Welcome to Biochemistry 3P03!

Introduction and Expectations:

In this course, students will be introduced to the concept of primary research design through the use of inquiry. Students will gain first-hand experience in devising their own research project. Students will be placed in Teams of 5-7, and each Team will be designated a Mentor.

This year the Teams will work closely with their Mentor to assist Dr. Felicia Vulcu in developing new DHFR mutants to be utilized by aspiring Biochemistry students in the Biochemistry 2L06/3P03 courses. The DHFR mutants created can be tested for drug resistance and used in screens for future drug design. These screens can be conducted in our High Throughput Screening (HTS) facility, in collaboration with Dr. Eric Brown. 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.

The work implemented by the Teams throughout this term will shape the future direction for the Biochemistry 2L06/3P03 courses.

Overview of research project:

Dihydrofolate Reductase (DHFR) and its role in drug design cannot be disputed. It has become a model-system for setting up drug-design trials and high-throughput screens. In fact, the Journal of Biomolecular Screening dedicated an ENTIRE section on utilizing DHFR for a virtual drug screening project that spanned research collaborations from all over the world. One such researcher partaking in this study was our very own chair of Biochemistry and Biomedical Sciences: Dr. Eric Brown. Check out the paper cited below:


There has been a lot of success in exploiting DHFR as a drugable target (both prokaryotic and eukaryotic forms). Multiple drugs that target the folate pathway by directly inactivating DHFR are now on the market. Drugs, like trimethoprim (TMP), are highly selective as they have been documented to bind bacterial DHFR proteins 10⁵ times tighter than vertebrate DHFR. This selectivity is highly advantageous both at the patient and business development level. Additionally, “significant structural information is available with over 100 different DHFR crystal structures available” (1). For example, the 3D structure of Mycobacterium tuberculosis DHFR complexed with several inhibitors is now available (1). Such information can be exploited for directed design of new and selective DHFR inhibitors. However, throughout the years the DHFR-directed drugs currently on the market have become less potent due to drug-resistance. Over time, the gene encoding DHFR has picked up numerous mutations that have led to subsets of DHFR proteins which no longer respond to the drug-induced mechanisms. Thus, this once model-protein for designing high-throughput screens has also become a legitimate target for discovering new anti-DHFR drugs…and research has been slow. Currently one new drug, Iclaprim, has made it to Phase III clinical trials and promises to be a good antibacterial drug target.
Given this information, it would be really interesting to find a way to utilize the data currently available to us in order to further our quest towards developing new and more potent inhibitors to DHFR. And we can get creative … why use one inhibitor when we can test multiple combinations and look at synergy between the multiple drug targets… But first we must set up a sound working hypothesis from which to base our entire experimental design. This is a massive undertaking and this Biochemistry 3P03 class is charged with the responsibility of setting up the main experimental design.

The aim of this entire 3P03 module is: to create multiple DHFR mutants that either mimic known DHFR drug-resistant mutations, or simply test different novel mutations to help discover novel drug-targeting pathways or possible hot-spots for mutations in the DHFR active site. You can be as creative as you would like with mutant design as long as you can clearly justify your experimental hypothesis and can demonstrate your in-depth knowledge of the current field. You can, for example, use PyMol to study and compare the different DHFR protein structures currently available and create mutants based on this information. You only have E. coli K12 folA to work with as your starting DNA template but that should not stop you from looking at mammalian DHFR drug targets (you only need to understand which areas between the two DHFR proteins are highly conserved and work within those constraints). You will need to create as many mutants as you feasibly think is possible given your resource and time constraints, purify the DHFR mutants, crystalize them (if you get to this step we can ask Dr. Junop to diffract the crystals with the hopes of solving the actual structure) and most importantly test your mutants for function. You can first test known drugs available and then we can collaborate with Dr. Brown and the High Throughput Screening (HTS) Facility (http://fhs.mcmaster.ca/cmcb/hts_small_molecule_libraries.html) to design a compound screen for us. If you are computer-savvy why not try your skills at virtual drug screening – which is the ultimate goal for this course. You can use computer programs like Dock Blaster (http://blaster.docking.org/) in conjunction with PyMol to help you design virtual screens. This project is a very large undertaking that promises to be a lot of fun. The data obtained will be carried over to both Biochemistry 2L06 and 3P03 courses in future years. Ultimately, I would like to have a structural map of DHFR showing all the mutants we created, crystallized and tested between the different biochemistry 3P03 and 2L06 classes. So good luck and remember to have lot of fun in this process.

References of interest:

Each team will design a:
- Research hypothesis
- Flowchart describing experimental design
- Step-by-step procedural protocol
- List of reagents and equipment (for each protocol)
- Timeline outlining the experiments
- Division of labour to designate work for all team members
• Biohazard Approval Form (in collaboration with their Mentor, Felicia and the Safety Office) - http://fhs.mcmaster.ca/safetyoffice/documents/Biohazardformv2.pdf  - you must click on the link, fill up the form on the computer and print off 2 copies and hand them in to your Mentor (instructions on completing the form are found in the “Budget” description of the course outline).

Throughout the course, students will gain an understanding of:

• experimental protocol
• experimental design
• analysis of results and troubleshooting
• verbal and written 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: vulcuf@mcmaster.ca; office: HSC 4H43 (please enter through the Undergraduate Program Office: HSC 4H45)

Students that have specific questions regarding techniques or the underlying theories used should contact resources in THE FOLLOWING ORDER:
1. Mentor
2. Dr. Felicia Vulcu

Office hours: 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.

Labs: Mon 1:30-5:30 pm and Tues 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 labs by Mentor/Felicia)

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 the safety office (and you must pass the quizzes) or you will not be allowed to work in the lab.
**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>Participation/ Preparedness/ Weekly Materials Forms/ MSDS Sheets(team)/ Team contract (team)</td>
<td>10</td>
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<tr>
<td>Notebook (individual)/ Quizzes (individual)</td>
<td>7</td>
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<tr>
<td>Proposal Review – includes handout (individual) and workshop (teams)</td>
<td>5</td>
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<tr>
<td>Proposal Report (team)</td>
<td>10</td>
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<tr>
<td>Weekly Reflections (individual)</td>
<td>10</td>
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<tr>
<td>Short Communications Report (individual)</td>
<td>23</td>
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**PRESENTATIONS**

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<tr>
<td>1. Proposal Presentation (team)</td>
<td>10</td>
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<td>2. Progress Presentation (team)</td>
<td>15</td>
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<td>3. Lab Meeting Presentation (team)</td>
<td>10</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td><strong>100</strong></td>
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<tr>
<td>DATE (MON-TUES)</td>
<td>DESCRIPTION</td>
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</table>
| Sept 10 and Sept 11 | **Monday Sept 10**  
- Welcome  
- First lecture describing course setup/project  
- Division into TEAMS and introduction to TEAM MENTOR  
**Tuesday Sept 11**  
- Safety talk  
- Lab safety walk-through and introduction to in-lab reference material (current lab protocols manual, books, etc.)  
- Safety update by FHS Safety Representative |
| Sept 17 and Sept 18 | **Monday Sept 17**  
- Work on research project  
**Tuesday Sept 18**  
- Work on research project  
Team contract due |
| Sept 24 and Sept 25 | **Monday Sept 24**  
- Work on research project  
**Tuesday Sept 25**  
- Work on research project  |
| Oct 1 and Oct 2 | **Monday Oct 1**  
- PROPOSAL PRESENTATION  
- Proposal Report due  
**Tuesday Oct 2**  
- PROPOSAL PRESENTATION |
| Oct 9 only (Oct 8 off) | **Monday Oct 8**  
- THANKSGIVING (NO CLASSES)  
**Tuesday Oct 9**  
- Proposal Review workshop (discuss proposals)  
Proposal Review Handout due |
| Oct 15 and Oct 16 | **Monday Oct 15**  
- Start of lab work (week 1)  
**Tuesday Oct 16**  
- Start of lab work (week 1)  |
| Oct 22 and Oct 23 | **Monday Oct 22**  
- Lab work (week 2)  
**Tuesday Oct 23**  
- Lab work (week 2)  
Weekly reflection (1) due |
| Oct 29 and Oct 30 | **Monday Oct 29**  
- Lab work (week 3)  
**Tuesday Oct 30**  
- Lab work (week 3)  
Weekly reflection (2) due |
| Nov 5 and Nov 6 | **Monday Nov 5**  
- Lab meeting (with instructor/mentor only) – Team presentation of:  
- progress  
**Tuesday Nov 6**  
- Lab meeting (with instructor/mentor only) – Team presentation of:  
- progress |
| Nov 12 and Nov 13 | **Monday Nov 12**  
- Lab work (week 4)  
**Tuesday Nov 13**  
- Lab work (week 4)  
Weekly reflection (3) due |
| Nov 19 and Nov 20 | **Monday Nov 19**  
- Start of lab work (week 5)  
**Tuesday Nov 20**  
- Start of lab work (week 5)  
Weekly reflection (4) due |
| Nov 26 and Nov 27 | **Monday Nov 26**  
- PROGRESS PRESENTATION  
**Tuesday Nov 27**  
- PROGRESS PRESENTATION |
| Dec 3 Classes end | **Monday Dec 3**  
- End of course reflection  
**Dec 5**  
- Short Communications report due |

"The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes."
Policy on: Attendance Missed Work, and Late Penalties:

- Attendance to ALL laboratories is mandatory. One missed lab (without MSAF/APPROVAL by the Associate Dean’s office) will constitute a ZERO in the course.
- An MSAF or Approval from the Associate Dean’s must be provided for any missed labs. Please go to the following website to obtain information on this process (http://www.mcmaster.ca/msaf/).
- Missed quizzes/budgets/proposals/reports/presentations/labs, etc. (without MSAF/APPROVAL by the Associate Dean’s office) will be graded as ZERO.
- Late lab notebook copies will NOT be accepted.
- Late penalty for reports/proposals, etc. is described below.
- Any report/quiz/notebook/lab report, etc. handed in without a name or ID number will receive an automatic ZERO.
- It is the responsibility of the student to back-up all their computer work. No allowances will be given to students for turning in late reports due to computer problems.
- Only an MSAF/APPROVAL from the Associate Dean’s office will suffice to provide some exemption from the above regulations.
- Any area in the lab left untidy will result in a mark of ZERO on the day’s participation sheet for the students (individual or entire team).

LAB RULES:

- 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. You will receive a mark of zero on your participation if we see food/drink containers in the lab area (includes garbage)!
- YOU MUST BRING YOUR LAB COAT, SAFETY GOGGLES, LAB NOTEBOOK, CALCULATOR, AND PEN TO ALL LABS!!!! You must wear close-toed shoes and long hair must be tied back! No contact lenses!
- 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!!!
- You need to carry your lab coat in a separate plastic bag so as to avoid contamination
- No laptops/cell phones/etc. are allowed during the lab
- You must always wash your hands in the designated hand washing sink prior to leaving the lab
- There is absolutely no improper behavior/horseplay allowed in the lab
- 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, pipettes, etc.)
- Any area in the lab left untidy will result in a mark of ZERO on the day’s participation sheet for the students (individual, pairs or entire team).

Time in the Laboratory:

A minimum of 8 hours per week are provided from 1:30-5:30 on Monday and 1:30-5:30 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/Felicia present. A timetable detailing all the experiments and corresponding times that the team will spend in the lab will be provided to Felicia and the Mentor at the same time as submission of the Budget. The time spent in the lab will be monitored and graded by the Mentor (with some input from Felicia) through lab participation/attendance sheets as well as quizzes.

Avenue2Learn:

A2L will be an important means of communicating between the course instructor, TAs and students, as well as of submitting documents. It is imperative that students check A2L on a daily basis, or a minimum of every two days for important announcements. Students should be aware that, when they 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. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

**Academic Integrity:** I am confident that students attending this course are here to genuinely discover the world of Biochemistry. 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/).

Below is a tabulated view of all assessment tools required in this course, due dates and where to find the guidelines and marking schemes. Since this is an inquiry lab course I strongly suggest that each Team communicates very closely with their Mentor (and in advance) to solidify the expectations for these assessment assignments.

<table>
<thead>
<tr>
<th></th>
<th>Assessment Type</th>
<th>Date due</th>
<th>Guidelines / Marking Scheme (page#)</th>
<th>Mark (point scale)</th>
<th>Percent (of final mark)</th>
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<tbody>
<tr>
<td>1</td>
<td>Participation/Preparedness</td>
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<td></td>
<td>• Weekly materials form</td>
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<td>Participation/weekly materials form/MSDS, every Mon and Tues</td>
<td>8-9</td>
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<td></td>
<td>• MSDS Sheets</td>
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<td>Team Contract – Mon Sept 17</td>
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<td>• Team Contract</td>
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<td>Participation – maximum 3 points (every Mon and Tues)</td>
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<td>MSDS – maximum 1 point weekly</td>
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<td>Team Contract – maximum 1 point</td>
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<td>2</td>
<td>Notebook</td>
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<td></td>
<td>• Quizzes</td>
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<td>Notebook, every Tuesday</td>
<td>9-11</td>
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<td>Quizzes, random times</td>
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<td>Notebooks – maximum 27 points/notebook (only 2 will be marked)</td>
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<td>Quizzes – maximum 5 points/quiz (random times)</td>
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<td>3</td>
<td>Proposal Report</td>
<td>Mon Oct 1</td>
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<td>Maximum 63 points</td>
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<td></td>
<td>• Budget</td>
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<td>• Biohazard approval form</td>
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<td>4</td>
<td>Proposal Review Handout</td>
<td>Tues Oct 9</td>
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<td>Maximum 16 points</td>
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<td>5</td>
<td>Weekly Reflection (1)</td>
<td>Tues Oct 23</td>
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<td>Maximum 4 points</td>
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<td>6</td>
<td>Weekly Reflection (2)</td>
<td>Tues Oct 30</td>
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<td>Maximum 4 points</td>
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<td>7</td>
<td>Weekly Reflection (3)</td>
<td>Tues Nov 13</td>
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<td>Maximum 4 points</td>
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<tr>
<td>8</td>
<td>Weekly Reflection (4)</td>
<td>Tues Nov 20</td>
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<td>Maximum 4 points</td>
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<tr>
<td>9</td>
<td>Short Communications Report</td>
<td>Wed Dec 5</td>
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<td>Maximum 73 points</td>
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<td>10</td>
<td>Proposal Presentation</td>
<td>Mon Oct 1 and Tues Oct 2</td>
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<td>Maximum 40 points</td>
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<tr>
<td>11</td>
<td>Progress Presentation</td>
<td>Mon Nov 26 and Tues Nov 27</td>
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<td>Maximum 50 points</td>
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<tr>
<td>12</td>
<td>Lab Meeting Presentation</td>
<td>Mon Nov 5 and Tues Nov 6</td>
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<td>Maximum 36 points</td>
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</tbody>
</table>
ASSESSMENT GUIDELINES:

1. **Participation and preparedness** → each lab day students will be assessed by their Mentor (with some input from the instructor) to ensure all students are prepared for the day’s lab. The assessment sheet outline follows:

   * The marking scheme is out of 3, where 0 = not satisfactory, 1= satisfactory, 2 = good, 3=excellent.

   - Lab Coat (must wear at all times; a mark of 0 on the entire day’s participation if no lab coat)
   - Safety goggles (must wear at all times; a mark of 0 on the entire day’s participation if no goggles)
   - Courseware and lab notebook (does the student have them?) a mark of 0 on the entire day’s participation if missing either one
   - Attendance (was the student late for the lab? A mark of 0 on the entire day’s participation if they are late)
   - Inappropriate behavior (is the student horse-playing in the lab? ; is the student talking back to the TA?; is the student not following instructions?, etc.) a mark of 0 on the entire day’s participation if inappropriate behavior seen
   - Lab Notebook (has the student completed all the sections required for the notebook?) zero on the entire day’s participation if a section is missing. Specify which sections were not completed.
   - Preparedness (does the student know what they are doing for the day’s lab? are they letting their group do everything, can they use equipment properly, are they working safely, is their reaction working etc.) (/3)*

   √ MSDS sheets provided (and information used properly) /1. If students do not use the information appropriately please let them know immediately and a mark of 0 on the entire day’s participation.

   - Weekly Materials Form: Each week during the “lab work” portion of the course, each team must complete and submit a “weekly materials form” on the THURSDAY BEFORE your lab period. **This is done on a weekly basis!**

This means that if you want to conduct a lab on Monday/Tuesday Oct 15/16 you MUST have submitted your form to the A2L dropbox folder by Thursday October 11th of the PREVIOUS week! If you do not place your order in on time we cannot guarantee that you will be able to conduct experiments on Mon/Tues (Oct 15/16). The form MUST be in by Thursday at noon. Full completion of this form counts towards team participation marks and if you do not complete this form properly (or at all) each team member will lose 1 mark from their participation mark for the week. The form templates are found on A2L as a Word file and should contain the following sections:

<table>
<thead>
<tr>
<th>Weekly Orders/Materials Form (date submitted):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Letter:</td>
</tr>
<tr>
<td>One paragraph describing the main experiments to be conducted and why (describe the number of samples, where you obtained them from, if you need to reproduce data and why, if you are troubleshooting and how, etc.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technique (i.e. SDS-PAGE, Western blotting, etc.)</th>
<th>Number of samples (please be specific and calculate number of gels needed, etc.)</th>
<th>Equipment needed (what type and how many)</th>
<th>Supplies needed (number of tubes, type of tubes, reagents, etc.)</th>
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<tr>
<td>Orders (please write out any chemicals/primers/kits that require ordering; please include the catalogue number, price and name of company):</td>
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<tr>
<td>Name of item to be ordered</td>
<td>Catalogue number</td>
<td>Price (Canadian $ please)</td>
<td>Company name</td>
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Comments from Mentor (please comment on above form, feasibility given lab times, any notes on how to best prepare for the labs to increase efficiency):
**MSDS (Material Safety Data Sheet)** – Each team must have: printed MSDS copies of ALL chemicals/biological used (only 1 copy/chemical). Pay particular attention to Hazards Identification/Handling and Storage/Exposure controls/Personal Protection/Disposal Considerations. You must use the contents of the MSDS sheet when working with the chemical/biological.

**Team Contract** - This contract must be prepared by each TEAM PRIOR to the start of the project. The contract is a binding 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 the specified due date. Copies of the contract will be made and distributed to each team member.

Guidelines: The contract can be as long as you wish and should include (at least) these topics:

- Names of team members and contact information (you can choose to use email or A2L for daily correspondence).
  **Please do NOT include your student ID numbers on any team assignments!**
- Team Goal/Objective – in a sentence or 2 clearly state the main goal that each member in your team will work towards in this course.
- Meeting information –
  - When, where, how often?
  - How will you communicate this information?
  - What is your timeline for allowing members to respond to the meeting time?
  - How long will the meetings last?
  - What is the team policy on attendance? SPELL IT OUT CLEARLY
  - What other expectations are there for team meetings (this includes preparedness for each member, professionalism, etc.)?
- Data sharing – how will the data be posted and by whom? (please use A2L whenever possible)
- Workload – you need to determine the following:
  - Person responsible for recording meeting minutes (one person or rotation)
  - Will you have a team leader? If so, what are their responsibilities?
  - How will you communicate changes that occur during the lab to one another (remember, you might be splitting up and working on different protocols throughout a given lab day, but you must ALL communicate your experiments for your lab notebooks)?
  - Person responsible for meeting timeline and deadlines (one person or rotation)?
  - How will you evaluate each other’s work BEFORE it is submitted in the form of: 1. report, 2. presentation?
  - Will you work individually on sections THEN meet OR will you accomplish all work at team meetings?
  - Will all decisions be made at meetings? If not, how will you communicate these decisions to everyone in the team?
  - How will you divide the work to ensure fairness?
- Team conflicts – how will you manage team conflicts? What are your expectations for each team member?
- Code of conduct

2. **Notebook** – Why is maintaining a proper laboratory notebook so important? – The simple answer is that a research scientist must produce REPRODUCIBLE data. The only way to succeed at this task is to keep very detailed notes on your experiments, the purpose of the experiments, the procedure, the results obtained and all other observations obtained throughout daily experiments. Details are extremely important in the scientific field as they can make or break an experiment.

The laboratory notebook is made up of carbon copied and numbered pages so that your supervisor or mentor can also keep a detailed record of your work. The contents of the notebook should be brief and concise, yet descriptive. It should be written in enough detail that another person with no knowledge of your experiment could reconstruct your study, and reproduce your results. Maintaining an effective notebook will also facilitate the future writing of a good quality lab report or scientific research paper, or act as a starting point for future experiments.

For these reasons, it is important that you follow these general instructions when writing your lab notebook:
Unfold the back cover of the notebook and place it directly under the page that you will be writing on – otherwise the pressure of your pen will imprint on the pages beneath it

Writing must be done in dark ink – black ball point pen is best, blue ink fades more readily

Pencil should never be used in the lab notebook

Place your name and date on every page

Record all data directly in the notebook – never use odd scraps of paper or the edge of your lab book to record data

Never write over unwanted or incorrect text or numbers – always cross out erroneous material with a single line and re-write the correct data

Never use white-out in a lab notebook!!!

Reserve two-three pages for a table of contents at the beginning of the notebook

Never tear out or remove a page from the notebook, unless it is the carbon copy duplicate

Data typed or obtained from a computer MUST be printed and TAPEd into your notebook; you might need 2 copies, one to hand in to your Mentor.

Table of Contents – please reserve a few pages at the beginning of the notebook for a table of contents. This should include the lab number, page number and a short (1-2 sentences) description of each lab. The rest of the notebook should contain the following:

Each lab needs to contain the following sections in your notebook (every WEEK!!):

1. Your name/ TA name/ Lab Day/ Date – on ALL pages!
2. Lab number and title of lab
3. Purpose of lab ➔ Please write 1-3 paragraphs stating – in YOUR own words – the main purpose of the lab. This should include the purpose of this lab within the main research project.
4. Flowchart ➔ highlighting the MAIN steps of the lab (not too much detail please) and how this experiment fits in with the overall flowchart of experiments for your research project.
5. Safety ➔ a list of major safety concerns. Please look up the MSDS for chemicals and write out all possible dangers related to exposure to the chemical, safe handling procedures (please make sure that you customize them for your own lab space whenever possible) and procedures in case of spills or other exposure to chemicals. MSDS sheets can be found online OR they can be found in the teaching labs. REFERENCES!!!!
6. Calculations ➔ must be completed PRIOR to coming to the lab – you must read the lab thoroughly and figure out which calculations you need before coming to the lab!!!
7. Protocol ➔ step-by-step procedures! This includes all the protocols being performed by everyone in the team!
8. Charts/ tables ➔ must be drawn in the notebook PRIOR to coming to the lab and which are used to collect data during the lab.
9. During the lab, each student must record their procedures. If the procedure is different from the original protocol please write down the difference (include information on which step of the procedure was conducted differently). ALWAYS WRITE OUT ALL OBSERVATIONS (INCLUDING COLOR/VISCOCITY CHANGES, ETC.).
10. Figures/Figure captions and Discussion as required by your Mentor, however you should have a copy of all raw data produced in your lab notebooks for reference.

MUST be legible or you will receive a mark of ZERO!

REFERENCES! You must have proper references for all your lab notebooks. Please embed references throughout your notebook (numerical) and include a reference list at the end of EACH lab notebook section. I prefer primary references (that implies research articles).

Here is an example of the notebook marking sheet (note: some components may change in terms of requirements and overall weight of mark):

| 1. Purpose of lab (/3) – 1-2 paragraphs describing the main purpose of day’s lab, the main results to be obtained and how data pertains to the overall goal of the project (both short term and long term) |
| 2. Flowchart (/3) - highlighting the MAIN steps of the lab (not too much detail but must encompass both your individual experiments and those to be performed by all members in the team). This should visually depict the main experimental techniques in a cohesive flow from one concept to the other |
| 3. Safety – (/3) ALL main safety precautions pertaining to the lab including safe handling instructions. MSDS sheets should be referenced here (websites are fine) |
4. Protocols and Procedures – (/3) must have step-by-step protocols (must include all protocols of everyone in the team) to coming to the lab
5. Charts/ tables and calculations – (/3) ALL charts/tables required to collect data must be present in the notebook PRIOR to coming to the lab
ALSO, a copy of all data generated (gel, picture, etc.) must be pasted in the notebook at the end of the lab period or prior to next week’s lab. If this section does not apply to the lab please write N/A in the appropriate box.
6. Discussion/Observations – (/3) a brief discussion of the results obtained, how they pertain to your flowchart and timeline, troubleshooting, etc. This section should also describe how the data generated pertains to the overall project (both short term and long term goal)
7. REFERENCES – (/3) must have references throughout, especially when describing a new technique, protocols, etc.
overall flow and organization (/3) - this section applies to each lab
8. clarity of thoughts (includes proper grammar and proper usage of technical terms) (/3) - this section applies to each lab

PLEASE NOTE: 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 may have multiple protocols for the week depending on your research project. You will hand in 5 lab notebook carbon copies for the 5 weeks you will be in the lab. Your Mentor will choose 2 of the 5 to mark.
Also, please note that any data generated (gels, blots, etc.) will be scanned and posted on A2L by Felicia/Mentor. You may not take this data home with you. It is the property of the Biochemistry Teaching Labs. A folder will be provided for you to store the original data while in the teaching labs.

• 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 test the students’ ability to understand their research project.

3. Proposal Report  Each team will submit a project proposal which is due October 1st, 2012 at 1:30pm prior to the start of Monday’s Proposal Presentations. Late penalties: 10%/ hour with a mark of zero after 4 hours.

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 iv 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 (state it CLEARLY) and how it fits in the current research field. REFERENCES!!! (Should have lots of references)
iii. Proposed Techniques – introduction to the main techniques you have proposed. These can include overall techniques like: CLONING (site directed mutagenesis, overlap PCR, etc.), DHFR small-scale expression, purification, Western blotting, functional analysis, x-ray crystallography, etc.

EACH proposed main technique should have a(n):
- Introduction to reiterate the purpose of your research and how this technique contributes to the overall goal of your project
- Description of EACH planned experiment (detailed protocols)
- Small discussion on the general aspects of each main technique including advantages and disadvantages.

FEASIBILITY – comment on why your experiments are “do-able”.

iv. Budget (including all 4 sections) does NOT count towards the final page count (see below for description)

Note: the detailed protocols do NOT count towards the final page count and should be attached at the end of the report.

• Budget (part of Proposal mark, to be submitted with the Proposal report and does not count towards Proposal report final page count) Students are to submit 4 sections:
i. **Flowchart of experiments** – a flowchart highlighting all the experiments to be conducted in the proper sequence, with a summary of how the results of each experiment flows into the next experiment. Try to keep this visual, easy to follow and preferably on 1-2 pages.

ii. **Timeline of experiments** - detailed timeline of each experiment that follows the course calendar timeline depicted above. Please note, students must also submit time spent in the lab that corresponds to hours OUTSIDE of the scheduled course hours. Also note, students are NOT allowed in the teaching labs after 1:00pm UNLESS the time corresponds to their scheduled course.

iii. **Division of Labour** – A table detailing the experiments and research to be conducted by EACH team member.

iv. **Budget Analysis** - For each series of experiments, each team will be required to submit a 'Budget Analysis' in table format, detailing the chemicals/biological (this includes primers, plasmids, etc.), their cost, and from which company they can be purchased. **Standard laboratory equipment such as an electrophoresis apparatus, Pipetmans, gloves, eppendorf tubes, etc. need not be considered in your budget.** Catalogues will be available from the teaching labs. Your entire project will need to conform to a $1000 budget. Each budget analysis should be submitted to both your Mentor and to Felicia at the same time as your Proposal submission (late penalties are as outlined for the proposal submission). A chemical inventory list can be found in the Teaching labs. Please consult this list to see which reagents are in stock and which ones need to be ordered so you can properly fill the “In House” column.

### Budget Analysis: $1000 (only the BULK cost should be used to calculate the budget!)

<table>
<thead>
<tr>
<th>Item #</th>
<th>Exp’t</th>
<th>Substance</th>
<th>Bulk cost</th>
<th>Source</th>
<th>Catalogue # (only if NOT in house)</th>
<th>In House (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1, 2, 3</td>
<td>LB media: Tryptone Yeast extract NaCl</td>
<td>N/A 500g 500g 500g</td>
<td>$76.50 1L 10g 5g 10g</td>
<td>Teaching labs</td>
<td>N/A Y</td>
</tr>
<tr>
<td>2</td>
<td>2, 3</td>
<td>SDS</td>
<td>500g</td>
<td>$50.40 10g</td>
<td>Teaching labs</td>
<td>N/A Y</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Antibody X</td>
<td>200 µL</td>
<td>$100 2 µL</td>
<td>QIAGEN A0003</td>
<td>N</td>
</tr>
</tbody>
</table>

Cost of items actually needed to buy (NOT IN HOUSE!): please note, for kits you can split the cost with other teams.

### Biohazard Approval Form

- completion of this form is required by anyone wishing to conduct any experiments involving Biological substances at McMaster University. This form will be submitted as part of your proposal package, but your instructor will then submit this form to the Faculty of Health Sciences Safety Office. They will, in turn, present your form in front of a Biosafety Committee for approval. This process was done for you by Dr. Vulcu prior to the start of Biochemistry 2L06, but now you are responsible for conducting an independent research study from scratch: safety awareness and approval is a major part of this process. The form can be found by clicking on this URL: [http://fhs.mcmaster.ca/safetyoffice/documents/Biohazardformv2.pdf](http://fhs.mcmaster.ca/safetyoffice/documents/Biohazardformv2.pdf) (you must click on the link, fill up the form on the computer and print off 2 copies and hand them in to your Mentor).

<table>
<thead>
<tr>
<th>Instructions for completing the Biohazard Approval Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal/ Co investigators</td>
</tr>
<tr>
<td>Phone Extension</td>
</tr>
<tr>
<td>Granting Agency</td>
</tr>
<tr>
<td>Import permit required?</td>
</tr>
<tr>
<td>Project title</td>
</tr>
<tr>
<td>Start date and end date</td>
</tr>
<tr>
<td>Containment level</td>
</tr>
<tr>
<td>Biological agents</td>
</tr>
</tbody>
</table>
you are using is designated Biosafety Level 1.

Bacteria: → Resistance:
List any resistance conferred by your bacterial strain (this does not have anything to do with any plasmids you plan on introducing in the bacteria at a later time). This implies the resistance is in the bacterial strain itself. Also, click on "lab strains" if this designation pertains to your system

Staff handling biohazards
Only include team members (no Mentor, instructor). Check off all training that you have completed (WH = WHMIS core, FS = fire safety core, Bio = Biosafety core, WUP/FUP/BUP are all the updates).

You do NOT fill in the following

- immunization
- animal involvement
- biological cabinets – unless you are using cultured cells
- do NOT sign the form

DNA constructs page
Please ensure that you fill in this page if you are using DNA.
If you are using a plasmid, please indicate the plasmid name (backbone), the company it originated from (Novagen) and any licensing agreement from Novagen for freely using this vector for your purposes.
If you obtain genomic DNA from an organism, please indicate the organism and state how the DNA was obtained (bought or isolated). If the organism was originally a BSL2 organism, please include the SOP for obtaining the genomic DNA and highlight the steps which render this organism non-viable and therefore no longer BSL2

Grant proposal Summary page
Needs to have the following sections:
1. one concise paragraph describing your research hypothesis
2. One concise table naming ALL lab experiments to be conducted (please be brief but informative), potential hazards identified and protective measures for these hazards. Example, if you are running an agarose gel, the microwave is a hazard as hot liquid can spill on your face so a face shield must be used, if ethidium bromide is used it is a carcinogen so gloves/goggles/lab coat must be used, waste must be collected and disposed of appropriately (describe it, you need to know how the waste will be disposed of. For example, you will place live bacterial cultures in the liquid biohazardous waste, but how do you inactivate these cultures, how do you get rid of the waste and what are you going to do to check from time to time that your method does indeed inactivate the bacteria?).
3. When working with biological agents you must include safety and proper disposal of these agents. If these agents were originally BSL2 you must emphasize how they were converted to a BSL1 prior to coming into the lab.
4. You must state where you are obtaining biological agents from and if there is any transfer of these agents or other reagents from the research labs you must state how this transfer will proceed.

The Budget is due at the same time as the Proposal on Monday October 1st, 2012 at 1:30pm in the Biochemistry Teaching Labs Drop Box. Late penalties: 10%/hour with a mark of zero after 4 hours.

Marking scheme for Proposal Report:

<table>
<thead>
<tr>
<th>BUDGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>Completeness of table - Has the team:</td>
</tr>
<tr>
<td>1. Completed the budget spreadsheet properly? (/4)</td>
</tr>
<tr>
<td>2. Completed a detailed flowchart highlighting all the MAIN experiments to be conducted in the proper sequence, with a detailed summary of how the results of each experiment flows into the next experiment? (/4)</td>
</tr>
<tr>
<td>3. Obtained their information from appropriate references? (/1)</td>
</tr>
<tr>
<td>4. Completed a detailed timeline of each experiment that fits within the Oct 15-Nov 20 timeline? The Team must also account for time spent in the lab that corresponds to hours OUTSIDE of the scheduled course hours. Is the timeline feasible? (/4)</td>
</tr>
<tr>
<td>4 = completed/ 3 = reasonable/ 2 = acceptable/ 1 = unacceptable/ 0 = no completion</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPOSAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abstract (300 words maximum) Is the abstract concise and clear to understand? Does it follow a logical progression of the project?(/4)</td>
</tr>
<tr>
<td>Introduction and Hypothesis – Does the introduction clearly represent the present state of the field as a whole? Is the hypothesis/objective clearly stated? Is the hypothesis/objective clearly integrated into the field as a whole? Please note: the introduction requires ample referencing! (/10) (1-2 = unsatisfactory, 3-4=marginal, 5-6=satisfactory, 7-</td>
</tr>
</tbody>
</table>
8=good, 9-10=excellent)

**Proposed Techniques** – introduction to the main techniques proposed (such as cloning, expression, etc.) Did the team organize the proposed main techniques in the proper order with respect to experimental and project design? Are the protocols easy to follow, complete and designed specifically for the teaching labs? (/4)

**Proposed Experiments (INTRODUCTION)** – Did the team explain the purpose of each main technique and how it contributed to the main hypothesis? (/10) (1-2 = unsatisfactory, 3-4=marginal, 5-6=satisfactory, 7-8=good, 9-10=excellent)

**Proposed Experiments (DISCUSSION)** – Did the team touch on the general aspects of each technique and described advantages/ disadvantages/ feasibility? (/10) (1-2 = unsatisfactory, 3-4=marginal, 5-6=satisfactory, 7-8=good, 9-10=excellent)

**OVERALL CONTENT**

**Content** – demonstrated an overall understanding of the project, great flow of organization, appropriate use of scientific (technical) writing (/10) (1-2 = unsatisfactory, 3-4=marginal, 5-6=satisfactory, 7-8=good, 9-10=excellent)

**References** – proper use of references throughout (/2)

**TOTAL** (max 63 points)

4. **Proposal Review Handout** ➔ this component requires that each individual submit a 1-page (can be single-spaced and point form, references and title page NOT included in the page count) review/critique of another Team’s research proposal (based on their proposal presentation). This component is due by **Tuesday October 9th** (at the beginning of the lab: no late submissions). Please include a title page with your name/mentor name/ team number you are assigned to review.

You MUST comment on the sections highlighted below:

a. Significance of work (summary of rationale for choosing specific mutations to test, value of stated objective(s). Please include your input/suggestions)

b. Overall design of study (rationale for time utilization and rationale for main technique(s). Please include your input/suggestions)

c. Feasibility of experiments (include possible problem areas, possible alternatives, possible future work).

d. Would you fund this research project? (please be constructive and positive in your response)

**Marking scheme for Proposal Review Handout:**

- a. Significance of work (summary of rationale for choosing specific mutations to test. Please include your input/suggestions) - /4 should depict a clear understanding of this section

- b. Overall design of study (rationale for time utilization and rationale for main goals. Please include your input/suggestions) - /4 should depict a clear understanding of this section

- c. Feasibility of experiments (include possible problem areas, possible alternatives, possible future work) - /4 should depict a clear understanding of this section

- d. Would you fund this research project? (please be constructive and positive in your response) - /4 should depict a clear understanding of this section

**TOTAL** (max 16 points)

- Proposal Review Workshop: this component requires that the Teams that reviewed each-other meet and discuss the proposed research projects. Meeting minutes need to be recorded by each Team and submitted to their mentor for marking and review at the end of the workshop (1 document/Team). The meeting minutes should encompass AT LEAST the following sections:

  - Troubleshooting Forum (summary of potential experimental difficulties and possible troubleshooting/solutions discussed)

  - Summary of suggested changes to the overall experimental design

  - Summary of suggested possible future work and implications on the field as a whole
Guidelines for weekly reflections (please try to make these reflections brief: 1-2 pages MAXIMUM):

5. **Weekly Reflection 1** in your own words, defend your choice of mutants (also, briefly outline the current cloning strategy, including your primers, where they anneal on your sequence, etc. Please try to make it visual/pictorial and easy to understand.)
Marking scheme: /4 (whereby 1=unsatisfactory, 2=satisfactory, 3=good, 4=excellent)

6. **Weekly Reflection 2** one materials and methods section of a main technique
Marking scheme: /4 (whereby 1=unsatisfactory, 2=satisfactory, 3=good, 4=excellent)

7. **Weekly Reflection 3** 1-2 MAIN data figures (complete with figure captions)
Marking scheme: /4 (whereby 1=unsatisfactory, 2=satisfactory, 3=good, 4=excellent)

8. **Weekly Reflection 4** future work (immediate and down-the road experiments to continue the project). Also include one technique, other than the technique you are currently using, for creating random point mutants of folA.
Marking scheme: /4 (whereby 1=unsatisfactory, 2=satisfactory, 3=good, 4=excellent)

9. **Short Communications Report** this report has to be written by each individual and handed in on December 5th, 2012 by 4:00pm (late penalty: 10% per day, will receive a mark of ZERO after 6 days) in the Biochemistry drop boxes (black cabinet by HSC-4H39).

The length of the submitted report should not exceed 5000 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 approximately 10-double spaced text pages in length OR 5-single spaced text pages in length. I would prefer if the report was written manuscript-style with 2 columns and embedded figures/captions. Title, references, figure captions, graphical abstract, abbreviations and highlights do not count towards the maximum word count.

The manuscript should follow this order:

1. Title (on separate title page together with your name, TA name, Team number, date)
2. Graphical Abstract
3. Highlights
4. Introduction
5. Materials and Methods
6. Results and Discussion
7. Abbreviations
8. References
9. Figures/ Tables (complete with Figure Captions)

Examples of this manuscript style are taken from the Journal FEBS Letters. You will notice that the Materials and Methods section is very short and only pertains directly to the main figures shown. You can expand on the materials and methods section by adding a Supplemental Materials and Methods section (please don’t make it too long, 1-2 pages max) if you should so wish.

- **Title**: should be short and straight to the point (no more than 2 printed lines), but should fully describe the main goal of your research project.
- **Highlights**: “Highlights are a short collection of bullet points that convey the core findings and provide readers with a quick textual overview of the article. These three to five bullet points describe the essence of the research (e.g. results or conclusions) and highlight what is distinctive about it”. Quote obtained directly from: [http://www.elsevier.com/highlights](http://www.elsevier.com/highlights)
- **Graphical Abstract**: A Graphical Abstract is a single, concise, pictorial and visual summary of the main findings of the article. The figure should be specially designed for the purpose of capturing the content of the article for readers at a single glance (this information was adapted from: [http://www.elsevier.com/wps/find/authorsview.authors/graphicalabstracts](http://www.elsevier.com/wps/find/authorsview.authors/graphicalabstracts)). Please make
sure you include a descriptive figure caption. Examples of graphical abstracts can be found at this site: http://www.elsevier.com/wps/find/authorsview.authors/graphicalabstracts#examples

- **Introduction**: should clearly place your findings in the context of the field as a whole. This section should not be used as a long summary of the field. The introduction should contain your hypothesis, the general view of the field to date, your part in the research field and a final paragraph highlighting the techniques used and the results obtained. This is very similar to many journal articles so do some reading before you tackle the introduction. Make sure you have ample references for this section.

- **Materials and Methods**: should be concise and easy to follow so that your experiments can be repeated by another researcher. Methods already published should be indicated by references.

- **Results and Discussion**: This section should combine both a description of the trends in your data and a discussion of the data itself. This section should contain ample data interpretation and troubleshooting. You can include future experiments that need to be done, other controls that should be performed and your opinion on what the data might mean to the field as a whole. Care should be taken not to over-analyze your data. You should present your ideas in a clear, thought-out manner. References must be included here.

- **References**: should be cited throughout the text by number, example [1]. Please embed references throughout your report (numerical) and include a reference list as well.

- **Figures/Tables with Captions**: should have titles and figure captions describing the experiment in sufficient detail to allow readers to understand the figure in the absence of additional text.

- **Abbreviations**: All abbreviations used in the text should be written out in long form the first time they are introduced, example polymerase chain reaction (PCR). This section should contain all abbreviations used along with their long form.

**Marking Scheme for Short Communications Report:**

<table>
<thead>
<tr>
<th>Overall Content of Article</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content – demonstrated:</td>
</tr>
<tr>
<td>1. an overall understanding of the project</td>
</tr>
<tr>
<td>2. great flow of organization</td>
</tr>
<tr>
<td>3. related the different sections together throughout the report</td>
</tr>
<tr>
<td>4. embedded the results of the figures appropriately throughout the results and discussion sections (4 for each point for a total of 16 marks)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Style and Clarity –</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. concise summary of findings</td>
</tr>
<tr>
<td>2. appropriate use of scientific (technical) writing</td>
</tr>
<tr>
<td>3. appropriate grammar and sentence structure</td>
</tr>
<tr>
<td>(4 for each point for a total of 12 marks)</td>
</tr>
</tbody>
</table>

**Structure of Article (45)**

<table>
<thead>
<tr>
<th>Title – should be short and straight to the point (no more than 2 printed lines), but should fully describe the main goal of your research project. (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highlights: should be clear, concise and encompass the point(s) of the research project. (1)</td>
</tr>
</tbody>
</table>

| Graphical Abstract: The figure should be specially designed for the purpose of capturing the content of the article for readers at a single glance. The figure should be clear and easy to follow with a descriptive figure caption. (4) |

<table>
<thead>
<tr>
<th>Introduction and hypothesis – should clearly place your findings in the context of the field as a whole. This section should not be used as a long summary of the field. The introduction should contain:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. your hypothesis</td>
</tr>
<tr>
<td>2. the general view of the field to date</td>
</tr>
<tr>
<td>3. your part in the research field</td>
</tr>
<tr>
<td>4. A final paragraph highlighting the techniques used and the results obtained.</td>
</tr>
<tr>
<td>5. Overall cohesive flow from one concept to another with proper emphasis on the current field and appropriate references. (10 for entire section)</td>
</tr>
</tbody>
</table>

| Materials and Methods - should be concise and easy to follow so that experiments could be repeated by another student. The experiments must be clearly laid out and must spell out all buffers used (including concentrations), all equipment used, centrifuge rotors used, speeds of centrifuges, method of lysing cells, etc. However, care must be taken not to over describe this section and include information not relevant to the technique (i.e. too much information is not allowed in this section). (10) |

| Results and Discussion: This section should combine both a description of the trends in your data and a discussion of the data itself. This section should contain ample data interpretation and troubleshooting. You can include future experiments that need to be done, other controls that should be performed and your opinion on what the data might mean to the field as a whole. Care should be taken not to over-analyze your data. You should present your ideas in a clear, thought-out manner. References must be included here. (10) |

16
**Abbreviations** - All abbreviations used in the text should be written out in long form the first time they are introduced, example PCR (polymerase chain reaction). This section should contain all abbreviations used along with their long form. (/1)

**References** – should be in the style of JBC (they don’t have to include titles of journal articles as long as everything else is correct). There is no limit on how many references they have to have. If no references are from primary literature (research article) deduct ALL marks. (/4)

**Figures/Tables/Figure Captions** – Should be:
1. numbered and referred to in the text appropriately,
2. the data should be large enough to see
3. Data should be clearly presented and labeled properly
4. Figure captions should include a heading describing the overall point of the figure, some experimental procedure (if applicable) and descriptive text to clearly identify the purpose of the figure.
(/10 for entire section)

**Total for the “structure of article” part (/45)**

**TOTAL (/73) (Overall content of article total + structure of article total)**

4: 1=unsatisfactory, 2=satisfactory, 3=good, 4=excellent
10: 1-2 = unsatisfactory, 3-4=marginal, 5-6=satisfactory, 7-8=good, 9-10=excellent

10. **Proposal Presentation** ➔ The main goal of the first presentation is to convey your full understanding of the project objective(s) and how it fits in with the field as a whole. This means that emphasis should be placed on:

- Overall aspects of the research plan – general introduction to the field, main “gaps” in the field of study to date, your “gap” interest (hypothesis) and its importance, etc.
- Experimental techniques that will be utilized to test your hypothesis (you should know the theory behind these research techniques and possible advantages/disadvantages of each technique)
- How these techniques are implemented in the context of your research objective(s)
- Your flowchart, including FEASIBILITY
- Your timeline, including FEASIBILITY

The presentation will be marked on content (some points are highlighted above) and delivery/structure. The latter includes overall flow of presentation, clarity of slides, grammar and technical language and REFERENCES (which must be embedded throughout the presentation and include a reference list on the last slide), to name a few main points.

The presentation CANNOT exceed 30 minutes, followed by 20 minutes of questions.

**Proposal Presentation Marking Scheme:**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Marking Criteria</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction</td>
<td>Clear presentation of overall field of interest/main “gaps” in the field. Familiarity with relevant literature. (/4)</td>
<td>(/4)</td>
</tr>
<tr>
<td>Hypothesis/objective</td>
<td>Clear delivery of hypothesis/objective. Clear explanation of hypothesis/objective in the context of the field as a whole. (/4)</td>
<td>(/4)</td>
</tr>
<tr>
<td>Flowchart</td>
<td>Clearly explained, order of experiments flows properly, feasibility of experiments explained well (/4)</td>
<td>(/4)</td>
</tr>
<tr>
<td>Main Techniques</td>
<td>Clearly identified, and background of techniques well explained. Included advantages/disadvantages and feasibility (/10)</td>
<td>(/10)</td>
</tr>
<tr>
<td>Clarity of slides</td>
<td>Clear slides, very little writing, large font, diagrams wherever possible, title for EACH slide, etc. (/4)</td>
<td>(/4)</td>
</tr>
<tr>
<td>Grammar/Technical Language and proper references</td>
<td>Proper grammar and technical language used throughout. Was the presentation formal, well understood, well delivered. (/4) (please comment on this mark)</td>
<td>(/4)</td>
</tr>
<tr>
<td>Questions</td>
<td>Did the team answer questions well? Were they knowledgeable or do they have major gaps in their understanding? There needs to be an even distribution in individual involvement in this process (/10)</td>
<td>(/10)</td>
</tr>
</tbody>
</table>

4: 1=unsatisfactory, 2=satisfactory, 3=good, 4=excellent
10: 1-2 = unsatisfactory, 3-4=marginal, 5-6=satisfactory, 7-8=good, 9-10=excellent

11. **Progress Presentation** ➔ Students will emphasize the progress of their experiments/research project. This presentation should be progress-loaded. 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.

The presentation will be marked on content (some points are highlighted above) and delivery/structure. The latter includes overall flow of presentation, clarity of slides, grammar and technical language and REFERENCES, to name a few main points. 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 30 minutes, followed by 20 minutes of questions.

Progress Presentation Marking Scheme:

<table>
<thead>
<tr>
<th>Introduction to research project and hypothesis (/2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Discussion of data</strong></td>
</tr>
<tr>
<td>1. Data analysis: interpretation and experimental judgement (/10)</td>
</tr>
<tr>
<td>2. Data Analysis: progress (sufficient, efficient, significant), troubleshooting, limitations of technique(s) (/10)</td>
</tr>
<tr>
<td>3. Data figure constructions: clarity on slides, properly explained within the context of the experimental design, labeling of figure, order of figure presentation, transition between experimental concepts, etc. (/10)</td>
</tr>
<tr>
<td>4. Future work (immediate and future). Re-iteration of study in the context of field as a whole (/4)</td>
</tr>
</tbody>
</table>

**DELIVERY/STRUCTURE**

Overall impression – was the presentation formal, well understood, well delivered, well referenced etc.
Clarity of slides – clear slides, very little writing, large font, diagrams wherever possible, title for EACH slide, etc. Proper grammar and technical language used throughout (/4)

Questions – Did the team answer questions well? Were they knowledgeable or do they have major gaps in their understanding? (/10) There needs to be an even distribution in individual involvement in this process.

4: unsatisfactory, 2=satisfactory, 3=good, 4=excellent
10: 1-2 = unsatisfactory, 3-4=marginal, 5-6=satisfactory, 7-8=good, 9-10=excellent

**PLEASE NOTE:** BOTH presentations will also be marked on CLARITY of SLIDES/ TECHNICAL LANGUAGE/REFERENCES

Also:
- Slides must have a white background (color is allowed in diagrams/text!). No texture/pattern allowed on slide backgrounds.
- Diagrams must be referenced properly and whenever possible diagrams should be constructed from scratch
- Each slide must include a descriptive title that summarizes the main point of the slide
- Slides MUST be numbered
- Text should be in Arial or Calibri (high font size)
- Point form ONLY is to be used
- References should be embedded throughout with a reference list as the final slide
- If you have a data figure: first describe WHAT we are looking at (an SDS-PAGE gel, a kinetic assay, etc.), briefly describe how the data was generated and what each point on the figure means (tell us how to read the figure), then point out the major areas on the figure that are important and finally, tell us the result and the significance. Please remember, you must explain EVERYTHING on a figure (not everything is important so you don’t need to spend a lot of time on each part of the figure, but everything must be explained).
- Do not overload your slide with too much text OR too many data figures
- Please be as “quantitative” as possible throughout the presentations. Don’t use words like “cheap”, “easy”, “fast” to describe techniques UNLESS you specifically define these words within the context of your system.
- YOU MAY NOT USE NOTES DURING THE PRESENTATION!

**12. Lab Meeting Presentation** → this is a more informal presentation (I would prefer having PowerPoint slides to help guide us through the meeting) between team members, mentor and instructor. Each team will have 50 minute to discuss their research project and progress with the instructor (this includes the entire meeting time). The PowerPoint slides should include progress to-date and future work and an informal presentation by the team members should be structured, however this is an open-forum and the instructor/mentor and team members can stop and ask questions throughout the informal presentation. This will occur approximately halfway through the lab work component of the course. Emphasis should be placed on why mutants were chosen, current raw data, troubleshooting, changes in timeline, future work. The Troubleshooting Forum component of the Proposal Review Workshop can be integrated in this meeting. I would like to see equal individual involvement in this meeting.
Lab meeting presentation marking scheme:

<table>
<thead>
<tr>
<th>Description</th>
<th>Mark (MAX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Understanding the problem and familiarity with relevant literature</td>
<td>4</td>
</tr>
<tr>
<td>Knowledge of experimental approach</td>
<td>10</td>
</tr>
<tr>
<td>Experimental progress made (is it sufficient, efficient and significant?)</td>
<td>4</td>
</tr>
<tr>
<td>Ability to interpret/analyze results (troubleshooting)</td>
<td>10</td>
</tr>
<tr>
<td>Ability to design future work (is it relevant?)</td>
<td>4</td>
</tr>
<tr>
<td>Overall ability to answer questions</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36</strong></td>
</tr>
</tbody>
</table>

4: 1=unsatisfactory, 2=satisfactory, 3=good, 4=excellent
10: 1-2 = unsatisfactory, 3-4=marginal, 5-6=satisfactory, 7-8=good, 9-10=excellent