Biochemistry 3P03
Inquiry into Biomedical Research

INTRODUCTION

In this course, you will be introduced to the concept of primary research design through the use of team based inquiry. You will gain first-hand experience in devising your own research project. This year, Teams will work closely with their Mentor to develop a research strategy for characterizing wild type and novel mutants of one of the protein targets specified below.

Felicia’s perspective – I developed this course structure with the hopes of:

- Engaging you in the world of Biochemistry and Biomedical Sciences – research perspective
- Allowing you the opportunity to develop strong technical and communication skills

The aims above are more content-driven, but I would also like to emphasize:

- Teamwork skills – this is really important for your future career path
- Presentation skills – how to construct professional, scientific presentations but also how to handle questions, how to maintain your emotions throughout a presentation, etc.

Finally, I would like to share with you some of my teaching/learning beliefs. I believe in:

- Creating a fun, safe and engaging learning environment. I would like all of you to feel safe and respected in this course.
- Teamwork. This course is based on teamwork. However, I also believe in individuality and so we will work hard to achieve a balance between the two.
- Your input. You have a HUGE say in your learning process. Your input is very important.
- Trust. If you have any problems/concerns about ANYTHING throughout the course you need to come see me so we can fix the situation. You will never be penalized for this in my course. You should not suffer in silence.
- “Sharing is caring”

Your individual perspective

I would like all of you to take a moment and think about the following:

- What are my course expectations?
- What are my course goals? (Technical skills, communication skills, teamwork, etc.)
- What are my future goals?
- What are my learning beliefs?
PROJECTS

**sIHF (SCO1480; Streptomyces integration host factor)**

This novel protein’s function in chromosome organization is currently being discovered by Drs. Guarne and Elliot in our very own department. They both agreed to provide the Biochemistry teaching labs with the pMC155 plasmid (see table 1 of the reference below). Your task is to conduct small scale protein expression studies in the hopes of purifying wild type sIHF as well as novel mutants of this protein which will be created by you. You will need to download the structure of the protein and mutate select positive residues on the surface of the protein with the hopes of creating mutant proteins that can still fold properly but have lost certain aspects of DNA binding. This will help in understanding the mechanism of action of this protein.


**D-amino acid oxidase (DAO)**

Dr. Brian Coombes is currently working on DAO to elucidate the biological role of this enzyme.

“It has long been known that immune cells, including neutrophils, utilise the nicotinamide adenine dinucleotide phosphate-oxidase (NADPH oxidase) to generate reactive oxygen species capable of severely limiting bacterial survival. Patients lacking this complex repeatedly fall ill to bacterial infections, but are interestingly not affected by catalase negative bacteria (bacterial unable to break down hydrogen peroxide). This raises the question of what is the source of hydrogen peroxide responsible for killing catalase-negative pathogens. It was originally believed that hydrogen peroxide generated by the bacterium itself was responsible but this has since been discredited. Recent work by Nakurma et al and Tuinema et al, have suggested that neutrophils generate a second source of hydrogen peroxide through the D-amino acid oxidase (DAO). DAO uses D-alanine liberated from bacterial membrane to generate toxic products responsible for bacterial clearance.” (written by Brian Tuinema, PhD student, Coombes lab)

D-amino acid oxidase (DAO) is a hydrogen peroxide producing enzyme found in a number of species, from yeast to human, but not in bacteria. DAO catalyzes the “stereospecific deamination of D-amino acids to their corresponding a-imino acids, which are hydrolyzed spontaneously to a-oxo-acids and ammonia. Reoxidation of the reduced FAD by molecular oxygen is accompanied by the release of H₂O₂”. (Excerpt obtained from: Gabler et al., 2000).

The biological function of mammalian DAO is currently unknown, however work is underway to utilize this enzyme as a cancer target (Rosini et al., 2009), for biosensor development (Rosini et al., 2008) and a potential anti-psychotic drug target (Adage et al., 2008). You currently have the porcine DOA gene and are tasked with developing point mutants of DAO in an effort to study its biological significance with respect to the drug-target potential of this enzyme. Please focus on antibacterial potential.


**DHFR (Dihydrofolate Reductase, *E. coli* K12)**

This project will assist Dr. Felicia Vulcu in developing new DHFR mutants to be utilized by aspiring Biochemistry students in the Biochemistry 2L06 courses. The DHFR mutants created can be tested for drug resistance and used in screens for future drug design. The purified mutant DHFR proteins can also be crystallized in collaboration with Dr. Murray Junop. Furthermore, teams will have the opportunity to describe their research purpose to the current Biochemistry 2L06 cohort. Last year, Biochemistry 3P03 students successfully created 4 DHFR point mutants: I14M, W30R, I14S, I14F. These mutants are available in the pET28b backbone vector. However, more mutants need to be developed (they can be double or triple mutants) and the already created mutant DHFR genes need to be expressed and purified. Thus purification/crystallization conditions for these mutants are required.


**3P03 PROJECT AIMS**

As a team, you will choose one project and design a:
- Research hypothesis
- Flowchart of experimental design
- Step-by-step procedural protocol
- Timeline outlining the experiments
- Division of labour to designate work for all team members

Throughout the course, you will gain an understanding of:
- Experimental protocol
- Experimental design
- Analysis of results and troubleshooting
- TEAMWORK and COMMUNICATION

As this is an inquiry course, proper collaboration and communication skills between Team members and Mentors is an imperative skill that should be exercised.

**Instructor:** Dr. Felicia Vulcu  
**Email:** vulcu@mcmaster.ca  
**Office:** HSC-4H43 (please enter through the Undergraduate Program Office: HSC 4H45) My door is always open for questions but I do prefer setting up an appointment by email. Please note, students are NOT allowed in the teaching labs after 1:00pm UNLESS the time corresponds to their scheduled course.

**Instructional Assistant** – Meagan Heirwegh  
**Email:** biochemistryadvisor@mcmaster.ca  
**Office:** HSC-1H6, 11:00am-12:30pm

**Labs:** Monday and Tuesday 1:30-5:30 pm in HSC 1H1-8
SAFETY TRAINING REQUIREMENTS

1. Fire Safety (update) – online (http://www.fhs.mcmaster.ca/safetyoffice/whmis_fire_update.html )

2. WHMIS (update) – online (http://www.fhs.mcmaster.ca/safetyoffice/whmis_fire_update.html )

3. BSL2 training (update) – online (http://www.mcmaster.ca/biosafety/biosafety_training_bsl_update.htm )

4. Site-specific training and lab safety walk-through (will be completed in lab by mentors)

ALL safety training MUST be completed PRIOR to the start of labs. This means that students must have completed ALL the training and handed in ALL quizzes to Meagan in HSC 1H6. You will not be allowed to attend your labs if you do not complete this safety training. You must PASS all safety training quizzes in order to continue in this course.

EVALUATION METHODS

Each team will be evaluated by their Mentor and the instructor throughout the term. The evaluation process will occur in the form of daily participation/ attendance/ preparation sheets to be completed by the Mentor (and sometimes the instructor), quizzes, and weekly reflections (that test preparedness throughout the term), reports (both team and individual) and presentations. The breakdown of marks is shown below:

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>MARK (%)</th>
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<tbody>
<tr>
<td>1. Sharing and helpfulness (self, peer and mentor assessment)</td>
<td>14</td>
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<tr>
<td>a. Includes team contract, reflections and self/peer/team evaluations</td>
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<tr>
<td>2. Weekly order forms/ MSDS summary sheets (team)</td>
<td>5</td>
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<td>3. Lab Notebook (individual)</td>
<td>6</td>
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<td>4. Quizzes (individual)</td>
<td>7</td>
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<tr>
<td>a. Includes proposal review</td>
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<td>5. Proposal report (team)</td>
<td>10</td>
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<tr>
<td>6. Weekly written communications (individual)</td>
<td>8</td>
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<tr>
<td>7. Short communications report – consists of two parts:</td>
<td>20</td>
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<tr>
<td>a. Individual report</td>
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<td>b. Team highlights report</td>
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<td>8. Proposal presentation (team)</td>
<td>10</td>
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<td>9. Lab meeting (team)</td>
<td>10</td>
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<td>10. Progress presentation (team)</td>
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# COURSE CALENDAR

<table>
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<tr>
<th>DATE</th>
<th>DESCRIPTION</th>
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<tr>
<td>Sept 8 - 9</td>
<td><strong>Monday Sept 8</strong>&lt;br&gt; Welcome, course introduction, TEAMS**&lt;br&gt; <strong>Tuesday Sept 9</strong>&lt;br&gt; Work on research project</td>
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<td>Sept 15-16</td>
<td><strong>Monday Sept 15</strong>&lt;br&gt; Work on research project**&lt;br&gt; <strong>Tuesday Sept 16</strong>&lt;br&gt; Work on research project</td>
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<td>Sept 22-23</td>
<td><strong>Monday Sept 22</strong>&lt;br&gt; Work on research project**&lt;br&gt; <strong>Tuesday Sept 23</strong>&lt;br&gt; Work on research project</td>
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<td>Sept 29-30</td>
<td><strong>Monday Sept 29</strong>&lt;br&gt; PROPOSAL PRESENTATION**&lt;br&gt; <strong>Tuesday Sept 30</strong>&lt;br&gt; PROPOSAL PRESENTATION&lt;br&gt; Proposal report due&lt;br&gt; Primer orders due&lt;br&gt; Weekly order form 1 due to your mentor Wed Oct 1&lt;sup&gt;st&lt;/sup&gt;</td>
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<td>Oct 6-7</td>
<td><strong>Monday Oct 6</strong>&lt;br&gt; Proposal review workshop (discuss proposals)**&lt;br&gt; <strong>Tuesday Oct 7</strong>&lt;br&gt; Start of lab work (week 1) – prep solutions, media, buffers.&lt;br&gt; Confirm primer calculations and re-suspend primers&lt;br&gt; Proposal Review Handout due&lt;br&gt; Weekly order form 2 due to your mentor Wed Oct 8&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>Oct 13-14</td>
<td><strong>Monday Oct 13</strong>&lt;br&gt; THANKSGIVING therefore no labs**&lt;br&gt; <strong>Tuesday Oct 14</strong>&lt;br&gt; Lab work (week 1)&lt;br&gt; Lab notebook carbon copies due&lt;br&gt; Weekly order form 3 due to your mentor Wed Oct 15&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>Oct 20-21</td>
<td><strong>Monday Oct 20</strong>&lt;br&gt; Lab work (week 2)**&lt;br&gt; <strong>Tuesday Oct 21</strong>&lt;br&gt; Lab work (week 2)&lt;br&gt; Lab notebook carbon copies due&lt;br&gt; Weekly written communications (1) due&lt;br&gt; Weekly order form 4 due to your mentor Wed Oct 22&lt;sup&gt;nd&lt;/sup&gt;</td>
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<td>Oct 27-28</td>
<td><strong>Monday Oct 27</strong>&lt;br&gt; Lab work (week 3)**&lt;br&gt; <strong>Tuesday Oct 28</strong>&lt;br&gt; Lab work (week 3)&lt;br&gt; Lab notebook carbon copies due&lt;br&gt; Weekly written communications (2) due&lt;br&gt; Weekly order form 5 due to your mentor Wed Oct 29&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>Nov 3-4</td>
<td><strong>Monday Nov 3</strong>&lt;br&gt; Lab work (week 4)**&lt;br&gt; <strong>Tuesday Nov 4</strong>&lt;br&gt; Lab work (week 4)&lt;br&gt; Lab notebook carbon copies due&lt;br&gt; Weekly written communications (3) due</td>
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<td>Nov 10-11</td>
<td><strong>Monday Nov 10</strong>&lt;br&gt; LAB MEETING (with Felicia/Meagan)**&lt;br&gt; <strong>Tuesday Nov 11</strong>&lt;br&gt; LAB MEETING (with Felicia/Meagan)&lt;br&gt; Lab notebook carbon copies due&lt;br&gt; Weekly order form 6 due to your mentor Wed Nov 12&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>Nov 17-18</td>
<td><strong>Monday Nov 17</strong>&lt;br&gt; Lab work (week 5)**&lt;br&gt; <strong>Tuesday Nov 18</strong>&lt;br&gt; Lab work (week 5)&lt;br&gt; Lab notebook carbon copies due&lt;br&gt; Weekly written communications (4) due&lt;br&gt; Weekly order form 7 due to your mentor Wed Nov 19&lt;sup&gt;th&lt;/sup&gt;</td>
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<td>Nov 24-25</td>
<td><strong>Monday Nov 24</strong>&lt;br&gt; Lab work (week 6)**&lt;br&gt; <strong>Tuesday Nov 25</strong>&lt;br&gt; Lab work (week 6)&lt;br&gt; Lab notebook carbon copies due</td>
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<td>Dec 1-2</td>
<td><strong>Monday Dec 1</strong>&lt;br&gt; PROGRESS PRESENTATION**&lt;br&gt; <strong>Tuesday Dec 2</strong>&lt;br&gt; PROGRESS PRESENTATION</td>
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<td>Dec 3</td>
<td><strong>Short communications report due</strong></td>
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COURSE EXPECTATIONS (includes missed work, re-grading request policy and lab rules)

Before we get started I have some expectations I would like to share with you:

- The labs are extremely important for this course and so, they are mandatory. However, if the lab must be missed due to unforeseen circumstances (such as illness) an MSAF or Approval from the Associate Dean’s office must be provided. Please go to the following website to obtain information on this process (http://www.mcmaster.ca/msaf/). Additionally, the information on the MSAF process is posted on the A2L content page. Once proper documentation is provided I will accommodate the missed lab on a case-by-case basis. Additionally, you must complete all requirements of the missed assessment component.
- Missed assessment components also require supporting documentation (MSAF/ APPROVAL by the Associate Dean’s office). We will tackle these on a case-by-case basis, but normally I re-distribute the missed mark.
- Try not to be late when handing in your assignments. Late penalties are usually 10%/day unless otherwise specified.
- Please take responsibility with respect to backing up your computer work and submitting complete assignments.
- I have a re-marking request policy. It is available on the A2L content page and on the McMaster Biochemistry website (go to “undergraduate studies”, “forms and procedures”).

Lab safety: Our lab is a fun working environment, but it is also a science lab full of chemicals/biologicals and equipment. And so, to maintain a fun and exciting work environment we need to ensure that we are all working together as a team to create a safe work environment. To do this we need to make sure that the following procedures are followed at all times while in the lab:

**GENERAL LAB SAFETY RULES**

- Please be alert at all times while in the lab. The lab is full of people: be prepared and always let the people around you know when you are working with dangerous substances/equipment. Also, be very cautious when moving around in the lab space. Notify your MENTOR/Meagan/Felicia immediately if you observe any unsafe practices.
- No food or drink in the lab. This means that you may NOT bring food or drink into the lab and you may NOT throw out empty food/drink containers in the lab garbage.
- No laptops/cell phones/etc. are allowed during the lab.
- You cannot work alone in the laboratory (a MENTOR /Meagan/Felicia must be present at all times).
- If you forget your labcoat or goggles you will be asked to purchase them from the bookstore prior to attending the labs. We do not provide you with lab coats or goggles.
- You will have a storage area for your book bags and jackets that is not in the actual wet-lab space. You must leave your pencil case, hats, etc. in this area. You may NOT eat or drink in this area!!! In addition, you cannot store any food or drink in this area. All water bottles/drinks and any food MUST be stored in your bag so that they are not visible to anyone standing in this area.
- You need to carry your lab coat in a separate plastic bag. Please do NOT wear your lab coat outside the lab space. The hallway is NOT an appropriate place for you to put on your lab coat.
- Wash your hands with soap and water in the designated hand washing sink after performing all experiments and prior to leaving the lab.
- Please make sure that you do not walk around the lab and distract other students during the lab period.
- Please make sure that you take notes during the lab safety walk through and you know the location of safety features in the lab. Please make sure that you know the proper procedures in case of emergencies.
- All chemicals/biologicals in the laboratory are to be considered dangerous. Avoid handling chemicals without gloves. Always read the MSDS prior to handling any chemicals/biologicals and follow the proper safe handling instructions. Do not taste, or smell any chemicals/biologicals. Never return unused chemicals to their original container.
- Report any accident (spill, breakage, etc.), injury (cut, burn, etc.) or broken equipment to your MENTOR immediately. **Do not panic.** If you or your lab partner is hurt, immediately (and loudly) yell out your MENTOR’s name to get their attention. **Do not panic.**
- Dispose of all chemical waste properly. Never mix chemicals in sink drains. Check with your MENTOR for disposal of chemicals and solutions. Never dump any chemicals down the hand washing sink.
- Please maintain good housekeeping practices. Work areas should be kept clean and tidy at all times.
Perform only those experiments authorized by your MENTOR. Carefully follow all instructions, both written and oral. Unauthorized experiments are not allowed. If you do not understand a direction or part of a procedure, ASK YOUR MENTOR BEFORE PROCEEDING WITH THE ACTIVITY.

You may not eat or drink anything from the lab. You may not take anything home from the lab (test tubes, gels, reagents, Petri dishes, pipette, etc.) or bring any outside experiments into the lab.

Please do not touch any of the equipment without proper training and supervision by your MENTOR.

USE OF AVENUE2LEARN (http://avenue.mcmaster.ca)
This course uses A2L to post the course outline, lab results and other notices. You should be aware that when you access the electronic components of this course private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure.

ACADEMIC INTEGRITY
“My assumption is that every student attending this course is doing so to discover the world of Biochemistry and Biomedical Sciences. Any student that would like to ignore my assumption should visit the Academic Integrity Policy at McMaster University for information on academic dishonesty (http://www.mcmaster.ca/academicintegrity/)”.

STUDENT ACCESSIBILITY
Students who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Academic accommodations must be arranged for each term of study. Student Accessibility Services can be contacted by phone 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information, consult McMaster University’s Policy for Academic Accommodation of Students with Disabilities.

COLLABORATION POLICY
This course focuses on teamwork and collaboration. This is because science and medicine both rely heavily on teamwork and sharing of ideas. Care must be taken to ensure equal distribution of work ethic and acknowledgement of individual ideas and creativity whenever collaborating with anyone. This is not only respectful but also fair. Additionally, it allows for a free-flowing, creative environment where individual ideas are proposed and acknowledged properly. This always gives rise to individual and team empowerment, productivity, optimism and a sense of contribution. Only wonderful things can happen when you acknowledge each other’s contributions.

Collaboration between your peers is wildly encouraged (in and out of class time). Care must be taken when undertaking these collaborations. When entering in peer collaborations, make sure you come prepared. Attempt the assignment on your own, write down possible answers and highlight sticking points (points you do not understand). You can then collaborate with your peers to discuss these sticking points. Following your collaboration, you can finish your assignment on your own while reflecting on your discussions. At the bottom of each assignment page, acknowledge all your collaborations (peer names and how you collaborated with them). Likewise, if you consulted a lab report from a previous year (which is totally acceptable, by the way), please acknowledge the report author. Please do not misrepresent others’ work as your own. If you did not collaborate with anyone you can simply state that your work was conducted on your own.

When collaborating on any team project, each team member must write down their name on each page/slide they contributed to. At the end of each team project, each member must write out (briefly) how they contributed to each project and reflect on their team collaboration experience.

ADDITIONAL LAB TIME
A minimum of 8 hours per week are provided from 1:30-5:30 on Monday and Tuesday to be spent in the lab or in meetings. These 8 hours are provided but are not expected to suffice. Additional time will need to be spent outside of the times specified in your timetable to conduct individual research and/or because experiments cannot usually be packaged exactly into a 4 hour time slot. No student is permitted to be in the lab without a Mentor/Meagan/Felicia present.

Expectations for lab time outside scheduled hours:
BRIEF DESCRIPTION OF ASSESSMENT COMPONENTS

Sharing and helpfulness (includes reflections/self/peer/team assessments) ➔ Each lab day you will be assessed by your lab MENTOR (with input from Felicia/Meagan). You will also assess your own performance throughout the term. You will assess your individual team members throughout this process, and they will assess your performance and engagement in the lab. This mark is an assemblage of all assessments in this component.

Team Contract ➔ This contract must be prepared by each TEAM PRIOR to the start of the project. The contract is an agreement between all members in the team to work together towards a common goal. The contract should contain all pertinent information that clearly communicates all aspects of this team process. This should alleviate any confusion regarding expectations towards team work. Please complete the contract and return it to your Mentor by September 15th.

Weekly Order Form ➔ Each week during the “lab work” portion of the course, each team must complete and submit a “weekly order form” to their mentor on the WEDNESDAY BEFORE the start of the lab period (see the course calendar for specific dates). This means that if you want to conduct a lab on Monday/Tuesday Oct 21/22 you MUST submit your form to your mentor (via A2L dropbox folder) by Wednesday Oct 16. Your mentor will look over and mark the form no later than Thursday of the same week. If you do not place your order in on time you will lose marks and we cannot guarantee that you will be able to conduct experiments on time. The form templates are found on A2L as a Word file. MSDS summary sheets – each lab work week, each team must have an MSDS summary sheet containing the names of all chemicals/biologicals to be used that week, main safety considerations within the context of the lab (how are using it, the concentration of the reagent), appropriate handling and personal protective equipment, proper handling of a small spill and appropriate references. This summary sheet must be submitted to your mentor at the same time as your weekly order form. Also, each student in the team must have a copy of this sheet in their lab notebook PRIOR to the lab. We will check your lab notebook to ensure your protocol is included. We will also check to ensure you understand the lab procedure, safety considerations, etc. If you are not prepared you will be asked to leave and forfeit your lab time for that day.

Lab Notebooks ➔ One lab entry should encompass the entire week (Monday and Tuesday). This means that you have 1 purpose, 1 timeline, 1 flowchart, etc. for the entire week. You will hand in your lab carbon copies on the Monday following your lab week so that you can insert your data and discuss the results fully. For figures generated, please paste one copy of a professional figure (with figure caption) in the lab notebook and submit one copy attached to your carbon copies. Please note; you are responsible for all the protocols and all the data generated by your entire team. You may have multiple protocols for the week depending on your research project. You will hand in 6 lab notebook carbon copies. Your Mentor will choose any 2 of the 6 to mark. The lab notebook guidelines and marking scheme are posted in the content page of A2L.

Quizzes ➔ The quizzes will be distributed at random times during the term and will encompass a number of areas from general concepts, to calculations, to flowcharts that assess your ability to understand your research project.

Proposal Review ➔ This component requires that each individual submit a 1-page (can be single-spaced and point form) review/critique of another Team’s research proposal (based on their proposal presentation). This component is due by Monday October 7th (at the beginning of the lab: no late submissions). You MUST comment on the sections highlighted below:

✓ Significance of work.
✓ Overall design of study (rationale for time utilization and rationale for main technique(s). Please include your input/suggestions).
✓ Feasibility of experiments (include possible problem areas, possible alternatives, possible future work).
✓ Would you fund this research project? (Please be constructive and positive in your response).

Proposal Review Workshop: this component requires that the Teams meet and discuss the proposed research projects.

Proposal Report ➔ Each team will submit their project proposal to the A2L appropriate A2L dropbox folder. The report is due Monday September 29th, 2014 by 1:00pm. Late penalties: you NEED to be on time with this! Maximum page count: 15, double-spaced pages (Times New Roman font size 12, 1-inch margins all around). The proposal should be broken down into the following four subsections:

i. Abstract – 300 word maximum
ii. Introduction and Hypothesis/objective – Introduction to the field as a whole with particular emphasis on your hypothesis/objective...
iii. Proposed Techniques – Introduction to the main techniques you have proposed. These can include overall techniques like: CLONING (site directed mutagenesis, overlap PCR, etc.), protein small-scale expression, purification, Western blotting, functional analysis, x-ray crystallography, etc. Each proposed main techniques should have a description of each planned experiment with detailed protocols and references.

iv. Timeline of experiments and division of labour - Detailed timeline of each experiment that follows the course calendar depicted above to be conducted during the lab periods. Please specify any additional time required outside of the lab time (simply state why you require extra time). Also, please specify which team member(s) will conduct each outlined experiment.

Weekly written communications – There are four communications that encompass the following:

Weekly written communication 1 – Individual. Design an illustrative flowchart (with caption) outlining your research proposal.
Weekly written communication 2 – Individual. Submit two figures (with figure captions). Discuss the results (be brief, 1-2 paragraphs).
Weekly written communication 3 – Team. Submit a flowchart/concept map highlighting the overall design of your short communications paper: team component.
Weekly written communication 4 – Team. Submit a draft of the short communications paper: team component. Include references! All team member collaborations in this process should be identified.

Short communications paper – consists of two parts:

a. Individual report – The length of the submitted report should not exceed 2500 words. As a reference: there are approximately 500 words/page double-spaced with 11-point font (Times New Roman) and 1-inch margins all around. This implies a maximum page length of approximately 5-double spaced text pages in length. Based on your initial individual flowchart of the research proposal (weekly written communication 1), reflect on the progress made thus-far. This reflection should include the following sections:

✓ A revised version of your initial flowchart highlighting the progress made (1-2 pages)
✓ Reflect on troubleshooting (be specific about experiments and how you worked through the troubleshooting)
✓ Future work (immediate and further down the line)
✓ Your individual input in the project

b. Team paper – This is a short communication paper designed to highlight your team research project in Biochemistry 3P03. As a team, you also have the choice to submit your team paper for review to our new “Catalyst” peer-reviewed online undergraduate journal. Submitting to the journal is not a requirement of the course, but if your team members are willing it would be a fun experience and a publication. The team paper template is posted on the A2L content page. Please follow the specified template. This paper is due by December 3rd, 2014, noon to the appropriate A2L dropbox folders (2 folders: one for individual submission and one for team submission)

Proposal Presentation – The main goal of the first team presentation is to convey your full understanding of the project objective(s) and how it fits in with the field as a whole. The presentation should be used to highlight 3 main areas of your proposed research:

1. PROBLEM – What is it and why should we care?
2. PROPOSED SOLUTION(s) – How will you solve this problem?
3. PREDICTED RESULTS – What are they and how will they help the problem?

The presentation will be marked entirely on your ability to communicate these 3 areas to your audience and fully help us understand your research. The presentation CANNOT exceed 20 minutes and will be followed by 20 minutes of questions. Please do not complicate your presentation, make sure you make good use of flowcharts and diagrams and that you are enthusiastic in your presentation style. Please note: often times presentations do not always go as planned. It is expected that each student fully understands the team presentation and can overcome any technical difficulties (or other adversities) that might arise.

Lab Meeting (10%) – This is a meeting between team members, Felicia and Meagan. Each team will have 50 minutes to discuss their research project and progress (this includes the entire meeting time). PowerPoint slides of all data generated to-date should be prepared; we will use the time to go over data analysis and discuss where to go from here. This is an open-forum lab meeting so please do not prepare a formal presentation. Each team member should be prepared to answer questions on their specific project proposal, data analysis, troubleshooting, future work, etc. I would like to see equal individual involvement in this meeting.

Progress Presentation – As a team, you will present the progress of their experiments/research project. Your focus should be in presenting the data generated and describing how your results fit in with your research plan and the field as a whole. This presentation should also include future work and troubleshooting. Please take care how you present the data itself. You must create professional figures, easy to see, well labeled, you must first present how the data was generated, go through the figure (what are we looking at, what do the controls mean, what does each lane/axis represent), then and only then you can tell us what the results are (and point to the exact place on the data figure that supports your presented results).

The presentation CANNOT exceed 20 minutes, followed by 20 minutes of questions.