Texas A&M University - Corpus Christi  
Department of Physical and Life Sciences  
Fall 2015

A. Course information

Course number/section: CHEM 4402.001  
Class meeting time: MW 2:00 –3:15 p.m.  
Class location: CS112  
Course Website: https://bb9.tamucc.edu/

B. Instructor information

Instructor: Dr. Narendra Narayana  
Office: Center for Science 208  
Office Hours: M 4 – 5 p.m. T 9 - 11 a.m. W 11 a.m. – 1 p.m. or by appointment  
Phone: 825-3644  
Email: nnarayana1@tamucc.edu

C. Course description

CHEM 4402 is the second part of a two-semester biochemistry course that covers the structure and function of bio-molecules (carbohydrates, lipids, nucleic acids and proteins) and the major metabolic pathways involved in their synthesis and degradation. This course has a laboratory component that dwells on a specific set of experiments. These practical classes build on the previous hands-on experience in Biochemistry I. Data acquisition, analysis, and interpretation will be performed.

Course objectives: In this course students will learn:

- To apply laws of thermodynamics to biochemical reactions and derive relationships between bioenergetics and thermodynamics.

- The role of cofactors and coenzymes in oxidation-reduction reactions and the production of energy-rich ATP molecule.

- The steps involved in the glycolytic pathway and citric acid cycle that result in the production of molecules required for the biosynthesis of larger molecules.

- The metabolic regulation of glycogen production and breakdown.

- About the carbohydrate, fatty acid, and protein catabolism.

- About the mechanism of phosphorylation and ATP synthesis.

- About the biosynthesis of lipids, carbohydrates, and proteins.
• To identify the key reaction mechanisms in metabolism, including oxidation-reduction, decarboxylation, and transamination reactions.

• About regulation and integration of mammalian metabolism.

• Perform basic biochemical laboratory techniques, including review of the primary literature, database analysis, bioinformatics, DNA extraction, digestion, ligation, transformation and sequencing, the polymerase chain reaction (PCR), gel electrophoresis, spectrophotometry, protein expression, purification, and analysis.

• Prepare a professional, written project report.

D. Pre-requisite: CHEM 4401

E. Required Text


Recommended Text:

Biochemistry: Lippincott’s Illustrated Reviews, Champe, Harvey and Ferrier

F. Student learning outcomes and assessment

By the end of this course students should be able to recognize different types of biochemical reactions involved in the catabolism of carbohydrates, proteins, and fats. Furthermore, students should be able to grasp a variety of themes in biochemistry and laboratory skills as listed above. Assessment of students learning is based on the lecture exams, laboratory performance, and quizzes throughout the semester as detailed below.

G. Instructional methods and activities

Lectures will be followed by a review of chapters, problem solving, and student participation.

H. Major course requirements and grading

Lecture Exams: There will be three semester examinations in addition to a comprehensive final examination. Examinations will be predominantly multiple choices but may include short answer, brief calculation or structure drawing questions. All answers on exam scantron cards are final, so please fill in your answer choices on your scantron card carefully.

<table>
<thead>
<tr>
<th>Exam</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam 1</td>
<td>100 pts</td>
</tr>
<tr>
<td>Exam 2</td>
<td>100 pts</td>
</tr>
<tr>
<td>Exam 3</td>
<td>100 pts</td>
</tr>
</tbody>
</table>
Exams will take place during regular class time. Please let me know ahead of time if you have a university-approved excuse, if at all possible, alternate arrangements can be made. We will not “drop” any of the examinations in the calculation of your final grade.

**Course Grading:** A combined grade for both lecture and laboratory will be given for the course. The lecture component will count for 75% of the grade and the laboratory component for 25%. The scale below indicates the minimum course score (out of a possible 100) required to obtain a particular grade. In the lecture class, 5% of your grade will be set apart for attendance and/or quizzes.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>90</td>
</tr>
<tr>
<td>B</td>
<td>80</td>
</tr>
<tr>
<td>C</td>
<td>70</td>
</tr>
<tr>
<td>D</td>
<td>55</td>
</tr>
<tr>
<td>F</td>
<td>&lt;55</td>
</tr>
</tbody>
</table>

The course score is calculated by adding the lecture \((70 + 5)\) and laboratory \((25)\) scores:

\[
\text{Lecture score: } \frac{(\text{exam points})}{400} \times 70 \\
\text{Laboratory score: } \frac{(\text{lab reports} + \text{worksheets} + \text{exam points})}{183} \times 25
\]

As mentioned above, there are 400 points possible in lecture from the three regular and one final examination. There will be a total of 200 points that can be earned in the laboratory component of the course from lab reports, worksheets, a mid-term exam, a final exam and laboratory performance.

Two examples are provided below that outline the type of final grade one might expect with a laboratory percentage of either 90% or 80%. Each example shows the final outcomes expected when varying levels of lecture points have been earned. The point is to show that a good score needs to be obtained in BOTH lecture AND laboratory in order to obtain a good overall grade for the course. DO NOT expect a good lab score to boost a weak lecture score by a full letter grade.

<table>
<thead>
<tr>
<th>Total Lecture points earned</th>
<th>Lecture Score</th>
<th>Total Laboratory points earned</th>
<th>Laboratory Score</th>
<th>Course Score</th>
<th>Final Grade (Lecture + Lab Score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 (50%)</td>
<td>37.5</td>
<td>180 (90%)</td>
<td>22.5</td>
<td>60.0</td>
<td>D</td>
</tr>
<tr>
<td>240 (60%)</td>
<td>45.0</td>
<td>180 (90%)</td>
<td>22.5</td>
<td>67.5</td>
<td>D</td>
</tr>
</tbody>
</table>
**Study guidance:** Keep up with the reading, do end-of chapter problems, come to class, review and annotate your notes. I suggest that you prepare one or two pages summary of the material covered in the class on all class days. This will help you review faster as well as to connect with materials covered later. It is extensive, so begin early and keep up with the material as we proceed through the semester. An additional, study guide (Osgood and Ocorr) is available on reserve at the library. Forming a study group with 1-2 other students is another strategy many students find helpful.

I. **Course content/schedule**

**Tentative Course Outline**

*Disclaimer: This syllabus is subject to change*

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
<th>Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 26</td>
<td>Introduction/Bioenergetics</td>
<td>13.1 – 13.4</td>
</tr>
<tr>
<td>August 31</td>
<td>Bioenergetics</td>
<td>13.1 – 13.4</td>
</tr>
<tr>
<td>September</td>
<td>Bioenergetics</td>
<td>13.1 – 13.4</td>
</tr>
<tr>
<td>September</td>
<td>Glycolysis</td>
<td>14.1 – 14.3</td>
</tr>
<tr>
<td>September</td>
<td>Glycolysis</td>
<td>14.1 – 14.3</td>
</tr>
<tr>
<td>September</td>
<td>Gluconeogenesis and PP pathway</td>
<td>14.4 – 14.5</td>
</tr>
<tr>
<td>September</td>
<td>PP pathway and Glycogen</td>
<td>14.5, 15.4</td>
</tr>
<tr>
<td>September</td>
<td>Exam 1</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>Citric acid cycle</td>
<td>16.1 - 16.3</td>
</tr>
<tr>
<td>September</td>
<td>Citric acid cycle</td>
<td>16.1 - 16.3</td>
</tr>
<tr>
<td>October 05</td>
<td>Fatty acid oxidation</td>
<td>17.1 - 17.3</td>
</tr>
<tr>
<td>October 07</td>
<td>Fatty acid oxidation</td>
<td>17.1 – 17.3</td>
</tr>
<tr>
<td>October 12</td>
<td>Amino acid oxidation</td>
<td>18.1 – 18.3</td>
</tr>
<tr>
<td>October 14</td>
<td>Amino acid oxidation</td>
<td>18.1 - 18.3</td>
</tr>
<tr>
<td>October 19</td>
<td>Oxidative phosphorylation</td>
<td>19.1 – 19.5</td>
</tr>
<tr>
<td>October 21</td>
<td>Exam 2</td>
<td></td>
</tr>
<tr>
<td>October 26</td>
<td>Oxidative phosphorylation</td>
<td>19.1 – 19.5</td>
</tr>
</tbody>
</table>
October 28  Oxidative phosphorylation  19.1 – 19.5
November 02  Photophosphorylation  19.6 – 19.10
November 04  Photophosphorylation  19.6 – 19.10
November 09  Carbohydrate biosynthesis  20.1 – 20.3
November 11  Carbohydrate biosynthesis  20.1 – 20.3
November 16  Lipid biosynthesis  21.1 – 21.4
November 18  Exam 3
November 23  Nitrogen metabolism / Amino acids  22.1 – 22.3
November 25  Biosynthesis of nucleotides  22.4
November 30  Integration of mammalian metabolism  23.1 – 23.3

Final Review

December 07  Final Exam 1:45 p.m. – 4:15 p.m.  Comprehensive

J. Course policies

Decorum: The best way to encourage learning is to provide an environment conducive to listening, concentration, and discussion. As in any class, students are expected to maintain the highest standards of decorum and to conform to college-level standards of ethics and academic integrity. **Cell phone use and photography is prohibited in the classroom.** Most of these involve common sense and courtesy, but please refer to the section on academic policies and regulations in the university catalog for a more thorough description of these expectations.

Student responsibility: Student should be aware of the contents of this syllabus and the course website on Blackboard. Announcements and changes are communicated in the classroom, Blackboard, and/or emails.

K. College and University policies

Academic Integrity (University)

University students are expected to conduct themselves in accordance with the highest standards of academic honesty. Academic misconduct for which a student is subject to penalty includes all forms of cheating, such as illicit possession of examinations or examination materials, falsification, forgery, complicity or plagiarism. (Plagiarism is the presentation of the work of another as one’s own work.) In this class, academic misconduct or complicity in an act of academic misconduct on an assignment or test will result in a failing grade.

Classroom/Professional Behavior

Texas A&M University-Corpus Christi, as an academic community, requires that each individual
respect the needs of others to study and learn in a peaceful atmosphere. Under Article III of the Student Code of Conduct, classroom behavior that interferes with either (a) the instructor’s ability to conduct the class or (b) the ability of other students to profit from the instructional program may be considered a breach of the peace and is subject to disciplinary sanction outlined in article VII of the Student Code of Conduct. Students engaging in unacceptable behavior may be instructed to leave the classroom. This prohibition applies to all instructional forums, including classrooms, electronic classrooms, labs, discussion groups, field trips, etc.

Statement of Civility

Texas A&M University-Corpus Christi has a diverse student population that represents the population of the state. Our goal is to provide you with a high quality educational experience that is free from repression. You are responsible for following the rules of the University, city, state and federal government. We expect that you will behave in a manner that is dignified, respectful and courteous to all people, regardless of sex, ethnic/racial origin, religious background, sexual orientation or disability. Behaviors that infringe on the rights of another individual will not be tolerated.

Deadline for Dropping a Course with a Grade of W (University)

The grade of W will be assigned to any student officially dropping a course. Please consult with the instructor before you decide to drop to be sure it is the best thing to do. Just stopping attendance and participation WILL NOT automatically result in your being dropped from the class. Should dropping the course be the best course of action, visit the Office of the University Registrar for the Course Drop Form that must submitted. No student is eligible to receive a W without completing the official drop process by this deadline. Please consult the Academic Calendar (http://www.tamucc.edu/academics/calendar/) for the last day to drop a course.

Grade Appeals (College of Science and Engineering)

As stated in University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures, a student who believes that he or she has not been held to appropriate academic standards as outlined in the class syllabus, equitable evaluation procedures, or appropriate grading, may appeal the final grade given in the course. The burden of proof is upon the student to demonstrate the appropriateness of the appeal. A student with a complaint about a grade is encouraged to first discuss the matter with the instructor. For complete details, including the responsibilities of the parties involved in the process and the number of days allowed for completing the steps in the process, see University Procedure 13.02.99.C2.01, Student Grade Appeal Procedures. These documents are accessible through the University Rules website at http://www.tamucc.edu/provost/university_rules/index.html, and the College of Science and Engineering Grade Appeals webpage at http://sci.tamucc.edu/students/GradeAppeal.html. For assistance and/or guidance in the grade appeal process, students may contact the chair or director of the appropriate department or school, the Office of the College of Science and Engineering Dean, or the Office of the Provost.
Disability Services

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please call (361) 825-5816 or visit Disability Services in Corpus Christi Hall 116.

If you are a returning veteran and are experiencing cognitive and/or physical access issues in the classroom or on campus, please contact the Disability Services office for assistance at (361) 825-5816. http://disabilityservices.tamucc.edu/

Statement of Academic Continuity

In the event of an unforeseen adverse event, such as a major hurricane and classes could not be held on the campus of Texas A&M University–Corpus Christi; this course would continue through the use of Blackboard and/or email. In addition, the syllabus and class activities may be modified to allow continuation of the course. Ideally, University facilities (i.e., emails, web sites, and Blackboard) will be operational within two days of the closing of the physical campus. However, students need to make certain that the course instructor has a primary and a secondary means of contacting each student.

Academic Advising

The College of Science & Engineering requires that students meet with an Academic Advisor as soon as they are ready to declare a major. The Academic Advisor will set up a degree plan, which must be signed by the student, a faculty mentor, and the department chair. Meetings are by appointment only; advisors do not take walk-ins. Please call or stop by the Advising Center to check availability and schedule an appointment. The College’s Academic Advising Center is located in Center for Instruction 350 or can be reached at (361) 825-3928.

General Disclaimer

I reserve the right to modify the information, schedule, assignments, deadlines, and course policies in this syllabus if and when necessary. I will announce such changes in a timely manner during regularly scheduled lecture periods.
CHEM 4402 Laboratory (once a week; Monday 11 a.m. – 1:50 p.m)

Green Fluorescent Protein - The Project

This semester will revolve around a central theme, the isolation, characterization and purification of the Green Fluorescent Protein (GFP). GFP is a naturally occurring protein found in certain species of jellyfish (*Aequorea victoria*). As the name indicates, its unique structure allows it to fluoresce, that is, radiate energy in the electromagnetic spectrum that we interpret as yellow-green light. The theme of the semester will involve several investigations of GFP; locating the DNA sequence for GFP in genomic databases, producing copies of the gene using the Polymerase Chain Reaction (PCR), purifying the expressed protein from a bacterial strain which carries a cloned copy of the gene, etc. Throughout this process, you will be exposed to several molecular techniques such as DNA isolation, PCR, electrophoresis, cloning, DNA sequencing and chromatography. It is hoped that by focusing on a single gene, and progressing sequentially through the various steps involved in expressing that gene, that you will attain a greater understanding of the relevant biochemical processes involved in the conversion of genetic material (DNA) to functional proteins.

Due to the fact that each lab builds upon information and data obtained during the previous week, it is crucial that you show up for every lab. We will not be turning in formal lab reports every week. Instead, you will be responsible for acquiring data and formatting it for presentation on a weekly basis. At the end of the semester, you will combine this data into a comprehensive lab report. Therefore, you will still need to keep a laboratory notebook/folder with each week’s relevant experimental details and results as well as an electronic copy of any formatted results. For the most part, course grading will be based upon preparation of these results in the proper format and upon assigned questions covering the theory and technique of the week’s experiment.

**Required Laboratory Materials**

**Text:** Experiments will be posted in portable document format (.pdf files) on the blackboard. Please download and print a copy prior to lab. You will need adobe acrobat on your computer to download the documents. **Provision of hardcopies of each week’s experiment is the student’s responsibility, not the laboratory instructor’s.**

**Laboratory Notebook** (required): A separate (not used for other classes) notebook is required for performing pre-laboratory work, recording observations, etc. Traditional, string-bound hard-covered versions are available at the University Bookstore.

**Safety Glasses/goggles**

**Lab Coat**

**Attendance:** Students are required to attend all laboratory periods. Please arrive on time and remain until the laboratory procedure is completed. Check with your instructor before leaving. Absence from laboratory without a university approved excuse and/or prior approval from the instructor will result in a grade of zero for that class. Occasionally a student may be permitted to
attend another laboratory section if a conflict arises with their scheduled section, and IF it is
cleared with all instructors involved BEFOREHAND, but no make-up lab periods will be held
outside of the scheduled sections.

Safety

Safety Lecture: You must be registered for, and complete, one of the Lab Safety Briefings
(PSCI 0091) prior to performing experiments in the laboratory.

Eye Safety: When in lab, always wear your safety goggles. A first violation will result in a
verbal notification. Subsequent violations may result in the student being asked to leave the
laboratory, with a grade of zero for the day. Also, be advised that wearing contact lenses in the
laboratory can be harmful to your eyes, even when you wear safety goggles over them.

Clothing: No open toe shoes or shorts (or short dresses) are allowed in the laboratory. A lab coat
must be worn at all times.

Keep it Clean: Keeping things clean will keep any chemicals in the lab and not in your home.
Always wash your hands just before leaving the lab. Never take samples or glassware out of the
lab. Do not place your coats, backpacks and other personal items on the bench tops or floor
in the lab. They can be placed in the cabinets under the benches. Keep in mind; anything you
bring into the lab should be treated with care at home. Your notebook and lab book may be
picking up stuff you spilled on the bench or floor and did not clean up.

Disposal of Chemical Wastes: During the experiments, you will generate several types of
waste, which need to be handled properly. Organic wastes should be placed in an appropriately
marked bottle for organic waste. Aqueous (water-based) waste should be poured into the
appropriately marked bottles. Solid wastes should be placed in an appropriately labeled solid
waste bottle. Broken glassware should be placed in the broken glassware box. Never put glass
into the regular trashcans.

Ask for Assistance: If you have any questions about the safety of any procedure, please ask your
instructor before proceeding.

A few reminders:
• No eating or drinking is allowed in the laboratory
• Know the location of fire extinguishers, eyewash stations, safety showers, fire alarms and
  Material Data Safety Sheets (MSDS forms)
• If an accident occurs, immediately notify the instructor or TA

Laboratory Facilities

Your laboratory fees, tuition and tax dollars pay for the instruments and lab ware in the
laboratory. We will teach you how to use all of the necessary equipment for each exercise. To
ensure optimal performance of instruments, do not attempt to use any equipment until your
instructor gives you directions. If equipment malfunctions, notify the instructor immediately
so we can repair or replace it as soon as possible.

This laboratory receives heavy use. As a courtesy to your fellow students, all lab teams are
expected to clean up their stations after each period. This includes replacing all equipment to
their original locations, turning off and covering instruments, cleaning glassware, and wiping down laboratory workspaces. Each team must check out with their instructor prior to leaving.

**Grading**

Your laboratory score will be determined based on points earned from weekly assignments, laboratory reports, a mid-term exam, a final exam and laboratory performance. There are a total of 183 points that can be earned. Laboratory counts for 25% of your course grade and is calculated as follows:

\[ \text{Laboratory score: } (\text{lab reports} + \text{worksheets} + \text{exam points}) \times 25 \]

183

All assignments are due at the **beginning** of the next laboratory period. We realize that the average student has a great many academic demands during the semester. Therefore, we offer a special **stress-relief clause**. You may turn in one assignment late (except the final laboratory report) for any reason. **Please let your instructor know that you intend to use your “free late” in writing at the time the assignment is due.** Your assignment will then be due at the beginning of lab the following week. Any other assignments turned in late will be penalized 10% for each additional day.

**Laboratory performance.** A portion of your grade (~ 5%) will also depend on your laboratory performance. This is not “extra credit”, but a score based on individual student behavior. Points are earned by avoiding behavior including, but not limited to:

- Arriving late to class
- Being unprepared for the laboratory
- Performing in a lackluster manner (not paying attention, not taking initiative, etc.)
- Leaving the laboratory before completing the exercise
- Being disrespectful to your instructor or fellow students
- Failing to clean up at the end of the laboratory
- Violating safety regulations
- Plagiarizing another student’s work
- In general, conducting oneself unprofessionally

Instructor is in charge of his laboratory sections, including attendance, instruction, and assistance with assignments, grading, and handling of missed laboratory periods. Your instructor should be the first person you go to with questions related to the laboratory. Be sure to find out the best way to contact your instructor, their office location and their office hours.

**Laboratory Assignments and final Report**

A final report will be required at the end of the semester. Be sure to retain both electronic and “hard” copies of all data results from the labs (photographs, tables, charts, etc.). The standard laboratory report format will be used, as described below.

Even though students work in teams, lab reports and assignments are expected to be the result of individual effort. Thus, while we encourage students to work together in regards to data analysis and interpretation, we also expect individuality in interpretation and style of writing, especially regarding the introduction and discussion sections. **If we suspect copying or plagiarism both the assignments will not be accepted and a grade of zero will be recorded.**
Laboratory reports are to be type written, photocopies taken directly from your laboratory notebooks are not acceptable. Reports should meet the key tests of being both legible and understandable. Legible means correct spelling and intelligible, complete sentences. Understandable means complete tables and graphs, with units, legends, column headings and axis titles present and clearly identified. Graphs and tables are to be computer-generated. Many software packages, such as Microsoft Excel and Word have convenient tutorials (“wizards”) for the construction of tables and graphs.

The full lab report should consist of a title page, introduction, procedure, results and discussion.

**Title Page:**
- Laboratory report title
- Your name
- Your lab partner’s name
- Your section number
- The name of your instructor or TA
- The date

**Introduction:** Clearly state the aim of the procedures used during the semester. Include background information on the basic principles and theory underlying the particular experimental techniques.

**Procedure (Materials & Methods):** Include a brief narrative description of the major steps for a particular technique/procedure (“...using primers “X” and “Y” and the Polymerase Chain Reaction”, ...using Gel permeation chromatography with “X” as the chromatography matrix”, etc.). You do not need to rewrite a step-by-step description of the procedure from your text, but try to summarize the important steps.

**Results:** This section should include all experimental data and its manipulation in the form of example calculations, photographs, tables, etc. Example calculations should be used instead of separate calculations for each sample. Be sure all experimental data is clearly labeled with column headings, axis titles, figure legends, chart and graph titles, etc. This is where students lose the most points.

**Discussion:** This section is for showing your understanding of the experiments. Be sure to analyze your results and argue why you can draw certain conclusions. Discuss any expected results compared with your actual results and observations. Draw on the theory and your experience in order to rationalize the outcome of the experiment, especially possible reasons for deviations from the expected results.

**Laboratory Notebooks:** A well-written laboratory notebook will be an invaluable aid in preparing your reports. However, laboratory notebooks are not intended to look perfect. Use your notebook to write down notes on what you think is happening in a particular exercise, hand-draw rough graphs and jot down observations to aid your analysis or conclusions. In addition, each notebook should contain your name, section number and a table of contents. This makes it much easier to find data, results, procedures, etc. on any given experiment. It also makes it easier for us to return a notebook if it should be left in the laboratory.

**Pre-lab:** As part of each experiment, we ask that you prepare a pre-lab in your laboratory notebook. This section should provide enough specific information on the procedure (e.g.,
identity and quantity of materials, times, temperatures, etc.) to enable you to perform the experiment. It should be organized in a summary format and include: title of the experiment, purpose of the experiment, technique(s) or procedure(s) being used, outline of steps, tables for data and sample preparation. Your Pre-lab will not be turned in as part of your formal laboratory report.

**Biochemistry Laboratory II Schedule**

**Tentative Course Outline**

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**Room CS 228**

**Mondays**

11 a.m. – 1:50 p.m.

<table>
<thead>
<tr>
<th>Week of</th>
<th>Laboratory</th>
<th>Topic</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>August</td>
<td>31</td>
<td>1 Introduction/Literature Searching</td>
<td>12</td>
</tr>
<tr>
<td>September</td>
<td>14</td>
<td>2 Database Searching</td>
<td>12</td>
</tr>
<tr>
<td>September</td>
<td>21</td>
<td>3 Primer Design &amp; PCR</td>
<td>12</td>
</tr>
<tr>
<td>September</td>
<td>28</td>
<td>4 Electrophoresis &amp; gel-extraction of DNA</td>
<td>12</td>
</tr>
<tr>
<td>October</td>
<td>5</td>
<td>5 Ligation &amp; Bacterial Transformation</td>
<td>12</td>
</tr>
<tr>
<td>October</td>
<td>12</td>
<td>6 Plasmid DNA isolation/Restriction enzymes I</td>
<td>12</td>
</tr>
<tr>
<td>October</td>
<td>19</td>
<td>7 Restriction Enzymes II/DNA sequencing I</td>
<td>12</td>
</tr>
<tr>
<td>October</td>
<td>26</td>
<td>8 DNA sequencing II/Mid-term exam</td>
<td>12, 10</td>
</tr>
<tr>
<td>November</td>
<td>2</td>
<td>9 Protein Explorer (Bioinformatics)</td>
<td>12</td>
</tr>
<tr>
<td>November</td>
<td>9</td>
<td>10 GFP Induction</td>
<td>12</td>
</tr>
<tr>
<td>November</td>
<td>16</td>
<td>11 Gel Permeation Chromatography</td>
<td>12</td>
</tr>
<tr>
<td>November</td>
<td>23</td>
<td>12 SDS-Polyacrylamide Gel Electrophoresis</td>
<td>12</td>
</tr>
<tr>
<td>November</td>
<td>30(12)</td>
<td>SDS Gel Photo/Checkout/Final exam</td>
<td>2,10</td>
</tr>
</tbody>
</table>

November 30 Final lab report due 24

Total 183