University of Houston Clear Lake

Syllabus: Biol 4242/Chem 4242 – 03 (Spring 2015)
Laboratory for Biochemistry
Monday (8:00 am – 11:50 am) at Bayou 3506

Quality Enhancement Plan (QEP)
Applied Critical Thinking for Lifelong Learning and Adaptability

I. **Applied Critical Thinking Statement**: This course has been authorized by UHCL as an Applied Critical Thinking (ACT) Course which means that in addition to learning about the specified course content, students will be engaged with some or all of the Elements of Thought and Universal Intellectual Standards of critical thinking. The objective of an ACT course is to develop the student's ability to become skilled at analysis and evaluation by applying a set of intellectual tools that may be effectively used across all disciplines (as well as to the student's personal life). Based on the Foundation for Critical Thinking model (http://www.criticalthinking.org/), critical thinking involves thinking for a *purpose*, asking *questions*, using *information*, applying *concepts*, drawing *inferences and conclusions*, identifying *assumptions*, anticipating *implications and consequences*, and recognizing *points of view.* The Universal Intellectual Standards that are applied to these Elements of Thought of critical thinking in order to develop Intellectual Traits include *clarity, accuracy, precision, relevance, depth, breadth, logic, significance,* and *fairness*.

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Office Hours: Wednesday 1-3 pm or by appointment

Textbook: Modern Experimental Biochemistry, 3rd Edition, by R. F. Boyer from Benjamin Cummings (Recommended)

Prerequisite: Organic Chemistry I

Prerequisite or Co-requisite: Biochemistry I

*** I reserve the right to modify this syllabus as necessary**.

II. How Critical Thinking is Present in Laboratory for Biochemistry

The course provides students with a research-inspired laboratory experience that introduces standard biochemical techniques in the context of investigating current and exciting research topics. In this course, student will be actively engaged in exploration of experimental techniques that include acid/base titration; isolation of chloroplast, protein and DNA; protein purification and quantification; and gel analysis of protein and DNA. In all of these experiments, students should be asking, "What are the ***relevant assumptions*** I need to identify on the basis of collected experimental ***data*** in order to draw accurate ***inferences and conclusions***?" For example, in lab 6 (the isolation and characterization of protein), student may ask: "are the methods for purifying protein efficient? How much protein will I obtain? Is the protein pure enough, why or why not? What conclusion I can draw based on my understanding of the experimental data for these questions? How can I apply the knowledge and skills learnt in these lab practices to my daily life and other courses?"

III. Student Learning Outcomes (SLOs):

The fundamental and powerful ***concepts*** involve in the course of Biochemistry Laboratory include:

a. Isolation or Purification of Chemicals (e.g., Centrifugation and column chromatography that will be applied to isolate chloroplast, protein and DNA)

b. Characterization of Biomolecules (e.g., quantification and characterization of acidity of a solution, protein concentration, the molecular size of protein and DNA, etc.)

Upon completion of this course, students will be able to:

1. Illustrate a thorough knowledge of experimental approaches to ***accurately*** apply the fundamental ***concepts*** in solving problems of a chemical nature and have an ability to extend that knowledge to the ***solution*** of new problems.

2. Apply skills of the discipline to ***precisely*** analyze, interpret collected ***information*** during the laboratory work and communicate results of laboratory experiments in written in a format of lab report with effective scientific communication skills.

3. Integrate ***relevant*** chemical concepts and ideas to actual experimental exercises to formulate hypotheses, perform experiments, collect data, compile and interpret results and draw reasonable and ***logical conclusions***.

In order to fully develop the powerful concepts outlined above, students are expected to:

a) understand, with *clarity*, the *concept* of concentration, acid/base, pH and buffer, and demonstrate the ability to prepare a solution of given pH. This will be specifically explored in the experiment of acid/base titration (Lab 1).

b) illustrate the ability to use the centrifugation as a tool for the *purpose* of separation and purification of biomolecules, which will be enhanced through the course of chloroplast isolation and protein purification (Lab 2 & Lab 6)

c) understand the *concept* of protein quantification, and display the ability to choose correct method for the purpose of protein quantification with precision, based on the variation of protein concentration and the differences among the studied protein quantification methods (e.g., Biuret, Lowry, Bradford, & Turbidity). Students will learn such skill in Lab 3 & Lab 6.

d) comprehend the principle of gel permeation column (GPC) chromatography, as well as other related column chromatographic methods that are applied to separate biomolecules. Be able to construct a graph, with accuracy, to estimate the molecular weight of protein using the data of GPC. (Lab 4)

e) understand the concept of enzyme kinetics and the consequence of enzyme-catalyzed reactions after changing the reaction conditions (e.g., pH, temperature, inhibitors). Students will explore this skill in Lab 6.

f) comprehend the concept of SDS-PAGE, & demonstrate the skills to accurately estimate the molecular weight of unknown protein according to the relevant protein standards. Students will repeatedly have this training in Lab 5 and Lab 6.

and f) understand, with clarity, the principle of PCR and enzyme restriction of DNA, and display the skill to estimate the size of DNA fragments after gel electrophoresis. (Lab 7)

Vocabulary of Critical Thinking:

In this course, students will learn and use the vocabulary of critical thinking while they undertake the experiments, analyze data and prepare lab reports, using both the Elements of Thought and the Universal Intellectual Standards.

The Eight Elements of Thoughts are:

a. ***Assumptions***: Axioms, presuppositions, and a-priori facts or knowledge.
b. ***Essential Concepts***: Definitions, ideas, models, laws, hypotheses, theories and principles.
c. ***Implications and Consequences***: Inferences, effects, and outcomes. Implications follow from thoughts, consequences follow from actions.
d. ***Information***: Facts, data, evidence, observations, reasons, and experiences
e. ***Interpretation and Inference***: Solutions and conclusions.
f. ***Point of View***: Perspectives, frames of reference, and orientations.

g. ***Purpose***: Goals, objectives, motives and intentions.

h. ***Question at Issue***: Problem, issues, and misconception that guide our thinking.

There are many universal intellectual standards, but nine (9) important ones* are: *clarity*, *accuracy*, *precision*, *relevance*, *depth*, *breadth*, *logic*, *significance*, and *fairness*.

* Richard Paul & Linda Elder, Critical Thinking: Concepts and Tools, 6th edition, Foundation for Critical Thinking Press, Tomales, CA, 2009.

Critical Thinking Process:

There are four major aspects of the Applied Critical Thinking Process, termed as the 4 C's: *curiosity*, *connections*, *creativity* and *communication*. In this course, the predominant C's in the student learning outcomes are connections and communication.

IV. Major Activities That Promote or Require Critical Thinking

1. **TESTS** (300 points, SLO-1)

Students will participate in two tests (in a total of 300 points, but not evenly divided) given at the indicated times. In these tests, students are responsible for all material in handouts, for all problems, for designated reading materials and for information presented in class. This will assess students' understanding of the basic concepts in solving practical problems and connections to particular problems based upon information acquired within the discipline. The make-up test will be allowed on a case-by-case basis that must be held within 24 hours of the regular test.

2. **LABORATORY REPORTS** (900 points, SLO-2 & SLO-3)

While students' lab reports will be graded on the basis of the contents in each components as described below, students' lab reports will be assessed for whether or not the critical thinking skills have been applied throughout the lab reports. Specifically, lab reports will assess students' connection and communication skills. Students will demonstrate that they have connected the experimental data to their assumptions and conclusions, have explained or elaborated the components of lab reports well, have included scientific literatures to support their experimental data. If an unexpected data was collected, students will make connections to the weird data based upon evidence acquired by research methodologies and literature, not to simply answer as "human error". In addition, students will demonstrate strong communication skill to state the main points of the lab exercises in clarity and concision, present data in a logic order.

A laboratory notebook will be kept by student, and reports will be turned in on the dates as noted at the end of this syllabus. Students will work in pairs for the purposes of lab safety and data collection; however, *each student will prepare a separate lab report that should clearly describes the purpose of the lab, collects relevant literature information, accurately interprets the experimental data and draws*

significant conclusion. During the preparation of lab report, students may discuss their results with other members of the class but the student **must** write his/her own report independently (duplicated reports or similar reports containing simple rephrasing of other reports will not be assigned for any credits). The reports will count 50% of the final grade. Although only one lab report is required for lab 6 and 7, respectively, the score for these labs are equivalent to 4 and 3 regular lab reports from lab 1 to lab 5. The three lowest grades of lab reports will not be considered to calculate student's overall points in lab report. However, if lab 6 is corresponding to the lowest score, only three out of the four equivalent scores will be dropped provided that all other lab reports have been turned in with higher scores and all contents in the four weeks experiments have been discussed in lab 6. The same rules apply for lab 7. There will be **no laboratory make-ups**.

Submission and Late Paper Policy

Lab reports must be turned in at the beginning of the lab period on the due days (an electronic copy of each lab report must be submitted through Blackboard for the purpose of plagiarism verification). The grades for reports received after the due days will be reduced by 10% of the merits after 8:20 am on the same day. An additional 10% of points will be reduced for every day that the report is turned in after the due day (i.e., the lab report will be worthy of only 30% of the original value if it were late for a week).

Neatness and Readability

When preparing lab reports, student should remember that the neatness and readability (and, therefore, comprehensibility) are of the utmost importance to your audience (the instructor). Reports must be **typed**, although graphs may be done on finely ruled scientific or engineering graph paper.

Components of Lab Reports

The components in the lab report will be weighed in different percentage values, which are: Title/Author/Date (7%), Abstract (10%), Introduction (10%), Material & Methods (3%), Results (20%), Discussion (30%), Conclusion (5%), References (5%), and Readability (10%).

3. **CLASS PREPARATION, PARTICIPATION & PERFORMANCE (**25 points**,** SLO-1 & SLO-2**)**

Students are expected to participate actively in all laboratory exercises and demonstrate a reasonable level of proficiency in the laboratory procedures (*e*.g., pipetting solutions, operating the spectrophotometer, using the various centrifuges, etc.). It is the student's responsibility to develop the laboratory skills! Student is also responsible to come to lab prepared and to work with lab partners to perform experiments in a safe, correct and timely fashion.

Student should prepare the lab material in advance, and make the table sheet ready for recording the experimental results. Mistakes during experiments or fail to collect data will all affect student's performance score. Student must show his/her lab preparation (such as prepared tables or data sheets for recording experimental

results, what can be learnt from that particular lab, what kinds of thing should be taken care of, etc.) before each class. Students not finishing that part will be asked to complete before going to lab, and 5 points will be taken away from their final score. Your instructor's subjective evaluation of your participation and demonstration of laboratory skills will count for 25 points toward your overall performance score.

Finally, students are required to keep a neat laboratory notebook and to clean the entire laboratory before leaving the lab (safety rule #7).

4. CLASS ATTENDANCE: (0 points**,** applying SLO-1 & SLO-2**)**

Student's actual attendance will be recorded in the provided signing sheet. Regardless of whatever reason applies, if the student misses a class, s/he will be recorded as absence. Although no points are assigned to your class attendance, your excellent record in both attendance and class performance would help you earn a high level grade, if applicable. For example, if your grade were calculated to be B^+, I might bump you up to A^- in consideration of your excellent record in both attendance and performance.

The lab sessions begin promptly at the listed times, and it is essential that students are there. Arriving late will often mean that the student has missed some key instructions, which in some cases may be related to safety procedures. If student comes to class late more than 20 minutes or leaves the class 20 minutes earlier than the completion of the experiment, the student will receive a conduct mark; likewise, being late for class more than an hour or leaving the lab an hour before the completion of lab work will be assigned three conduct marks. **Each conduct mark** will lead to a deduction of 5 points from the performance score.

Student's final grade will be determined according to the following table.

Score	Grade	Score	Grade	Score	Grade
> 1150	*A*	1100-1149	*A* $^-$	1040-1099	*B* $^+$
980-1039	*B*	920-979	*B* $^-$	860-919	*C* $^+$
800-959	*C*	735-799	*C* $^-$	675-734	*D*
< 675	*F*				

The instructor reserves the option of adjusting the grade cut-offs to lower scores if necessary.

The end goal of the above activities with respect to Applied Critical Thinking is to develop the student's Intellectual Traits–critical thinkers routinely apply intellectual

standards to the elements of thought in order to develop the following intellectual traits:

1. Intellectual Integrity
2. Intellectual Humility
3. Confidence in Reason
4. Intellectual Perseverance
5. Fair-mindedness
6. Intellectual Courage
7. Intellectual Empathy
8. Intellectual Autonomy

V. Assessment Methods Linked Back to the Student Learning Outcomes

As noted in the QEP proposal submitted to SACS, UHCL's overarching QEP Student Learning Outcomes are as follows:

The assessment of student's overall performance of Applied Critical Thinking skill are embedded into various activities as described above (**section IV**). Students making connections with clarity to the particular concepts based upon the experimental data collected in the lab, and drawing accurate inferences and conclusion of the said data with support of reasonably relevant literature will be rated as excellent (90%-100%), provided that students have demonstrated high level of communication skills in written. Students who demonstrate inferior performance of the above activities will be rate as "acceptable" (60%-89%) and students who have not made clear connection of concepts to experimental results and are weak of communication skills with scientific reasoning will be rated as "unacceptable" (0%-59%).

Student labs and exams will be uploaded as artifacts into the University of Houston-Clear Lake Applied Critical Thinking software for archiving.

Use of Class Products in Assessment

The University of Houston–Clear Lake may use your work in this class to generate assessment data. Any works used will be used only for educational purposes.

6-Drop Rule Limitation

Students who entered college for the first time in Fall 2007 or later should be aware of the course drop limitation imposed by the Texas Legislature. Dropping this or any other course between the first day of class and the census date for the semester/session does not affect your 6-drop rule count. Dropping a course between the census date and the last day to drop a class for the semester/session will count as one of your 6 permitted drops. You should take this into consideration before dropping this or any other courses. Visit www.uhcl.edu/records for more information on the 6-drop rule and the census date information for the semester/session.

Safety Rules

IMPORTANT: These safety rules must be followed:

1. Goggles or safety glasses must be worn at all times!
2. Closed-toed shoes must be worn; lab coats are recommended.
3. No eating, drinking or smoking in the laboratory.
4. When students are performing experiments do not purposely distract them.
5. No mouth pipetting; use a bulb or automatic pipetter.
6. Protective gloves are available in the lab; use them when necessary.
7. You are responsible for maintaining the laboratory. **All** laboratory benches and equipment must be **clean** at the end of the period; this is considered part of proper laboratory technique and as such affects your grade!

UHCL Honesty Policy

The Academic Honesty Policy at UHCL (found on page 101-103 of the 2014-2015 catalog) states: "Academic honesty is the cornerstone of the cornerstone of the academic integrity of the university. It is the foundation upon which the student builds personal integrity and establishes a standard of personal behavior".

The Honesty Code of UHCL states:

"I will be honest in all my academic activities and will not tolerate dishonesty." Because honesty and integrity are such important factors, you should be aware that failure to perform within the bounds of these ethical standards is sufficient grounds to receive a grade of "F" in this course and be recommended for suspension from UHCL.

Course Schedule

Date	Exercise	Description	Due Date
01/19		Labor Day Holiday	
01/26		Introduction to the laboratory	
02/02	1	Acids, Bases and Buffers	02/16
02/09	2	Cellular fractionation-density gradients	02/23
02/16	3	Proteins—Quantification	03/02
02/23	4	Proteins—separation by chromatography	03/09
03/02	5	Proteins—separation by SDS PGAE	03/23

03/09		**Mid Term Exam**	
03/16		**Spring Break**	
03/23	6	Enzymes—isolation and purification	04/27
03/30	6	Enzymes—quantification and characterization	04/27
04/06	6	Enzymes—physical and kinetic characterization	04/27
04/13	6	Enzymes—further characterization and analysis	05/27
04/20	7	DNA isolation	05/04
04/27	7	DNA Digest and amplification	05/04
05/04	7	Review	
05/11		**Final Exam**	