Directions: Please use the following form to develop your proposal. If you are submitting a proposal that involves a sequence of courses, please provide information for each of the courses. Your narrative responses to questions 6 through 9 should total no more than four single-spaced pages.

Proposal Submission: Pre-proposals for course redesign are invited from all programs that offer core, foundational, or gateway courses. The deadline for proposals is 1 p.m., Monday, October 10, 2011. Proposals should be submitted electronically. Please send your proposal as an attachment (PDF or Word format) to an email message to Shirley Guitron, Institute administrative assistant, at Shirley.Guitron@ColoState.edu. Original signature pages should be sent via campus mail to Shirley Guitron at the Institute for Learning and Teaching, Campus Delivery 1052, TILT Building.

For More Information: Questions concerning the competition should be directed to Shaun Beaty, Associate Director, The Institute for Learning and Teaching, at 491-3132 or Shaun.Beaty@ColoState.edu.

1. Contact Information
   a. Name: Dr. Corey Campbell Rosenberg
   b. Phone Number: 491-6809
   c. Email Address: corey.campbell@colostate.edu
   d. Mailing Address: Campus Delivery 1870, Fort Collins, CO 80523
   e. Department Chair Name: Dr. P. Shing Ho
   f. Department Chair Mailing Address: Campus Delivery 1870, Fort Collins, CO 80523
   g. Department Chair Email Address: shing.ho@colostate.edu
   h. Dean Name: Dr. Jan Nerger
   i. Dean Mailing Address: Campus Delivery 1870, Fort Collins, CO 80523
   j. Dean Email Address: Janice.Nerger@colostate.edu

2. Course Number and Title: LIFE 212

3. This course is in the AUCC:
   ☐ Yes  X No

4. Course Enrollment:

<table>
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<tr>
<th>Year</th>
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<th>Spring</th>
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</tr>
<tr>
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<td>NA</td>
</tr>
<tr>
<td>2011</td>
<td>127</td>
<td>NA</td>
</tr>
</tbody>
</table>

5. Identify courses for which this course:

   Is a prerequisite: LIFE 212 is a formal prerequisite for BC 404. It is a required course for Biochemistry and Biomedical Sciences majors.
It is an unofficial concurrent requisite for LIFE 210 and LIFE 211.
Is a prerequisite with a grade of C or better: None.
Is a prerequisite with a grade of B or better: None.

6. Course Description and the problem(s) that you hope to address.

**Course Description**  LIFE 212 is a 2 credit hour introductory lab course taught by the Biochemistry and Molecular Biology Department (BMB Dept) where students develop techniques common to the research laboratory. Students gain hands-on experience in the execution of lab techniques pertinent to the disciplines of biochemistry, cell biology and molecular biology. They also learn to critically evaluate data and master critical thinking skills. Collaborative learning and problem-solving are essential to student success. Weekly quizzes, a Lab Notebook and form-based Lab Reports make up 69% of course credit. This course is taken by many Biomedical Sciences and Biochemistry majors. Additional majors often represented are: Biomedical Engineering, Microbiology, Chemistry, undeclared Health Sciences, Sociology and English. Many students intend to transition into post-graduate training in health care fields. Students interested in a research career must gain important wet lab research experience before graduation. This often takes place in the context of Research Topics courses for mid- or upper-classmen, or, for the lucky ones, paid part-time jobs. Students unable to attain this sort of lab experience are at a distinct disadvantage in the job market. Therefore, the lab technique skills taught in LIFE 212 provide an unofficial but crucial pre-requisite to these positions, and, thus, are an essential part of solid training in the biochemistry/molecular biology/cell biology area.

Importantly, a major goal of the course is to encourage development of critical thinking skills, useful whether or not students remain in the sciences following graduation. This course is uniquely positioned, because of its design, to exploit the best features of active-engagement. Active-engagement as a teaching method is gaining popularity over traditional lecture formats (R. Hake, 1998, Am. J. Phys. 66 (1), p64-74). A study of problem-based instructional strategies showed that the quality of learning is most influenced under conditions that make use of collaborative learning and instruction in problem-solving skills (Norman and Schmidt, 1990, Medical Education, Vol. 34, p721-728). A lab course, such as LIFE212, inherently emphasizes the core elements of active-engagement by allowing students to solve wet-lab problems in a peer-learning environment. The following skill areas emphasized are consistent with the problem-based learning philosophy: 1) hands-on practice in mastering technical procedures 2) core problem-solving in a peer learning environment, 3) development of critical thinking skills, 4) data analysis and 5) practice in technical writing.

LIFE 212 was within a course cluster (LIFE 210, LIFE 212, LIFE 211) that won the TiLT Course Redesign Competition for the 2006-2007 terms. Under that proposal, Drs Paul Laybourn and Farida Safadi-Chamberlain re-organized the curriculum to generate a smoother progression through the topic areas and synchronization of lecture and lab topics, so that core course principles could be more effectively conveyed to students. The subject areas for study were also broadened to include yeast cell biology and fluorescence microscopy. The proposal outlined the intended incorporation of technology into course design. Although such changes were incorporated into the lecture course LIFE 210, this implementation has not yet been extended into LIFE 212.
Problems to address There are several problem areas that hinder students' assimilation of course content.

a) Biochemistry majors use the Enzyme kinetics material as an important foundation for BC404, however other majors often find the Enzyme kinetics material to be difficult. Redesign of this section of the course would allow us to add tangible parallels between Enzyme kinetics and 'real-world' systems to which students may be more familiar. The goal of this improvement would be to enhance student learning of enzyme kinetics concepts.

b) Suboptimal experimental protocols hamper students' understanding of the basic concepts of enzyme kinetics and exacerbate the problem outlined in a) above. 25% of lab exercises in this course use a partially purified potato extract. Although inexpensive to generate, the use of potato extract is problematic for several reasons. TAs must devote hours per week to prepare reagents for these experiments. Some of these reagents are hazardous, and the course generates gallons of hazardous waste each semester. Several technical problems arise that cloud or hamper student comprehension of key concepts. For example, the current purification method results in a very cloudy, impure enzyme extract. The cloudiness causes artifacts in spectrophotometer readings, which, in turn, confuse students and leads to low quality standard curves and thereby hampers subsequent data analysis. Additionally, there is no lab experiment including enzyme inhibitors in the current curriculum. The change to a different enzyme system would require creation of new experimental protocols, and these new protocols must be tested to iron out any unexpected problems that might arise before they are used by the students. In addition, new student assessment instruments, similar to the form-style Lab Reports currently in use, but with redesigned content, would also be developed. Such changes require more effort than can be managed during a typical course term, and winning the Redesign Award would allow me release time to make the needed changes.

c) Ambiguities in exam and form-style Lab Report questions are a continuing problem. These problems hamper student assimilation of key course concepts in an otherwise highly effective course.

d) In LIFE 212, students practice technical writing skills with the added benefits of active engagement and collaborative learning to solidify new concepts and terminology. However, there is no current emphasis on development of technical writing skills. Under this proposal, one goal is to shift TA labor from laborious reagent preparation to spending more time in grading of Lab Reports; higher quality feedback should enhance student learning.

e) Currently, there is no use of RamCT for electronic assessments and assignments throughout the semester. Incremental incorporation of electronic assessments would begin with a study guide. This guide could be used by students to prepare for exams.

7. Redesign Rationale. The BMB Dept is committed to keeping course quality high. As shown above, course enrollment increased upon the establishment of the Biomedical Sciences program and implementation of improvements by Drs Laybourn and Safadi-Chamberlain in 2006-2007. To help maintain course quality, in 2009, I came on board to as Co-Instructor with Dr. Safadi-Chamberlain. In the years since 2009, the course sections and all responsibilities are divided equally between us. A re-organization occurred again in 2011, wherein, the BZ course series required additional lab classroom space, thus requiring us to compress our lab space from 2 to 1 lab classroom in Yates Hall. This space re-organization has reduced the time slots available for sections from 8 to 6, and consequently, has resulted in a slight drop in enrollment. Nevertheless, as a
required course, LIFE 212 remains in high demand by undergraduates. Enrollment would likely increase to 2010 levels if sections during available time slots were opened.

Our goals are to improve and streamline course design to increase student learning in the areas of critical thinking, problem-solving, technical writing, and lab math in the context of wet lab experiments. LIFE 212 is a very labor-intensive course. To execute all of the grading requirements, student supervision and lab prep duties, the Co-Instructors maintain a staff of 4 Graduate Teaching Assistants (TAs), and 9 undergraduate TAs and one Volunteer TA. Course Redesign would allow us to more efficiently convey foundational lab techniques and make better use of active engagement, and higher quality grading by TAs. Most students have primary contact with a single Co-Instructor. In cases where course material is ambiguous or multiple interpretations of material are possible, students in different sections may receive different information. Course Redesign would allow us to re-structure Student Assessment instruments, ie., form-style Lab Reports, to remove ambiguities and incorporate questions that more clearly assess students’ understanding of the material.

Redesigning the course would allow us to more effectively instill understanding of key concepts, critical thinking skills, and develop more effective methods for teaching technical writing skills. Generally, students generally consider LIFE 212 to be a lot of work. Their efforts are frustrated by ambiguities in the course manual and technical problems with the enzyme preparations that hamper interpretation of results. Although development of problem-solving skills is certainly a goal of the course, and the current technical challenges certainly give opportunities for problem-solving, elimination of the major technical problems would enhance assimilation of the key course concepts and allow development of problem-solving skills in a more controlled and directional basis. An added benefit would be a reduction in generation of hazardous waste, which is pertinent to CSU’s ‘green University’ status.

Suggested Areas for Redesign

The use of a commercially prepared enzyme, such as beta-galactosidase, would facilitate a more clear-cut and less problematic workflow for student data interpretation. It would eliminate technical problems that frustrate and confuse the lower classmen for which this course is designed. The enzyme would come from a single commercial source, and would therefore be consistent across all sections. The labor required to purify the enzyme would be eliminated. Moreover, the Co-Instructors would have more time to train TAs, who grade Lab Reports, which would, in turn, improve student outcomes through higher quality grading. Additional benefits would be found in the reduction in technical problems that hamper student assimilation of important course concepts in several areas: 1) spectrophotometry readings, 2) standard curve preparation, 3) measurements of enzyme activity under varying conditions. Technical problems should be reduced to those resulting from user-error rather than those introduced by the experimental system, as is currently the case.

A new, complete set of Lab Manual content, form-style Lab Reports, and student Assessment materials would be developed for the Enzyme Lab series, using enzyme beta-galactosidase, rather than potato tyrosinase. For the Fall 2012 class, 1 of the 6 sections would test the new content and newly designed experiments. This would allow optimization of all procedures and content before it is incorporated into the entire course. Any new content would be designed to convey the same core concepts as the current course, thus allowing students from all sections to take the same exams. The Co-Instructors and Ms Ho would come to a consensus regarding the specific types of improvements made and assess whether the intended design improvement goals have been met. TAs would also provide feedback as to whether improvements are substantive.
An electronic Study Guide would be created that would help students study for exams. This Study Guide would enable students to get instant feedback as to whether they have mastered key course concepts. Our goal is that implementation of this Study Guide would be the first of several additions of electronic media into course content. We hope to work with consultants from TiLT to implement this improvement.

Lastly, GTAs and undergraduate TAs would receive more detailed grading rubrics and training on grading of Lab Reports. These grading rubrics would be developed during the course redesign phase. They would facilitate higher quality grading feedback to enhance student learning.

8. Contribution to Learning in Other Courses. LIFE 212 is a foundational course for Biochemistry majors and is also an important part of the curriculum for Biomedical Sciences majors. Biochemistry majors use the foundational concepts, wet-lab and problem-solving skills learned in LIFE 212 to increase their likelihood of success in BC404. However, regardless of the specific major, all students learn crucial lab and critical thinking skills in LIFE 212 that they will take with them after they graduate. These skills enhance abilities to think rationally under pressure, critically evaluate information in an unbiased manner, and work with a team. All of these skills help students be successful in the competitive workplace, whether they choose to stay in the sciences or move into some other field after graduation.

9. Desired Outcomes. The course improvements outlined in this proposal would improve student assimilation of core concepts presented in LIFE 212. They will allow us to make more effective use of active engagement, collaborative learning, and technical writing opportunities that are inherent to the course. Moreover, our hope is that LIFE 212 enrollment would continue to increase, even in the face of limitations in space allocation as outlined above. LIFE 212 has the potential to be a model at CSU for the active-engagement teaching method. Redesign could make the course more popular with students in other majors. It is our hope that future University Course Curricula will incorporate more active-engagement style courses, such as LIFE 212, into the AUCC to improve the quality of the undergraduate core program and enhance the number of science-trained professionals in the workplace.

10. Team Members. The following Team Members will contribute toward course redesign and implementation:

Dr. Corey Rosenberg, Co-Instructor and Project Leader, will coordinate with Dr. Safadi-Chamberlain and Margaret Ho to devise an alternative to the current Enzyme Biochemistry series, execute any experiments that need to be performed, prepare new student content to accompany these changes.

Dr. Safadi-Chamberlain, Co-Instructor and Margaret Ho, MS, Volunteer Teaching Assistant, will each serve as Consultant to assess the effectiveness of course improvements, as well as help with implementation.

Ms. Ho and Drs Rosenberg and Safadi-Chamberlain will all participate in the decision-making process of determining whether course Redesign objectives have been met and the final implementation of course improvements.

11. Department Contributions.
12. **Signatures.**

   Project Leader: [Signature] Date 6 Oct 2011
   Department or Program Head: [Signature] Date 10/6/2011
   Dean: [Signature] Date 10/8/11

13. **Current Course Syllabus.** Please attach a syllabus for the course.

14. **Letter of Support.** Please attach a letter of support from the department or program.
October 6, 2011

Letter in support of Course Redesign Proposal by Dr. Corey Rosenberg

To the Review Committee:

I am writing to support the proposal submitted by Dr. Corey C. Rosenberg to redesign aspects of the LIFE212 (Introductory Cell Biology, Laboratory Techniques) to improve student learning and to streamline certain exercises to make more efficient the use of GTA and instructor time and efforts, and to follow best practices under CSU's efforts as a "Green University".

Dr. Rosenberg has been an Instructor in the Department of Biochemistry and Molecular Biology since 2009. Her primary responsibility in the department has been to serve as one of two instructors for LIFE212 during the Fall semester of each academic year. In the past year, her contributions in the course has been particularly important, as the schedule for laboratory sections were dramatically changed in order to accommodate the loss of a physical laboratory available to this course. Consequently, there has been a need to consider revisions to the course curriculum in order to maximize the efficient use of the instructors' and GTAs' time and efforts in the course.

Dr. Rosenberg has proposed a set of changes to the course that will reduce the labor associated with one of the most tedious components of LIFE212, an enzyme kinetics experiment that requires significant investment of time and effort into isolating the enzyme tyrosinase from potatoes. The proposed change will utilize a commercially available enzyme (β-galactosidase), which will free-up the time to allow instructs and GTAs to focus more on student progress in learning principles and techniques, and technical writing. In addition, the Dr. Rosenberg proposes to implement a set of electronic assessment tools to allow critical evaluation of learning outcomes.

LIFE212 is a critical course for undergraduate majors, particularly in Biomedical Sciences and in Biochemistry and Molecular Biology, interested in pursuing careers in the life sciences, including human and animal health. Thus, the quality of this course impacts a large segment of the campus population.

Sincerely,

P. Shing Ho
Professor and Chair
INTRODUCTORY CELL BIOLOGY LABORATORY
LIFE212
Fall Semester 2011

RECITATION: Monday, 4:00pm to 4:50pm in Yates 104 (attendance mandatory)
LAB: Yates 311.

LABS: Tues 2:00 - 4:50PM, Wed 2:00 - 4:50PM, Thurs 2:00 - 4:50PM.
Instructor: Dr. Farida Safadi-Chamberlain
Office hours: Wednesday 10 AM- 12:00 PM or by appointment.
Rm: MRB 285, Phone 491-1771
Email: fsafadi@lamar.colostate.edu

LABS: Tues 9:00 - 11:50AM, Wed 9:00 - 11:50AM, Thurs 9:00 - 11:50AM
Instructor: Dr. Corey Campbell Rosenberg
Office hours: Thurs 7:45-8:45AM, Fri 8-9AM or by appointment.
Rm: Yates 311, Phone 491-6809
Email: corey.campbell@colostate.edu

Teaching assistants:

<table>
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<tr>
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<tr>
<td>Srinivasa Boddeda</td>
<td>W 12-1pm</td>
<td>MRB 227</td>
<td>W  pm</td>
<td><a href="mailto:srinibio@mail.colostate.edu">srinibio@mail.colostate.edu</a></td>
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<tr>
<td>Jake Herman</td>
<td>Fri 10-11am</td>
<td>Yates 310</td>
<td>R am</td>
<td><a href="mailto:Jake.Herman@colostate.edu">Jake.Herman@colostate.edu</a></td>
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<tr>
<td>Ryan Rogge</td>
<td>R 2-3pm</td>
<td>MRB 301</td>
<td>T  pm</td>
<td><a href="mailto:Ryan.Rogge@rams.colostate.edu">Ryan.Rogge@rams.colostate.edu</a></td>
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<tr>
<td>Tao Wang</td>
<td>W 2-3pm</td>
<td>MRB 355</td>
<td>W  am</td>
<td><a href="mailto:Tao.Wang@colostate.edu">Tao.Wang@colostate.edu</a></td>
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Office Hours: Please contact the instructors or TAs at least a day in advance to schedule an appointment. We will be happy to assist you with any questions you may have.

References: Lab exercises and report forms will be made available in the form of a purchasable packet from the Bookstore. Additional exercises will be posted on RamCt and should be downloaded prior to the lab period. It is your responsibility to print them out and to bring them to the lab.

Course Description: This laboratory course is an introduction to important techniques currently employed by cell biologists. We start with a review of basic principles such as units used in experimental cell biology, data collection and analysis. Later sessions introduce techniques such as UV/visible spectrophotometry in the study of protein and solute concentrations, purification of enzymes and enzyme kinetics, protein gel electrophoresis in the study and analysis of proteins, and immunoassays in the detection of antigens or antibodies in organisms or tissue extracts. Students will also gain experience in basic principles of light microscopy and fluorescence cell staining in the study of cell structure and types. Additionally, methods for studying respiration and photosynthesis will be covered.

Background information and a brief description of the protocol will be introduced either in the recitation or briefly before the lab but it is your responsibility to be prepared for the lab by doing the pre-lab write-up in your lab notebook (see pg 3).
SCHEDULE

Week of:  

**LECTURE AND LABORATORY**

1- Aug 22  
**Recitation**: course overview, organization; introduction to Concentrations of solutions, small volume measurement, accuracy and precision of data measurement  
**Lab Exercise**: Check into laboratory; Concentrations of Solutions, proper Pipetting, Accuracy and Precision of Measurements.

2- Aug 29  
**Recitation**: Introduction to Immunoassays  
**Exercise**: Assaying antigens and antibodies using ELISA Immunoassay

3- Sept 5  
**Recitation**: Cancelled, Labor Day Holiday  
**Lecture**: Introduction to Enzyme Kinetics: Spectrophotometric assays  
**Exercise**: ENZYMES I: Partial purification and characterization of tyrosine enzyme from potato tubers.

4- Sept 12  
**Recitation**: Factors affecting Enzyme rates  
**Exercise**: ENZYMES II: Effects of enzyme concentration, pH and temperature on enzyme activity

5- Sept 19  
**Recitation**: Parameters of Enzyme kinetics  
**Exercise**: ENZYMES III: Kinetic analysis of the Tyrosinase Enzyme: $K_m$ and $V_{MAX}$: Enzyme inhibitor analysis

6- Sept 26  
**Recitation**: Protein Characterization: Protein assays and Protein Gel Electrophoresis  
**Exercise**: Quantitative determination of protein concentration by UV and colorimetric assays, gel electrophoresis: Assessing the purity of Tyrosinase enzyme by SDS PAGE

7- Oct 3  
**Recitation**: Review session.  
**EXAM I**, Notebooks DUE

8- Oct 10  
**Recitation**: Introduction to Microscopy  
**Exercise**: Introduction to the compound light microscope: Proper use of the microscope

9- Oct 17  
**Recitation**: Light Microscopy/continued  
**Exercise**: Microscopic viewing: cells of Living Organisms

10- Oct 24  
**Recitation**: Cell fractionation, Mitochondria isolation and respiration  
**Exercise**: Qualitative assay of Mitochondrial oxidation

11- Oct 31  
**Recitation**: Introduction to Photosynthesis: Light/Hill reactions  
**Exercise**: Chloroplast isolation and quantitative assay of Hill reaction

12- Nov 7  
**Recitation**: Introduction to fluorescence microscopy  
**Exercise**: Immunostaining of cells for fluorescence microscopy

13- Nov 14  
**Recitation**: Fluorescence Microscopy/continued, Cell viability assays  
**Exercise**: Stained cell viewing, Cell viability Assay

14- Nov 21-Nov 25  
**Fall Recess**: Thanksgiving Break

15- Nov 28  
**Recitation**: Cell signal transduction and cell cycle: Yeast pheromones  
**Exercise**: Yeast cell and reproductive cycle

16- Dec 5  
**Recitation**: Review session  
**EXAM II**, Notebooks due, checkout and evaluation

**Execution of Experiments**: Students will work in pairs; a two-student team will be assigned a section of the laboratory bench and will work together using instrumentation and equipment found in a typical cell biology research laboratory. All written work will be done individually.
Laboratory Notebooks: (200 points)

Pre-laboratory Write-up and preparation: A Lab Notebook should be used to plan the pre-lab portions of the experiment. The Title & Date, Introduction and Materials and Methods sections should be completed before you come to the recitation. Pre-lab write-ups should be in the student’s wording and not copied directly from the handouts. Pre-lab planning will help the students to do well on the open notebook quizzes and to conduct and finish the experiments in a timely manner.

A secure spine-bound, not spiral bound, no tear out page perforations notebook is used to outline the experiment before the lab period, document your experimental data and conclusions. Laboratory notebook will be collected twice during the semester and graded according to the criteria below. Any calculations, notes, and results should be recorded in ink (ball-point pens) directly into the notebook. The laboratory notebook of a scientist is a legal document that shows the progress of experiments on a given day. It is written in as the experiment proceeds, and nothing should be erased or obliterated. Mistakes are crossed out with a single line so the original work is still visible. Your notebook should be legible and should contain the following:

A) Table of Contents: at the beginning of your notebook, dedicate a few pages for use as a table of contents which includes title of each experiment and page numbers for each experiment. Keep it up to date as you write in your notebook.

B) Title and Date: this section should be written before class. The title of each experiment needs to be descriptive yet concise. It is crucial to record on what date (and possibly what time, if applicable) the experiment was carried out.

C) Introduction: This section should be written with your own wording before the lab period. The introduction section briefly summarizes 1) the theory behind the experiment (not more than 3 to 5 sentences), 2) the question to be investigated based upon the background (one sentence), 3) hypothesis which includes the predicted results (one to two sentences maximum), and 4) the objectives of the experiment (one to two sentences). Cutting and pasting from handouts’ material is NOT allowed.

D) Materials and Methods: This section should be written before the lab period and then modified as needed during the conduction of the experiment. The experiment section should contain the materials and reagents, the equipment used and the methods (protocol). Use a flow sheet of the protocol whenever possible. One should be able to repeat the experiment using only the methods you have written in your notebook.

E) Results and discussion: Completed during and after the experiment. The results section contains your observations, sketches of biological specimens, raw data, calculations, and tables and graphs that you generate from the data, as well as any other notes. For legal reasons such as patents of experimental results, your raw data should go directly into your notebook. However, for the purpose of this class only, your lab report (after grading) may be taped or stapled to the notebook to serve as a Results and discussion section.

F) Graphing: when graphing is called for, students may use either provided graphing paper or a computer to generate graphs. Hand drawn graphs on regular paper are unacceptable. You are expected to keep e-copies of graphs.

G) Conclusions: (Not more than 10 sentences) This section is written right after the experiment is completed or after you write your report and before you submit it for grading. Summarize 1) the results of the experiment, 2) your interpretation of the results, 3) the significance of your findings 4) what you learned from this experiment, and 5) what would you do next to carry over and expand the results. 6) answer the