Introduction and Expectations: Welcome to Biochemistry 3P03! In this course, students will be introduced to the concept of primary research through the use of inquiry. Students will gain first-hand experience in designing their own research project. Students will be placed in groups of 6-8, and each group will be designated a Teaching Assistant. The Groups will work with the Teaching Assistant to design a research project that integrates work currently being implemented by the Teaching Assistant or their Research Supervisor.

Each group will design:
1. a research hypothesis
2. a flowchart describing the experimental design committed
3. a step-by-step protocol containing all experimental design
4. a list of reagents
5. a timeline outlining the experiments
6. a division of labour to designate work for all group members
7. a Biohazard Approval Form (in collaboration with their TA, Felicia, Adam and the Safety Office) - http://fhs.mcmaster.ca/safetyoffice/documents/Biohazardformv2.pdf

Throughout the course, students will gain an understanding of experimental protocol, experimental design, analysis of results and troubleshooting. Additionally, students will gain ample experience in verbal and written communication through their assessment in the form of reports and presentations. As this is an inquiry course, proper collaboration and communication skills between group members and TAs is an imperative skill that will be developed.

Instructor: Dr. Felicia Vulcu
Email: vulcuf@mcmaster.ca; office: HSC-1H6

Instructional Assistant: Adam Pyke
Email: pykead@yahoo.com

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 1:30-5:30pm and Tues 2:30-6:30pm 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. BSL1 training – online (http://www.fhs.mcmaster.ca/safetyoffice/training.html)

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.

Evaluation Methods: Each group will be evaluated by their TA, the instructor and Adam Pyke throughout the term. The evaluation process will occur in the form of daily participation/ attendance/ preparation sheets to be completed by the TA (and sometimes the instructor/Adam), quizzes, and worksheets (that test preparedness throughout the term), reports (both group and individual), presentations and an oral assessment. The breakdown of marks is shown below:
<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>MARK (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation/ preparedness/ MSDS Sheets/Biohazard Approval Form</td>
<td>10</td>
</tr>
<tr>
<td>Quizzes/Worksheets/ Reflective Journal/Group Assessment (the majority of this mark will come from the reflective journal/group assessment)</td>
<td>10</td>
</tr>
<tr>
<td>Notebook (individual)</td>
<td>10</td>
</tr>
<tr>
<td>Proposal Review (group)</td>
<td>5</td>
</tr>
<tr>
<td>Proposal (group)</td>
<td>10</td>
</tr>
<tr>
<td>Figures Handout (group)</td>
<td>5</td>
</tr>
<tr>
<td>Final Report (individual)</td>
<td>20</td>
</tr>
<tr>
<td>Oral Assessment (individual)</td>
<td>10</td>
</tr>
</tbody>
</table>

Presentations

1. Proposal Presentation (group)                                             | 5        |
2. Progress Presentation (group)                                            | 15       |

TOTAL 100

Course Calendar:

<table>
<thead>
<tr>
<th>DATE (MON-TUES)</th>
<th>DESCRIPTION</th>
</tr>
</thead>
</table>
| Sept 13 and Sept 14 | Sept 13: Introduction to course and expectations. Assignment of students into groups. Assignment of groups to TAs. Worksheet/ Group Assessment (work on reflective journal).
| Sept 14          | Sept 14: Work on design of research project, design of experimental procedures, reagents needed, timeline and division of labour. |
| Sept 20 and Sept 21 | Work on design of research project, design of experimental procedures, reagents needed, timeline, and division of labour. |
| Sept 27 and Sept 28 | Sept 27: PROPOSAL PRESENTATION/ proposal and budget due!  
Sept 28:PROPOSAL PRESENTATION |
| Oct 4 and Oct 5   | LAB WORK (to be scheduled by students in their “timeline” submission form) |
| Oct 12 only (Oct 11 off) | |
| Oct 18 and Oct 19  | |
| Oct 25 and Oct 26  | |
| Nov 1 and Nov 2    | |
| Nov 8 and Nov 9    | |
| Nov 15 and Nov 16  | Group work – prepare for presentation  
Individual work – prepare for final report and oral assessment |
| Nov 22 and Nov 23  | Nov 22:PROGRESS PRESENTATION  
Nov 23:PROGRESS PRESENTATION |
| Nov 29 and Nov 30  | ORAL ASSESSMENT |
| Dec 6             | No classes |

"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 APPROVAL by the Associate Dean’s office) will constitute a ZERO in the course.
- Missed quizzes/budgets/proposals/reports/presentations/labs or tests 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/worksheet/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 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 group).
- Students may NOT switch lab groups!!

Time in the Laboratory:

A minimum of 8 hours per week are provided from 1:30-5:30 on Monday and 2:30-6:30 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. It is the individual student's responsibility to ensure that their TA is able to stay later if necessary. No student is permitted to be in the lab without a TA or the instructor/Adam present. A timetable detailing all the experiments and corresponding times that the group will spend in the lab will be provided to the TA, instructor and Adam Pyke at the same time as submission of the Budget. The time spent in the lab will be monitored and graded by the TA (with some input from instructor/Adam) 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.

Description of Assessment Tools:

1. Participation/preparedness (10%) → each lab day students will be assessed by their TA (with some input from the instructor/Adam) to ensure all students are prepared for the day’s lab. The assessment sheet outline follows:

| 1. Lab Coat (must wear at all times; a mark of 0 on entire sheet if no lab coat) |
| 2. Safety goggles (must wear at all times; a mark of 0 on entire sheet if no goggles) |
| 3. Lab notebook (does the student have it?) a mark of 0 on entire sheet if no notebook |
| 4. Lab Notebook (has the student completed all the sections required for the notebook?) (/1) |
| 5. Preparedness (does the student know what they are doing for the day’s lab? are they letting their partner do everything? etc.) (/2)* |
| 6. Preparedness (does the student use the equipment properly? is the student collaborating with their partner? (/2)* |
| 7. Attendance (was the student late for the lab? Has the student attended the required number of hours? A mark of 0 on entire sheet if they are late OR if they |

3
The marking scheme is out of 2, where 0 = not satisfactory, 1 = satisfactory, 2 = good/excellent. The TA/instructor/Adam reserves the right to distribute a mark of ZERO for the entire day’s participation depending on the student’s (groups’) behaviour in the lab (as judged by instructor/TA/Adam).

- **MSDS (Material Safety Data Sheet)** – Each group 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.

2. **Quizzes/ Worksheets/Group Assessment (10%)** → this component will be completed in class either as individuals or as part of a group and is designed to help students maintain their preparedness in the lab and introduce them to related topics.
   - 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.
   - Workshops – will assess the student’s grasp of scientific techniques and principles.
   - Reflective Journal/Group Assessment – students will assess each other as well as assessing their skills and goals throughout the course.

   **Notebook (10%)** → requires the following sections:

   - **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:
     - **Introduction/Hypothesis** - Overall statement of hypothesis followed by a brief description introducing the field of study, the general problem, your part of the problem, etc.
     - **Flowchart of experiments** - Overall flowchart detailing the number of experiments, the type of experiments and the order of experiments (for each term).
     - **Timeline of experiments** - Proper timeline (in table format) containing the dates of the labs on the left hand side and a description of how each lab period will be filled up. Place the labs described in the flowchart in this timeline. Also, account for all other times you need to be in the lab to set up experiments.

   **Each lab needs to contain the following sections in your notebook:**

   - **Your name/ TA name/ Lab Day/ Date** – on ALL pages!
   - **Lab number and title of lab**
   - **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.
   - **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.
   - **Safety** → a list of major safety concerns. If working with dangerous chemicals please look up the MSDS for that chemical and write out all possible dangers related to exposure to the chemicals, safe handling procedures 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!!!!
   - **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!!! This may not always be explicitly stated. This means that you need to read and understand the lab!!!
   - **Protocol** → step-by-step procedures!
• Charts/tables ⇒ must be drawn in the notebook PRIOR to coming to the lab and which are used to collect data during the lab.
• 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/VISCOSITY CHANGES, ETC.).
• Figures/Figure captions and Discussion as required by your TA.
• 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).

Please note that you will need to go to the following RefWorks site:

Start an account and learn how to use RefWorks. Build your reference list. You will export your reference list (bibliography) using the ACS (American Chemical Society) citation style. This is a requirement for this course!

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

| 1. Table of Contents (1) – Should contain a list of all experiments, with each lab containing a proper title that describes the lab, page number, etc. |
| 2. Hypothesis (overall) – Overall statement of hypothesis followed by a brief description introducing the field of study, the general problem, your part of the problem, etc. (marked as part of the “proposal” section for each term)(3) |
| 3. Flowchart of experiments (for Wk 1 only) – Overall flowchart detailing the number of experiments, the type of experiments and the order of experiments(3) Weekly flowchart (/3): Each week should contain a “flowchart” section in your lab notebook that relates your week’s progress to the initial flowchart and any changes that need to occur to the timeline |
| 4. Timeline of experiments (for Wk1 only) - Proper timeline (in table format) containing the dates of the labs on the left hand side and a description of how each lab period will be filled up. Place the labs described in the flowchart in this timeline. Also, account for all other times you need to be in the lab to set up experiments(3) |
| 5. Purpose of lab (/3) – 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. |
| 6. Safety – (/3) ALL main safety precautions pertaining to the lab including safe handling instructions. Each pair should also have a copy of the MSDS sheets for each chemical used. |
| 7. Protocols and Procedures – (/3) Detailed, step-by-step protocol along with additional notes if changes occur |
| 8. Charts/tables – (/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. |
| 9. Discussion – (/3) A brief discussion of the results obtained, how they pertain to your flowchart and timeline, troubleshooting, etc. |
| 10. REFERENCES – (/3) must have references throughout, especially when describing a new technique, protocols, etc. |
| 11. Overall flow and organization – (/3) |
| 12. Clarity of thoughts (includes proper grammar and proper usage of technical terms) (/3) |

1=unsatisfactory, 2=good, 3=excellent

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 6 lab notebooks for the 6 weeks you will be in the lab.

3. Budget (part of Proposal mark) ⇒ Students are to submit 4 sections:
   • Flowchart of experiments – a detailed flowchart highlighting all the experiments to be conducted in the proper sequence, with a detailed summary of how the results of each experiment flows into the next experiment.
   • Timeline of experiments - (detailed timeline of each experiment must be submitted 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.
   • Division of Labour – A table detailing the experiments and research to be conducted by EACH group member.
   • Budget Analysis - For each series of experiments, each group will be required to submit a 'Budget Analysis' in spreadsheet 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 Adam Pyke in the teaching lab. Your entire project will need to conform to a $1000 budget. Each budget analysis should be submitted to both your TA and to Adam Pyke at the same time as your Proposal submission (late penalties are as outlined for the proposal submission). Please consult with Adam Pyke THROUGHOUT this process! Adam Pyke will let you know which reagents he has in stock and which ones he has ordered so you can properly fill the “In House” column. Also note: orders must be brought to Adam on the **THURSDAY BEFORE your lab period on a weekly basis**! This means that if you want to conduct a lab on Monday/Tuesday Sept. 13-14 you MUST have submitted your order (through your TA) to Adam by Thursday September 9 of the PREVIOUS week! If you do not place your order in time you will not be able to conduct experiments on Mon/Tues (Sept 13-14) and you will lose both time and participation marks. The weekly order needs to be submitted to your TA and your TA will submit it to Adam. The order MUST be in by Thursday at noon (this means that you NEED to submit the order to your TA PRIOR to noon on Thursday, and please give your TA some time to respond!).

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>ACTUAL cost</th>
<th>Source</th>
<th>Catalogue #</th>
<th>In House (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1, 2, 3</td>
<td>LB media</td>
<td>1kg</td>
<td>$76.50</td>
<td>1L</td>
<td>$76.50</td>
<td>SIGMA</td>
</tr>
<tr>
<td>2</td>
<td>2, 3</td>
<td>SDS</td>
<td>500g</td>
<td>$50.40</td>
<td>10g</td>
<td>$1.01</td>
<td>SIGMA</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Antibody X</td>
<td>200 µL</td>
<td>$100</td>
<td>2 µL</td>
<td>$1.00</td>
<td>QIAGEN</td>
</tr>
</tbody>
</table>

Cost of items actually needed to buy (NOT IN HOUSE!):

The Budget is due at the same time as the Proposal on September 27, 2010 by 1:30pm in the Biochemistry Teaching Labs Drop Box. Late penalties: 10%/hour with a mark of zero after 4 hours.

4. **Proposal (10%)** → Each group will submit a project proposal which is **due September 27, 2010 by 1:30pm in the Biochemistry Teaching Lab drop box. Late penalties: 10%/hour with a mark of zero after 4 hours.** Maximum page count: 6, double-spaced pages (Times New Roman font size 12, 1-inch margins all around). The proposal should be broken down into the following subsections:

a. Abstract – 300 word maximum

b. Introduction and Hypothesis – introduction to the field as a whole with particular emphasis on your hypothesis (state it CLEARLY) and how it fits in the current research field. REFERENCES!!! (at least 15 journal articles of which only a maximum of 4 can be review articles ... NO BOOKS or WEBSITES!!!)

c. Proposed Experiments – here you need to expand on your flowchart of experiments by providing detailed protocols of ALL experiments you plan on using with PROPER REFERENCES (see Final Report guidelines for preferred reference style).

EACH part should have:
- Introduction to reiterate the purpose of your research and how this experiment contributes to the overall goal of your project
- Description of the planned experiment (detailed protocol)

d. Small discussion on the general aspects of each technique including advantages and disadvantages.

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

e. Budget (as highlighted in step 3 above) – budget (including all 4 sections) does NOT count towards the final page count
Note: the detailed protocols do NOT count towards the final page count and should be attached at the end of the report.

5. **Proposal Presentation Review (5%)** – this component requires that each group submit a 2-page (maximum) single-spaced (references and title page NOT included in the page count) POINT FORM critique of another group’s research proposal (based on their proposal presentation). This component is due by **OCTOBER 4/5th** (at 2:30pm, no late submissions) You will have exactly 1 week to hand in the review (so if your proposal presentation was on Monday September 27th, the critique of another group’s proposal will be due on Monday Oct 4. If your proposal presentation was on Tuesday September 28th, the critique of another group’s proposal will be due on Tuesday Oct 5. Please include a title page with your group name/TA name. Please do NOT include your names anywhere else on the review. A copy of each peer review will be provided to the groups (no names will be included).

The group MUST comment on the sections highlighted below:
   a. General statement of research project (the research question)
   b. Significance of work on society (biomedical significance)
   c. Summary of work to date in the field of research
   d. Overall design of study
   e. Feasibility of experiments (include possible problem areas, possible alternatives, possible future work).
   f. Would you fund this research project (be quantitative in your response!)

6. **Figures Handout (5%)** → each group will submit a 5-10 page ‘Figures Handout’ summarizing the figures obtained during the term. The handout needs to consist of all your MAIN figures, complete with figure captions (1 figure (including figure caption) per page). The figures need to be publication quality and the figure caption should be formally written. Don’t include too much information, but the reader should gain an understanding of the experiment just by reading the figure caption. These figures/figure captions can be used again in your final report. The ‘Figures Handout’ must be handed in on November 22nd, 2010 by 1:30pm in the Biochemistry Undergraduate Teaching Lab Drop Box. Late handouts will receive a mark of zero!

7. **Final Report (20%)** → this report has to be written by each individual and handed in on **November 29th, 2010 by 11:00am** (late penalty: 10% per hour, will receive a mark of ZERO after 6 hours) in the Biochemistry Teaching Labs Drop Box. The final report should be 20 pages of text (MAXIMUM LIMIT) double-spaced with 12-point font (Times New Roman) and 1-inch margins all around. Title, references, figures, tables do not count for the 20-page limit.

The manuscript should follow this order:

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

- **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.
- **Abstract**: should be clear and concise in its summary of your main finding(s). Should not exceed 300 words.
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. Diagrams explaining your points are beneficial and at least 1 diagram is required (they must be original creations NOT copied from other sources!) The diagram should be included with the rest of the figures on a separate page (1 figure with figure caption/ page) and DOES COUNT towards final page count. This section NEEDS TO CONTAIN AT LEAST 20 references: all from research articles and only 2-3 can be REVIEW articles.

Materials and Methods: should be concise and easy to follow so that your experiments can be repeated by another student. The experiments must be clearly laid out and must spell out all pertinent information such as buffers used (including concentrations), 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). Too much / Too little information will be penalized. For example: 1. “A 5 mL sample of cells was centrifuged …” This information is useless as another person cannot reproduce this experiment. There is no indication of the number of cells used and no indication of how the cells were pelleted. However, you should state: “A 5 mL sample of E. coli cells at O.D. 600nm of 0.74 was centrifuged at 5 000 rpm in the Avanti JE (Beckman-Coulter) using the JLA25.5 rotor”. Now the reader can trace back to your starting culture and mimic (to some accuracy, though the number of cells in the culture is still relatively unknown) these conditions. They can also calculate g-force using the information you provided, especially if they need to use another centrifuge/rotor and they need to convert between the two systems. However, you should continue to state that you pipetted 5 mL in an eppendorf or Falcon tube, etc… now you are providing too much information and in this section you need to assume prior knowledge of your reader, but give them concise and efficient information to allow them to reproduce your experiments. In terms of buffers: always provide information that is useful … like concentration. “Buffer P (containing 50 mM KCl, 2% w/v SDS, 150mM Tris-Cl pH 7.5) was used …” This is informative because you have provided the recipe for making Buffer P. Note, you must ALWAYS state the final working concentrations NOT the initial stocks. Stating “Buffer P was made by taking 5 mL of 2M KCl, 2mM 20% SDS, etc…” This information is useless to the reader as the final concentration is not provided. You can divulge the final volume so the reader can work back to working concentrations but that’s a lot of work for them and a lot of writing for you.

In case of other buffers, such as BugBuster, stating “A 5mL sample of BugBuster was added to the pellet” is not very informative and should not be used. If you cannot describe buffers as concentrations, make sure you use other informative values such as: “Bug Buster was used in a 5:1 ratio (5 mL BugBuster: 1 mg cell wet weigh)”. Now, the reader can reproduce your experiment.

Therefore, the materials and methods section should NOT look like your lab protocols, but should resemble the Materials and Methods section in a journal article. Make sure you divide up this section into sub-sections that have a general theme like: Bacterial strains and growing conditions, Plasmid construction, Protein purification, etc. Also, make sure that you do NOT repeat the information from one section to another.

Referencing techniques is allowed but all experiments performed by you must be laid out in a concise manner. Referencing techniques (I MEAN PRIMARY LITERATURE NOT THE LAB MANUAL) is imperative in this section.

Results: This section should describe the data presented in your figures. Care must be taken not to over-analyze or discuss the data in this section, but you must present the data clearly and state the main conclusion(s) from each figure/table presented. It is recommended that the results section is broken down into different subsections, each containing a 1-sentence statement highlighting the main point to be made in the subsection.

Discussion: This section is designed entirely for interpreting the data. 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. You can even use a diagram to make your point clear. 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 (from at least 20 journal articles of which only 1-2 can be review articles).

Conclusion: This section should not exceed 1-2 pages and should include a concise statement of your results, how they fit into the field as a whole and what you think future directions might be for this field (you can draw from your results).

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.

References: should be cited throughout the text by number, example (1). You must have proper references for all your lab notebooks. Please embed references throughout your report (numerical) and include a reference list as well. I prefer primary references (that implies research articles).
You will export your reference list (bibliography) using the ACS (American Chemical Society) citation style as stated in the “notebook” section.

- **Tables:** Should contain a title and a short description of the table.
- **Figures/ Figure Captions:** should have titles and figure legends describing the experiment in sufficient detail to allow readers to understand the figure in the absence of additional text. Feel free to use the figures/figure captions from your Progress Report. HOWEVER, all figures/tables (complete with captions) must be provided on separate pages with a maximum of 2 figures/page (some figures can have multiple panels).

8. **Oral Assessment (10%)**

1. Each group is to show up to the Biochemistry Undergraduate Teaching Labs (HSC 1H1-8) only to their designated oral exam day/time as specified in class.
2. One person from the group will be invited into the designated assessment area at a time. Each individual will be asked 3-5 questions pertaining to their project. These questions are designed to test your knowledge on the information that you acquired throughout the term. You may use the board to explain your answers.
3. Once finished, each individual is to leave the classroom WITHOUT talking to the rest of the group.
4. Each individual from the group will be asked the same 3-5 questions.
5. The questions are different for each group.

NOTE:
- The group waiting outside may NOT use phones, laptops, etc.
- No notes are allowed in the examination room

The TA’s, the instructor and Adam Pyke will be marking the students. Each student will receive a mark (/4, whereby: 1 = unsatisfactory, 2 = satisfactory, 3 = good, 4 = excellent) for each question answered.

9. **Proposal Presentation (10%)**

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.

10. **Progress Presentation (15%)**

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 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),
than 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).
You can only use 5-6 words/ bullet point AND ONLY 4-5 bullet points/slide!!!!
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!

Academic Integrity
You are expected to exhibit honesty and use ethical behavior in all aspects of the learning process. Academic credentials you earn are rooted in principles of
honesty and academic integrity.
Academic dishonesty is to knowingly act or fail to act in a way that result or could result in unearned academic credit or advantage. This behaviour can result in
serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic
dishonesty”), and/or suspension or expulsion from the university.
It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the
Academic Integrity Policy at McMaster University.

Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained.
Improper collaboration in group work.
Copying or using unauthorized aids in tests and examinations.