebook.

3. **Lab problems and exercises. (100 pts)** I have some bioinformatics exercises and lab problems related to the work we do in lab. These will be due 1 week after assigned.

4. **Lab safety and cleanliness (50 pts).** You can lose points for unsafe behavior and lack of cleaning up after yourself. If you are an exceptional lab citizen, your grade will reflect this.

**Class Policies:**

**There will be times when you will need to return to class to finish some laboratory steps:** Our lab is too short for the work in the class. I will announce times when the lab will be open for you to set up cultures, take out plates, stain a gel etc. You will be working in groups, so you can share time returning with others in your group or ask for assistance from others in the lab.

**Safety:** Students are expected to work safely and clean up after classes. Safety is a priority- if you have doubts about the safety of what you are doing, stop and ask instructor! Students should work carefully with equipment. Students should read and understand the safety component of each lab. You can’t work safely if you don’t know what you are doing. **Do not eat or drink in the lab! Instructor reserves the right to toss your food or drink.**

**Attendance Policy:** Attendance in lectures and laboratory exercises is required and will be part of your total grade. You are responsible for any material missed by being absent. Absences from exams or quizzes due to illness, death in the family, or institutional activities will be excused with the appropriate written notification to the instructor. In the case of illness, you must provide a physician’s note stating that you could not be present during the exam period for medical reasons. See Marshall University Undergraduate Catalogue - Academic Information for guidelines (online catalog, p. 127, at http://www.marshall.edu/ucomm/catalog/ug_05-07.pdf). This policy will be strictly enforced.

**Computer literacy:** Course materials, quizzes, and course e-mail are located on Marshall University Online link on the homepage. Alternatively click this link. (http://marshall.blackboard.com/webct/entryPage.dowebct). Log-in using your MyMU user name (901 number) and password. **If IST 340 is not listed in WebCT, notify me.** Additionally, you will be expected to use a word processing program to compose your written report, and Microsoft Office Excel to prepare some of the graphs for lab. Computers with these programs are located on campus in the Drinko Library and in computer labs in Morrow Library.

**Academic Accommodation:** If you have a learning disability, go immediately to the Help Center, Myers Hall (this is costly), or Mrs. Sandra Clements (this service is free), PH 117. If you present a diagnosis of the learning disability, they have the authority to send a statement of your needed accommodation to the instructor via campus mail. No accommodation can be allowed until this documentation is received and it must be received several days in advance of the exam to allow the professor time to arrange the conditions required.

**Weather Policy:** Class will follow the Marshall University policy for cancelation of class due to inclement weather (http://www.marshall.edu/president/board/Policies/MUBOG%20GA-%209%20Weather%20Closings%20and%20Delays%20_amended_.pdf).
**Academic Dishonesty:** *Academic dishonesty will not be tolerated.* All written assignments, quizzes, and exams are to be independent efforts of each student unless participating in a team assignment. Refer to Undergraduate Catalog pages 105-109 ([http://www.marshall.edu/ucomm/catalog/ug_05-07.pdf](http://www.marshall.edu/ucomm/catalog/ug_05-07.pdf)) for definitions of cheating, fabrication/falsification, plagiarism; bribes/favors/treats; and complicity.

**Electronic Devices:** Please, as a courtesy to the instructor and others, don’t use your cell phones in lab. If you have an emergency call, use the vibrate option and step outside to take the call. Other electronic devices (calculators, laptop and handheld computers, instant messaging devices, PDAs, pagers, data-bank watches, etc.) must be turned off during exams and student presentations.

Lab schedule is approximate and will be refined as the course progresses.

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<tr>
<th>Week</th>
<th>Lab Topic</th>
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<tr>
<td>1</td>
<td>August 23 Intro to lab safety, Genetic engineering regulations, Biosafety, pipetting exercise, Learning how to present Data in figures and write figure legends; Keeping a lab notebook, plating bacteria from the environment,</td>
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<td>August 30 Screening bacteria from the environment with single colony isolation, enzyme assays of Saliva and purified enzymes, Protein concentration assays of Saliva, calculating specific enzyme activity</td>
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<td>3</td>
<td>September 6 Purifying DNA from Bacteria; Estimating DNA concentration; Agarose gel to assess DNA quality; <strong>Presentation of first paper on bacterial DNA purification</strong></td>
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<td>September 13 PCR of genomic DNA, Agarose Gel Electrophoresis of PCR product, Restriction Enzyme cutting of Genomic DNA <strong>Short report on first paper due</strong></td>
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<td>September 20 Southern Blot Mapping (run gel, blot, hybridize, wash, expose film)</td>
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<td>September 27 Software demonstration of Plasmid and Genomic DNA mapping, Plasmid DNA Restriction Enzyme cutting, Agarose Gel</td>
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<td>October 4 Recombinant DNA ligation, Competent Cell Transformation, Screening for transformants <strong>Midterm</strong></td>
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<td>October 11 Plasmid Miniprep, Plasmid Megaprep, Plasmid Mapping</td>
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<td>October 18 Southern Blot of Plasmid DNA (run gel, blot, hybridize, wash, expose film)</td>
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<td>October 25 PCR confirmation of colonies, DNA sequencing <strong>Presentation of second paper on Cloning and characterizing amylase</strong> Friday October 29 Last Drop Day</td>
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<td>November 1 Western Blots, Enzyme Assays <strong>Short report on second paper due</strong></td>
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<td>November 8 Enzyme Assays</td>
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<td>November 15 Fermentation of Bacteria</td>
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<td>November 22 Thanksgiving Week</td>
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<td>15</td>
<td>November 29 Fermentation of Bacteria <strong>Presentation of third paper on metagenomics</strong></td>
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<td>16</td>
<td>December 6 Exam Review <strong>Short report on third paper due</strong> <strong>Final Exam</strong> Friday December 10 12:45-2:45</td>
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<td>December 13 Final Grades turned in</td>
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