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# Reading and Understanding the Scientific Literature: ACE 10 Course: Biochemistry 435 Advanced Topics

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# Reading and Understanding the Scientific Literature

ACE 10 Course: Biochemistry 435 Advanced Topics

Edward N. Harris



## ACE 10 Question

### Learning Objectives

**Writing:** Students will generally be writing in a scientific format for the first time. This may be very different from prior writing in the university. This will come from discussions in the classroom sessions and from feedback on the course paper chapters that are submitted during the progress of the course.

**Oral Communication:** This is reinforced by the presentation of relevant papers from the scientific literature during most of the class periods. Students need to learn to master the content of such papers, prioritize the important elements, and present them in a coherent fashion. The student effort receives intrinsic feedback during the process by questions and comments from the instructor and from the other students.

**Critical Thinking:** Critical thinking can only be done once a student has mastered a significant amount of foundational literature. Students at the start of the topic will have little ability to carry out critical thinking about the course theme. As students read more of the primary literature and seek out other references to flesh out certain aspects and to reconcile contradictory reports, they will be encouraged to reflect on the epistemology of the conclusions.

**Ethics:** Each section of the class involves one class session related to an ethical issue. This usually involves a case study that is read prior to the class and a group discussion. In some cases, it is productive to have students attempt to present differing viewpoints, but in for other topics, students seem able to grasp the diverse social impacts.

**How are the learning objectives embedded in the course?** This course focuses on the broad discipline of biological chemistry that cuts across the various life science disciplines. Students receive a few lectures of introduction, and then start reading journal articles selected by the instructor. Then, most of the remainder of the semester is comprised of students searching the primary literature and collecting relevant articles with information to build a coherent paper that proposes the direction of future research in one aspect of the general topic. Students learn to make presentations of their selected papers and reflect on how the data reported represents an incremental increase in knowledge and understanding. The individual sections of this course are taught by different instructors, thus the topics do vary.

## Rubric for evaluating student work

### Writing Rubric for the review paper

Grade	A	B	C	D
<b>Coherence</b>	Clear organization that walks the reader through the paper, does not stray off central theme	Clear organization but may be slightly or sections are linked	Organization is less than clear, or organization is clear but some digressions or poor development of a central theme	Organization is lacking and/or paper strays substantially from topic
<b>Support</b>	Numerous, varied and relevant details and facts support coherent arguments	Details and facts support arguments, but not enough or may be as relevant as possible	Some details and facts to support arguments, but not enough and some lack relevancy	Little to no relevant details and facts to support arguments
<b>Content Knowledge</b>	Demonstrates excellent understanding of content and is comfortable with nuances in material	Conveys content adequately but fails to elaborate	Gets basic content correct but is otherwise uncomfortable with material	Basic content is wrong, incorrect, or substantially incomplete
<b>Originality</b>	Demonstrates excellent analytical originality, either in creating new arguments or in relating facts in new ways (beyond what is covered in course material)	Demonstrates some, but not a great deal of, analytical originality, either in creating new arguments or in relating facts in new ways	Demonstrates little analytical originality, relies mainly on arguments and evidence already covered in class	Makes no attempt to provide original analysis
<b>Citation</b>	Variety of citations which support the text	Adequate citations, but some sense that text describes the limited number of citations found	Limited variety of citations, but some sense that evidence of scholarship	Few citations
<b>Vocabulary</b>	Rich and appropriate use of scientific vocabulary	Generally good vocabulary use	Limited scientific vocabulary, not always precise or accurate	Incorrect use of scientific vocabulary, very limited range
<b>Grammar</b>	No major errors, a few minor errors that do not distract	One major error or several minor errors that do not distract	Two or three major errors combined with minor errors	Numerous major errors
<b>Argumentation (final chapter)</b>	Paper has clear, original arguments that go beyond description	Paper has discernible arguments but may be somewhat unclear or weak	Paper has arguments but often falls into description	Paper has little to no arguments, spends most time describing

### Samples of presentation evaluation sheets

Evaluation of Presentation Presenter's name \_\_\_\_\_

- I understood what the presentation was about. NO 1 2 3 4 5 YES
- The flow of the presentation was logical. NO 1 2 3 4 5 YES
- The presenter spoke clearly. NO 1 2 3 4 5 YES
- The slides were clear and easy to understand. NO 1 2 3 4 5 YES
- The presenter spoke to the audience. NO 1 2 3 4 5 YES
- The presenter made good use with the pointer. NO 1 2 3 4 5 YES
- The presentation was within the prescribed time limits (20 min +/- 2 min.). NO 1 2 3 4 5 YES
- The presenter answered questions clearly (no B.S.). NO 1 2 3 4 5 YES
- The presenter gave his/her opinion of the state of the science in this subject. NO 1 2 3 4 5 YES
- I would enjoy listening to this type of presentation again. NO 1 2 3 4 5 YES

Score: \_\_\_\_\_/50 Your name \_\_\_\_\_

**Presentation Evaluation**

Names of Presenter: \_\_\_\_\_

I. Was the subject clearly presented?

(1) Organization of presentation material A+, A, A-, B+, B, B-, C+, C, C-

(2) Were the slides clear and easy to follow? A+, A, A-, B+, B, B-, C+, C, C-

(3) Speech, attitude, and behavior A+, A, A-, B+, B, B-, C+, C, C-

II. Did the presenter make an interesting presentation? A+, A, A-, B+, B, B-, C+, C, C-

III. Any other comments and suggestions \_\_\_\_\_

IV. Did you learn something? (Brief summary of presented material, significance of the topic, and the most important information you will likely remember.) \_\_\_\_\_

## Method of Analysis

Each instructor for each section provides the college with the syllabus and samples of student work. Samples of the written review papers are uploaded in Blackboard and the current standard is to provide two samples of very good papers, two samples of average papers, and two samples of poorly written/poorly thought out papers.

## Findings

The college (CASNR) keeps all of the current archived data. The department currently has not used any quantitative data from the ACE 10 courses to formulate correction, revisions, or additions to other biochemistry courses. The department is currently building an assessment tool to measure student knowledge of biochemistry from freshman to senior years. All the instructors have noted that the writing proficiency varies widely among the student body from barely proficient to very good.

## Student Work

**Writing sample:** A key aspect for critical thinking is for students to clearly write about the subject material. In this course, students must read numerous research articles in their specific chosen subject and synthesize a paper reviewing current status of the research and what needs to be done in order to progress the field. This involves evaluating the research methods, outcomes, and impact of the research in that particular field.

To assess the student's writing, the specific sections of the review paper are sent to the instructor in electronic format over the course of the semester. The instructor then goes through the written work and uses the "Track Changes" feature in word to edit and make comments. The students revise their work and should learn their own weaknesses in writing/thinking about their subject. Below is an example of the introduction part of the paper that the student sent in and received back from the instructor. By the end, of the semester, the entire paper is evaluated and graded with the rubric (see top middle section). The rubric was adapted from <http://www.apsanet.org/tlc2007/TLC07Rublee.pdf>

### Sent to the instructor

**Introduction**

Advanced glycation end products (AGEs) are produced endogenously through glycation reactions. This addition of a saccharide to a protein affects the physical characteristics of the protein, as well as changing its biochemistry. These are posttranslational modifications that accumulate in long-lived proteins with age. AGEs affect health in a variety of ways. The biggest impact on health can be attributed to the protein modifications that cause the proteins to behave differently than their intended purpose, the **EXTRACELLULAR MATRIX**.

AGEs are harmful to the body in a multitude of ways. First, they change protein function through modification. The original protein is no longer able to execute its original function, and instead will be recognized by the receptor for advanced glycation end products (RAGE). When AGEs are recognized by RAGE, an inflammatory response is induced. AGEs are also involved in the crosslinking of proteins, which stiffen tissues. Finally, AGEs induce radical formation, which accelerates body aging.

RAGE is an interesting receptor, as it can bind a wide variety of ligands, while differentiating between them. The different ligands will induce different responses. The binding of AGEs to RAGE leads to the production of pro-inflammatory cytokines, along with reactive oxygen species. This binding also leads to the creation of more AGEs, which leads to more binding, and a self-perpetuating pathway. The inflammation is involved in a variety of diseases.

Peripheral neuropathy is a major long-term problem for diabetics. It is believed to be caused by AGEs binding with RAGE. However, there is a form of soluble RAGE (sRAGE) that binds to AGEs without activating the signaling or pathways that have been indicated in the peripheral neuropathy. This is a new area of study that needs to be researched further.

### Received back from the instructor

**Introduction**

Advanced glycation end products (AGEs) are produced endogenously through **phenolically random Maillard** reactions. This addition of a **hexosamine to a protein** affects the physical characteristics of the protein, as well as changing its **extracellular matrix** biochemistry. These are posttranslational modifications that accumulate in long-lived proteins with age. AGEs affect health in a variety of ways. The biggest impact on health can be attributed to the protein modifications that cause the proteins to behave differently than their intended purpose, the **EXTRACELLULAR MATRIX**.

AGEs are harmful to the body in a multitude of ways. First, they change protein function through modification. The original protein is no longer able to execute its original function, and instead will be recognized by the receptor for advanced glycation end products (RAGE). When AGEs are recognized by RAGE, an inflammatory response is induced. AGEs are also involved in the crosslinking of proteins, which stiffen tissues. Finally, AGEs induce radical formation, which accelerates body aging.

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**BIOC435: Biochemical Basis of Disease and Therapeutics**  
Instructor: Jaekwon Lee

**Combating Disease of Humans, Animals and Plants**

**Goals**

- Reinforce
- Writing
- Oral communication
- Critical thinking
- Ethics
- Review writing
- Presentation of papers

**Activities**

- Twelve lectures by the instructor
- Write a review paper on an assigned disease
- Three one-on-one meetings with instructor to discuss progress in review writing
- Present papers and lead discussions
- Primary literature discussion (16 papers)
- Peer evaluation to suggest presentation skill
- One written exam

**Instructor memorizes all student names to facilitate discussion.**

**BIOC 435. ADVANCED TOPICS IN PROTEIN ENGINEERING**  
Robert J. Spreitzer (Instructor), Fall 2011

Baker, M. (2011) Protein engineering: Navigating between chance and reason. *Nature Methods* 8: 623-626.

**BIOC 435: Advanced Topics in Glycobiology**  
Instructor: Dr. Edward Harris

A review in the current literature on how glycan polymers and modifications affect protein function, organogenesis, disease outcomes and protein engineering.

**BIOC 435: Advanced Topics in Metabolic Engineering**  
Instructor: Ed Cahoon (Spring 2010 & 2012)

Using biochemistry in real world applications

## Improving ACE 10 Learning

The Dept. of Biochemistry is always seeking to maintain a high quality of instruction with their undergraduates. The BIOC435 course was originally intended to expose students to the primary scientific peer-reviewed research articles and foster literacy across a broad range of topics. The observation from all of the instructors is that despite the core-curriculum from the prior 3 years of instruction, including ACE 1-9, student preparation for this course is quite variable. Several improvements have been made including:

- Teaching students *how* to read a research article: This means breaking the article apart with the students and putting the parts back together one at a time.
- Instruction of new material begins with reviewing some of the material that the students learned in BIOC431/432 for familiarity.
- The use of new teaching methods in the classroom such as Just-In-time teaching (JITT) or peer instruction (PI)
- Development of BIOC205, a new pilot course for biochemistry majors that utilizes the scientific literature to demonstrate how basic research enhances human therapies.