Due by Date: May 1 2018

Assignment of NHB 203

RAK Medical and Health Sciences University
Ras Al Khaimah, UAE

RAK COLLEGE OF NURSING
(AY 2017-2018)

NHB 203 HUMAN BIOCHEMISTRY ASSIGNMENT

A. Description. One of the requirements of this course is to complete **two (2)** assignments and this assignment is the second. Please keep the following expectations in mind:

1. Each assignment is worth 100 points.
2. Read instructions carefully and be sure to complete all aspects of the assignments.
3. Be thorough and complete in your work.
4. The assignment was developed to correspond to chapters/topics that we will be studying throughout the term. You will need to turn in your work by the deadlines designated in your syllabus and on the assignment sheet. No late assignments will be accepted.
5. All written assignments must be typed and double-spaced.
6. Please use APA rules of citation.
7. The deadline of submission is on May 1, 2018.
8. Hard/printed copy must be submitted. Please print an extra so that I can sign it as a proof that you submitted your assignment on time.

B. Purpose*:* This assignment is related to your class in Biochemistry

C. Type/Length of activity: Academic Article Reading and Review

D. Instruction. Read the article entitled**, *"A Focused Assignment Encouraging Deep Reading in Undergraduate Biochemistry by Bryan D. Spiegelberg."*** Then prepare a 1500 – 3000 words essay/critique about the mentioned article. The assignment must contain the four components identified the assignment format.

E. ASSIGNMENT FORMAT:

1. A paper at least 4 pages long, not including any reference section
2. The paper must contain the following sections:
   - Introduction
   - Discussion
   - Conclusion
   - References

3. Typed and double spaced, with Arial (10-point font) or Times New Roman (11 or 12-point font) and 1-inch margins
4. Proofread for spelling and grammatical errors
5. Provide in-text citations and reference any of your sources using APA format

F. <u>HOW WILL YOUR ASSIGNMENTS BE GRADED</u>. Please find the marking rubric below:

PARTICULARS	INSTRUCTION	MAX.MARKS
Originality	*The assignment must be original. It must pass through a plagiarism check. The acceptable standard is 30% similarity index*	30
Assignment Title	*Select a topic for your discussion*	5
Introduction	*It must contain why you selected the topic and its relevance. Word count must be 200-500.*	10
Discussion	*Discuss main points. This part must contain 1500 – 2500 words*	40
Conclusion	*It must contain summary and recommendations. This part must contain 100-200 words.*	10
References	*A minimum of three references is required.*	5
Total		100

Assignment Checklist

Before you turn in any written work, be sure you ask yourself the following:

- ❒ When is it due? ________________________________
- ❒ Is it typed and double-spaced?
- ❒ Did I answer all of the questions?
- ❒ Are my answers complete and thorough?
- ❒ Did I explain answers in my own words and avoid copying text from my textbook or other sources?
- ❒ If I needed to take information directly from another source, did I use quotation marks and cite my source (including the textbook), by indicating the author, publication date, and page number?
- ❒ When I provide my opinion, belief, or idea about something, did I also explain why and support my answer?
- ❒ Is my work proofread and free from grammatical errors?
- ❒ Do I understand what I wrote?
- ❒ If someone who did not know much about the topic I am writing about, understand it better after reading my paper?
- ❒ Have I printed extra copy?
- ❒ Do I have a backup copy saved?

Article

A Focused Assignment Encouraging Deep Reading in Undergraduate Biochemistry

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Abstract

Encouraging undergraduate students to access, read, and analyze current primary literature can positively impact learning, especially in advanced courses. The incorporation of literature into coursework typically involves reading and responding to full research reports. Such exercises have clear value as students make connections between experiments and are able to probe and critique scientific logic. The exclusive use of full papers, though, may reinforce certain students' tendencies to rely on textual clues rather than a critical analysis of the actual data presented. I propose that structured activities requiring students to focus on individual parts of research papers, even on a single figure, are beneficial in a literature-centered advanced undergraduate course, because they promote the deep reading that is critical to scientific discourse. In addition, I describe how one such focused assignment boosted learning and was well received by students in a second-semester biochemistry course.
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Keywords: *active learning; teaching and learning techniques methods and approaches; sources of difficulties and teaching strategies to correct difficulties*

Introduction

Successful immersion in scientific argumentation requires the ability to access and critically interpret published research. The importance of deep reading among scientists of all types cannot be overstated. Deep reading is, however, not a skill that comes naturally to many budding scientists [1, 2]. Novice scientists face challenging vocabulary and other issues that often preclude more than a surface comprehension of the content of research reports. A key goal as educators of undergraduate scientists, then, is to help students become comfortable using the vast and growing body of scientific literature as a primary learning tool.

The education literature has addressed the improvement of reading ability among nascent scientists (for a recent extensive study, see ref. [1]), and it has provided many interventions to help students improve their reading skills (e.g. ref. [2–8]). By using or adapting some of these tools, I have found that an emphasis on primary literature in an upper-level class leads to positive outcomes. As I have employed literature-centered activities, I have experienced enhanced engagement in the classroom and improved performance on exams. Solicited and unsolicited comments confirm that students enjoy learning about scientific principles more directly from scientists themselves, as opposed to traditional textbook coverage. Despite the successes of these exercises, though, I have continued to struggle to get students to read deeply; most especially, students are often unwilling to engage with the actual data, which one might consider the most crucial aspect of a research report.

This struggle is not specific to students in my course at Rider. In their extensive analysis of undergraduate reading, van Lacum *et al.* surveyed several students about their reading habits [1]. These surveys provide anecdotal support for the existence of a general reticence to engage with data in a research report; instead, novice scientists tend to rely mostly or solely on authors' words to provide the message. Van Lacum *et al.* convey the case of Jessica, for example, who "did not pay much attention to the article's inscriptions. 'Everything is in the text. I only look at graphs and tables if I'm confused about something'" [1]. Similarly,

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instead of looking at the data, Bill "looked for verbal descriptions of tables and figures… 'Here they say in words what was presented in the table. That's easy'" [1]. Such reliance on authors' interpretation of data presents a serious roadblock to a personal and critical analysis of data that would support the argumentation that characterizes modern science. Moreover, students that focus on understanding experiments are being exposed more thoroughly to new scientific tools—tools that might impact their creative processes in future endeavors.

In considering student work, I realized that many reading assignments tend to enable this tendency to avoid struggling with complex data. Interventions that I have employed in advanced undergraduate courses require students to address the arguments contained in entire articles, either in classroom discussions or in out-of-classroom assignments. Here, students may avoid drilling down into the research itself, instead relying on the authors' words, or even a professor's guidance, to grasp arguments being made. Interestingly, in Chapter 9 of his fine book *Engaging Ideas: The Professor's Guide to Integrating Writing, Critical Thinking, and Active Learning in the Classroom*, John C. Bean describes an intervention that explicitly encourages students to avoid data [9]. He advises students tasked with analyzing an article from a psychological journal, to "skim… all of RESULTS," "focus only on what you can understand" [9]. It is clear that Bean has certain intentions for this tool that might not include a deep understanding of statistics and psychological experimentation, but such encouragement of avoiding difficult data, especially if utilized in courses comprised of future scientists, may harm the learning process in the long run.

While the use of literature in undergraduate courses can be highly beneficial, reports in journals such as *Science, Nature*, and the *Journal of Biological Chemistry* are not targeted to an undergraduate audience. Because research literature and modern data often push the limits of undergraduates' toolboxes, I contend that asking students to analyze entire papers can be overwhelming and thus might encourage the surface reading as described by Jessica and Bill [1]. Employing a reductionist approach to undergraduate reading, then, may pay dividends in supporting their ability to think critically. To this end, I have developed an assignment requiring students to focus on specific pieces of a research report. I have found this focused assignment, building on an assignment described by Mowshowitz and Filner [10], to be a positive part of a literature-centered course.

The Course

The focused literature analysis project has been implemented and adjusted in Biochemistry II (BCH330) over the past three years. This course is an integral part of the Biochemistry curriculum at Rider University, and it serves as a popular elective course for Chemistry, Biology, and Behavioral Neuroscience majors. We meet for three hours per week, and the course has an accompanying three-hour laboratory component. In a typical semester, half of the students will be Biochemistry majors, but all of the students will have taken Biochemistry I, which serves as a standard one-semester survey of biochemical topics, including biomolecular structure and function and basic metabolism.

As an extension of the survey course, Biochemistry II has traditionally covered a diverse set of topics, focusing on the identification and utilization of current research. A typical semester will cover several topics, including bioenergetics, DNA metabolism, protein synthesis and degradation, and basics of signal transduction. The textbook is deemphasized in this class; textbook readings are included as introductions to various topics, but deeper learning is guided by peer-reviewed primary and secondary literature sources.

As this is a course that is focused on reading and interpreting data, particularly recent data from the biochemical literature, I have implemented several strategies to develop reading skills in the course. For example, several class periods each semester are dedicated to a journal-club type discussion of recent papers of my choice that relate to the topic at hand. I am indebted to several peers whose published work has guided these discussions, in particular in helping to make them student-led discussions, encouraging preparation and engagement with the material [11].

The Assignments

To encourage students to perform detailed analyses of data papers that they read, I have instituted a semester-long "project" as an adjunct to other literature-centered activities in this course. The main theme of this project is "focus:" rather than analyzing an entire paper or series of experiments, I ask students to consider fragments of a paper. Notably, this exercise sacrifices an extended analysis of authors' overall scientific strategies. However, since such strategies are discussed throughout the course itself, I believe that this encouragement on focus is an effective tool in the enculturation of these budding scientists.

The project itself consists of five main assignments accomplished over a semester: a statement of interest, three written primary literature analyses, and an oral presentation. Within two weeks of the beginning of the semester, students are asked to decide on an overall topic: a protein that will serve as the focal point for the written and oral tasks. In principle, such an overarching topic is not necessary—students could simply analyze several papers that are essentially unrelated—but I feel that a guiding topic establishes a cohesiveness that enhances the learning experience.

Statement of Interest

The choice of topic is crucial to the success of the project. A protein that is not of interest to the student will lead to disengagement, and proteins with little current research make selection of papers difficult. Students are forced, therefore, to carefully consider their choice of protein while crafting a two-page statement of interest early in the semester. Through the use of review articles and, perhaps, popular scientific literature, they describe the general biological importance of the protein, possibly relating this to a broader (often medical) significance. As part of this assignment, I also ask students to provide at least three primary research articles that could be analyzed throughout the semester. Importantly, this exercise provides context for a discussion of "scholarly" works and the differences between primary and secondary sources, and it builds investment in the project as students begin to become experts on their protein.

Primary Literature Analyses

During and after the topic selection process, students use various means to find appropriate papers for analysis. Through previous courses and through independent research, many Rider students have become comfortable with Pubmed and SciFinder as literature retrieval tools. We also discuss other means of finding appropriate papers, for example via journal websites and via "Works Cited" sections of review articles and other research reports.

Students submit to me, via email, two possible papers for analysis at least three days before the analysis assignment is due. Importantly, this requirement encourages students to begin the analysis process well before the deadline. I may veto one, or both, of the papers if they are not appropriate for the assignment. I encourage students to choose papers no more than five years old, although I will relax this requirement if proposed papers are of high quality. I also spend time considering the experiments themselves. Because the assignment requires a description of the experimental strategy, I push students to consider experiments that are reasonably accessible to advanced undergraduates. For example, I steer students away from research describing biomolecular nuclear magnetic resonance (NMR) or X-ray crystallographic studies. On the other hand, experiments that work well in this context include co-immunoprecipitation experiments (even chromatin immunoprecipitation (ChIP) assays), analyses of enzyme kinetics, *in vitro* analyses of nucleic acid structure and function, and experiments designed to study the quaternary structures of proteins. I spend time responding to each student's choice of paper, offering pointers about which figures might be most amenable to this assignment and, if necessary, indicating potential misinterpretations.

I deliver a sheet to students containing nine questions that they must answer. The questions, in a distilled form, are shown in Fig. 1. These questions address (1) a simple reflection about how the paper was found, (2) the structure of the introduction (focused around the "Create a Research Space" (CARS) technique described by Swales [12]), and (3) the experimentation and interpretation of a single figure. The students craft their responses on a computer and turn in a hard copy of their answers. Note that several of the questions require that the students highlight relevant passages in the introduction, so they also turn in a hard copy of the paper itself.

Analysis of a single figure (or a subset of panels in a large figure) is the central focus of this assignment. Rather than diving into the interpretation of the figure, students are first asked to take a step back and describe the logic of the experimental strategy itself. This description enhances the depth of reading, but it is often the most difficult part of the assignment. It requires students to read the paper deeply and, often, to seek other sources (including their professor) for clarification. As an example, "bands" in a figure may increase in intensity leading to the conclusion that a gene is more highly expressed under certain conditions, but understanding the difference between Western and Northern blotting is critical to a detailed understanding of the results. As mentioned previously, it is important that students choose accessible experiments; it might be outside the realm of the assignment to ask students to describe experiments leading to X-ray crystallographic data, for example.

Literature search

1. Reflect on the process used to find your paper

Introduction

2. *Background.* What is the broad implication of this work?
3. *Problem.* What uncertainty in the field prompted this particular work?
4. *Hypothesis.* What hypothesis guided this work, or what were the major findings?

Result

5. *Experimental strategy*
   a. Describe the logic of the major experimental technique in general terms.
   b. How was the technique applied here?
6. *Experimental interpretation.* What conclusions can be drawn from the data?
7. *Controls.* What controls were used, and what alternative explanations were being tested?
8. *Relationship of the experiment to the whole.* How does this experiment address the hypothesis or contribute to the major findings?

FIG 1 Condensed description of the written primary literature assignments. Complete handouts are available in Supporting Information. Note in particular that students are asked to indicate on the paper itself specific sentences in the introduction that express the background, problem, and hypothesis (or findings).

In addition to describing the experimental strategy itself, students are asked to use their own words to explain the particular application of the strategy. Successful students will, for example, clearly explain all of the experimental variables employed, noting the meanings of axes labels on graphs or the differences between multiple panels in a figure. They will interpret the data, relying in part on authors' words in the text of the results section. They will describe controls used and, where appropriate, any alternative explanations for data that positive and negative controls excluded. Finally, I ask that students reflect on the importance of the experiment. They consider their experimental interpretation (question 6 in Fig. 1) and explain, in their own words, how it fits in the hypothesis or overall thrust of the paper that they described in their analysis of the "Introduction" (question 4 in Fig. 1).

Oral Presentation

During the semester, we discuss elements of an effective scientific presentation. Near the end of the semester, then, students deliver a ten-minute presentation about their topic protein and research that they have analyzed. Sticking to the theme of "focus," I require the students to present only a single piece of data from the three that they have analyzed. These presentations are judged, in part, on the clarity with which the scientific question, the experimental strategy, and the conclusions of this single piece of data are delivered.

Grading

The biggest difficulty of this assignment involves supplying students with effective feedback. In the latest iteration of the course, I was fortunate to have a relatively small class of 14 students. Even with such a small contingent, evaluating and responding to the written assignments was quite time-consuming. As the evaluator of student work, I am tasked with understanding each of the figures presented to a high degree of accuracy. As the topics were wide-ranging and outside of the course content, I needed to learn on the fly as I read the chosen papers and students' responses to them.

The evaluation itself is fairly simple when the introduction and the figure are read and understood. In my experience, the questions that I pose are clear, so it is relatively easy to determine the extent to which a student has clearly, accurately, and completely addressed them. Students are provided with the rubric that I use to assess the report (available in Supporting Information). This rubric clearly delineates the expectations for each of the eight assigned questions. In addition to assigning number grades, I provide significant positive comments and constructive criticisms to facilitate student learning. In several cases, in-person consultations with students before and after the assignments were completed were necessary to complete the educational experience.

Effectiveness of the Technique

Pushing students to analyze data through a focused assignment has had significant positive effects on students' growing abilities to read papers. Assessment of the assignment's effects on student learning thus far has been performed in two qualitative ways. First, I evaluated student performance on examinations. In two hourly tests during the semester, I give students real data, pulled from the recent primary literature. I then ask directed questions requiring students to describe the experiment that was performed and to interpret the data, using only the figure and its legend. These data relate intimately to topics covered in the course proper, but the students have most likely not yet encountered the figures that I choose. Consistent with a positive effect of the focused primary literature assignment, I have continually noticed an improvement on these data analysis questions as the semester proceeds.

A second method of assessment of the intervention's effectiveness was by analysis of end-of-semester confidential student evaluations. I employed a strictly free-form question to assess student opinion about the assignment. Strikingly, 100% of the students who were in class when evaluations were performed replied positively about the assignment. No students hinted that the assignment was not worthwhile. Thankfully, some students gave constructive criticism about the timing of the assignments or other

- Thanks to PLA I can read scientific papers! First one was difficult but then it makes more sense.
- I believe the primary literature assignments were very useful and insightful. It forced me to use a database to look for papers and very carefully read through papers. I felt at the end of the semester it was much easier to read papers.
- Very useful experience. My favorite part of the course. I would've liked to have done more and have that be a bigger portion of the grade.
- Helped me learn how to efficiently read and interpret scientific papers. No improvement necessary.
- Great experience. Tough to read scientific papers & be able to extract useful information.
- It was helpful to focus on one protein to get a more in-depth knowledge.

FIG 2 End-of-semester student comments about the focused assignment, Spring 2013. The prompt was: "Please comment on the 'primary literature assignment.' Was it a useful experience? How might it be improved?" Shown are verbatim responses from six of the twelve respondents. All responses were positive.

details, and some students discussed the difficulty of the assignments, but students were generally very enthusiastic about the nature of the project itself. Several representative responses from the most recent iteration of the course (Spring, 2013) are reproduced, verbatim, in Fig. 2.

Considerations

Instructors who may wish to employ this strategy should consider the burden of grading. As mentioned, effective responses to students require that the instructor reads and understands a significant portion of each student's chosen paper. For a class with 20 students performing three primary literature analyses, the instructor must understand 60 papers over the course of a semester. The benefit, of course, is that the instructor is exposed to a great variety of often intriguing research. To mitigate the downside of this issue, though, I have several suggestions. First, one might choose to have students perform fewer analyses. I have seen significant improvement over the course of three assignments, but it is likely that students would benefit even with fewer repetitions.

Second, an instructor might limit the variety of papers available to be analyzed. I feel that student choice of topic leads to ownership of the project and thus engagement, but alternatives can be implemented to afford a balance between student freedom and instructor preparation. For example, rather than letting students choose papers *carte blanche*, an instructor might assign a single, particularly well-suited, report to all students. Middle ground might be established if students select from a list of topic proteins (possibly related to the instructor's personal scholarship), and the instructor provides a database of appropriate papers from which to choose.

A third way to ask students to analyze data is for the instructor to provide a paper and to ask students directed questions about the data therein. An example of this activity in the analytical chemistry classroom has been described [3]. In my class, analyses similar to this are performed, typically with students reading an assigned paper and then analyzing data in a think-pair-share method during class time. The parallel use of the more open-ended strategy, though, affords significant student independence, resulting in a realistic feel and enhanced student ownership of the work. In short, I believe that directed analyses are useful and even essential at this stage in students' careers, but the general questions asked in this assignment (Fig. 1) represent an effective intervention to be used alongside other approaches.

Conclusions and Directions

Many novice scientists tend to rely on the words of authors of research reports and thus to avoid understanding and interpreting experiments for themselves. This tendency clearly hinders the ability of the reader to critically analyze data, and it may inhibit the incorporation of others' work in the reader's own ideas. The semester-long project outlined in this paper has encouraged undergraduate students in biochemistry to struggle with and analyze data as their scientific thought processes mature. As this project evolves, I plan to integrate its implementation with efforts to improve students' scientific writing ability [5] throughout our biochemistry curriculum, especially in the laboratory component of this course. I am also interested to see how alumni of this experience feel about it as they perform research in graduate school and other endeavors.

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