

# Making Research Papers Less Painful

**Pamela L. Connerly**

Biology Department, Indiana University Southeast, 4201 Grant Line Rd., New Albany IN 47150 USA  
([pconnerl@ius.edu](mailto:pconnerl@ius.edu))

Students come to biology courses with a wide range of writing experience and skill. Upper-level Cell Biology students complete a long, intensive literature research paper about an organelle or cellular structure of their choosing. Requiring multiple mini-assignments leading up to the final paper, with detailed feedback on each, has improved the general quality of papers. The mini-assignments, due every 2-3 weeks, include submitting the topic, a course contract regarding plagiarism, an outline, an annotated bibliography, and a draft of two sections of the paper. Details on the assignment and additional suggestions from mini-workshop participants are included in this short paper.  
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## Introduction

Writing is an essential skill that should be extensively developed by college students in all disciplines. One traditional writing assignment used in many fields is the term paper. I have always incorporated a long, literature-based research paper into my upper-level Cell Biology course. Students need to practice the research, organization, synthesis, writing, and citation methods required for such an assignment. This learning process is often painful for both the students doing the work and the instructor reading and grading the papers. As my course has evolved over time, so has my research paper assignment. The biggest change I have made is to require multiple specific mini-assignments leading up to the final paper that each count toward the final grade on the paper.

At Indiana University Southeast, BIOL-L312 Cell Biology is a lecture-only course with a prerequisite of a sophomore level Molecular Biology course. Many students take Cell Biology in their last semester; nearly all students are juniors or seniors. Although appropriately advanced students enroll in this course, their writing skills and familiarity with the scientific literature often vary widely. The research paper assignment supports two course learning goals: (1) Summarize the structure and function of typical components of a eukaryotic cell. (2) Write a clear and accurate detailed description of the structure, function, and some aspects of current research being conducted on one organelle of your choosing.

In its current form, the assignment requires a 7-10 page (2000+ word) paper about an organelle or cellular structure

of the student's choosing. Giving students freedom to choose their organelle topic serves to improve student interest and alleviate grading monotony. Papers must cite at least eight scientific sources, five of which must be primary articles. While students can focus their papers on aspects of their organelle of most interest to them, sections titled Introduction, Organelle Structure, Organelle Function, Current Research, Conclusions, and References Cited are required. The paper is worth 20% of the final course grade.

I have created multiple mini-assignments leading up to the full research paper including submitting the topic, a course contract regarding plagiarism, an outline, an annotated bibliography, and a draft of at least two sections of the paper. These mini-assignments are due approximately every 2-3 weeks leading up to the final paper submission deadline. Most students who take these mini-assignments seriously find them helpful in building up to their final paper. A recent revision of the paper assignment to be shorter in length seems to maintain the usefulness of assignment, while alleviating some of the anxiety for students and grading time for faculty.

In the *Student Outline* section, I have included the document I distributed to my Cell Biology students in the fall semester of 2014. Although no longer relevant, I have left the specific due dates in the assignment to show how detailed due date information for all parts of the assignment are included in this assignment document. In the Notes to the Instructor section, details on each mini-assignment follow some general advice aimed at aspects of the paper assignment that have proven difficult in the past.

## Student Outline

### Research Paper Assignment Cell Biology (Biol-L312) Fall 2014

In order to gain a deeper understanding of one aspect of cell biology, each student will write a seven to ten page research paper (double spaced; 2,000+ words total) on an organelle or other cellular structure. The paper should include specific, labeled sections covering Introduction, Organelle Structure, Organelle Function (relating function specifically to structure), Current Research on the Organelle, Conclusion, and References Cited. The current research section should describe at least one relevant primary articles published in or after 2004. Your paper should include at least 8 references, at least 5 of which must be primary research articles. The following mini-assignments must be turned in for full credit. *If any of the mini assignments are turned in after 9:30 am, I will assign penalties as described in the syllabus, and I will not accept any assignments after the due date has passed.* I am investing significant time and effort into giving comments both to help you improve your research/writing skills and to help you produce a better final paper that will earn a better grade. I may make comments through *Oncourse* or on paper as appropriate. My goal for returning comments on the mini-assignments is one week. I will comment on each mini-assignment, and I expect you to modify your subsequent work based on my comments. You will turn in your graded mini-assignments with your final paper. If comments made on your mini-assignments are not addressed/fixed in the final paper, your score on the mini-assignment will be changed to a zero.

1. Submit your topic and turn in the Course Contract by Tuesday, September 2<sup>nd</sup>.

Your topic should be either a cellular organelle or a discrete cellular structure for which you know you have access to adequate reference material to write a paper in the expected depth. All I need is the name of the organelle or structure you wish to study – the name should be turned in on paper by 9:30 am on 9/2/14. Additionally, the completed and signed Course Contract (including the results from the plagiarism tutorial quiz) must be turned in by 9:30 am on 9/2/14.

2. A detailed outline of your paper is due Thursday, September 11<sup>th</sup>.

The details can be more organizational than factual, depending on how familiar you are with your sources at this point. At least a single page of outline with several subheadings is likely to enable me to give you helpful comments. You should have completed some of your research to be sure there is enough information available for each aspect of your paper. The outline should be typed and turned in on paper by 9:30 am on 9/11/14.

3. An **annotated bibliography** summarizing the information found in at least 8 references (5 of which must be from the primary literature) is due **Tuesday, October 7<sup>th</sup>**.

An annotated bibliography includes the formal citation for your source (we will use CSE style) and a paragraph describing both the information in the source and how you plan to use it in your final paper. You should have 8 total citations with at least 5 being primary articles, and you should include annotations (descriptions) for at least 5 of your 8 sources. You need to clearly specify which sources are primary. The purpose of completing an annotated bibliography is three-fold. (1) To do a good job, you must actually have your references in hand and have read them, giving you more time to re-read them, seek out additional sources, and craft your paper. (2) You will write out the citation for each source in proper format - if you make a mistake I'll let you know now so you can fix it before the final draft. (3) Giving a 1 paragraph summary of each source (or at least the portion of the source relevant to your paper) should give you some practice at putting information into your own words, plus describing how you plan to use the source in your paper will help you further develop the paper's organization, building on your outline. To avoid plagiarism, your writing process should involve first reading the source, then putting it away before you attempt to write about it. You may need to make notes (in your own words) on each source to keep track of where different material came from. The annotated bibliography should be turned in electronically in the Assignments 2 tab of *Oncourse* by 9:30 am on 10/7/14. I will post comments in the Assignments 2 tab as well, so be sure to consult them to made adjustments to your final paper. The bibliography will automatically be submitted to Turnitin.com, which will return an originality report including a percentage of "unoriginal" text. For a bibliography, this percentage sometimes appears high because titles of articles are quoted directly. I will look at the specific matches identified by Turnitin.com, and so should you. If you submit early, you can review the Turnitin.com results and make changes before submitting a final version – I will not begin grading until the 9:30 am deadline has passed.

4. A good **draft of your Current Research section, one other section of your choosing and the relevant References Cited section** of your paper is due **Tuesday, October 28<sup>th</sup>**.

Your draft **MUST** include in-text citations to specific references and a list of References Cited in those sections. Remember the information we have covered regarding plagiarism. Scientific writing does not typically make use of quotations. We cite the ideas of other authors, but put those concepts into our own words. I am interested in your understanding, as expressed in your own words. The closer this draft is to your best work, the more I can help you improve and earn a higher grade on the final draft. The draft should be turned in electronically in the Assignments 2 tab of *Oncourse* and on paper by 9:30 am on

10/28/14. The draft will automatically be submitted to Turnitin.com, which will return an originality report. Again, you are welcome to submit early, check the report, and resubmit before the deadline. I plan on a 1 week turnaround time for comments on drafts. Please let me know when you consider your draft submission complete – I will grade early drafts (from 10/23/14 until the due date) early and get comments back based on when drafts were submitted. If you want to turn in your paper early, consider an early draft as well!

5. The **final paper** is due anytime between **Thursday, November 6<sup>th</sup> and Thursday, November 13<sup>th</sup> at 9:30 am**. The final paper should be submitted electronically in the Assignments 2 tab of *Oncourse* by 9:30 am on 11/13/14 at the latest. An identical paper copy must also be turned in to me in class by the same time. I am offering a week-long window of time in which to turn in your paper so that my grading load will be spread out a little bit. I will grade papers as they are turned in and will return them as they are graded. Many people find having their grade returned earlier helps in their preparation and planning for the final exam. If you wish to turn in your paper on a non-class day, please either place your printed copy outside or under my door or bring it to our next class meeting. I will mark the date turned in as the date it was submitted to *Oncourse*.

### Grading Criteria

**NOTE: Plagiarism in your final paper will result in a grade of zero on this assignment AND the reporting of the incident of academic misconduct to the campus administration.** Remember that taking a sentence from a source, changing a few words and putting it into your paper is a form of plagiarism, even if you cite the source. All words you use should be your own. If you cannot CLOSE THE SOURCE and restate the information, you do not understand the information and you need to do more research and/or come and ask questions to help your understanding. Additionally, using information from a source and not citing where that information came from is also plagiarism. The citation for information should come at the end of **each sentence** that includes information from any source. Ideally, your paragraphs will include citations from multiple sources as you take the information you have learned and synthesize it as you develop your own understanding.

#### *Preparation – 35 points*

Timely submission and quality of work on each of the required mini-assignments (topic, outline, annotated bibliography, and draft) will determine this portion of your grade.

#### *Content of the Paper – 70 points*

Your paper should include sections on each of the following topics:

Introduction

Structure of the Organelle

Function(s) of the Organelle, linking the function(s) of the organelle to the described structure

Current Research on the Organelle, with at least one example of current (2004 to present) research about the organelle

Conclusion

Information presented should be accurate, complete, sufficiently detailed, and relevant.

#### *Organization - 10 points*

Information included in the paper should be well-organized so that your reader can follow the information. The details about the organelle come together in a logical way.

#### *Use of References - 25 points*

Information should be cited correctly in the text and in a References Cited section. References should be appropriate in depth and scope (a small number of webpages can be used, but may not count toward total sources). At least the minimum numbers of primary and total references should be used. All references cited in the text must appear in the References Cited list. All references listed in the References Cited list must actually be cited within the text.

#### *Writing Quality - 10 points*

Grammar matters. Please proofread thoroughly for spelling and grammatical errors. Sentence fragments and other examples of poor grammar are not acceptable.

Use the following grade sheet (Table 1) as you write, edit, and proofread your paper to guide your efforts. I will use this form as I read and score your work, so it is in your interest to be sure you have met all of the described criteria to the best of your ability.

**Table 1.** Biol-L312 cell biology organelle research paper grading criteria.

	Comments	Score
Topic (5pts) – submitted on time, appropriate		
Outline (5) – submitted on time, sufficiently detailed		
Annotated Bibliography (10 pts) – submitted on time, sufficient citation info included for 8 sources, summaries included for 5		
Draft (15 pts) – submitted on time with 2 complete sections and references		
Introduction (7.5 pts) – topic is introduced – may include importance of organelle, rationale for study, description of flow of paper		
Description of organelle structure (15 pts) – accurate, complete, detailed, relevant		
Organelle function and relation between structure and function (20 pts) –accurate, complete, detailed, relevant		
One specific examples of current research (20 pts) – article is specifically cited, methods, results and implications of the paper are described and integrated into the discussion of the organelle, info is accurate, complete, detailed, relevant		
Conclusion (7.5 pts) – information in the paper is summarized and overall conclusion is drawn		
Organization (10 pts) – easy to follow and logical, proper length (2000+ words, ~7-10 pages)		
Reference citation (12 pts) – correct citation formatting both in-text and final listing, proper usage of in-text formatting		
Reference quality (13 pts) – appropriate in depth, scope and number – at least 5 primary and 8 total		
Writing quality (10 pts)– free of errors and poor grammar		
Total (150 pts)		

## Notes for the Instructor

### General Advice

#### *Give Students Guidance Early and Often*

Every deadline and mini-assignment is detailed in the research paper assignment that is distributed during the first week of class. Students are expected to consult the assignment for each mini-assignment and for the final paper. A complete list of grading criteria for the paper is included in the assignment description. One to two weeks before a mini-assignment is due, I use class time to discuss details about expectations for the specific assignment, highlighting aspects that are often problematic.

#### *Be Vigilant about Plagiarism*

All students are required to visit a Cornell University website describing proper citation practice (<http://plagiarism.arts.cornell.edu/tutorial/exercises.cfm>) and complete an online quiz at that website with detailed scenarios about various citation situations. They turn in a copy of their quiz score and a course contract, which they sign, stating that they understand what plagiarism is, have taken the quiz, and understand the consequences of plagiarism. Indiana University Southeast utilizes Turnitin.com to create originality reports about submitted student writing. I allow students to submit their work multiple times to use the reports as a learning tool about plagiarism. Yet, issues with plagiarism crop up every semester. Requiring multiple mini-assignments to be submitted in Turnitin.com has helped move plagiarism conversations and interventions into the formative portion of the paper writing work, reducing the likelihood of plagiarism in the final paper and the resulting academic misconduct consequences to the course grade, student record, and faculty workload.

#### *Emphasize the Differences Between Primary and Secondary Scientific Literature*

Although students engage in the scientific literature in multiple prerequisite courses for Cell Biology, a noticeable percentage of students in the course demonstrate an inability to distinguish primary from secondary scientific articles. Again, the mini-assignments help to address this misunderstanding so students can correct their errors before the final paper.

#### *Utilize Rubrics and Grading Criteria for Consistency*

Grading student writing is much more subjective than many forms of assessment common to biology courses. Consistency in grading is very important, and something that I spent probably too much time on during my first few rounds of grading research papers. I find that the more I specifically develop grading criteria and grading rubrics, the faster and more consistent my grading becomes, allowing time for more detailed and useful comments on student work. I continually tweak grading criteria and rubrics for the mini-

assignments, so I have not included them here. I am happy to share with you the latest versions of my grading tools if you contact me directly.

#### *Require Adjustments Based on Instructor Comments*

I often scan graded student work before returning it. On several occasions, I have felt déjà vu while writing a particular comment in response to a specific error in a paper and consulted earlier graded mini-assignments from that student to discover that I had indeed made that same comment before. This issue is one I am currently addressing with a policy to reduce any mini-assignment grade to zero if changes are not made in future mini-assignments or the final paper that address specific instructor comments.

### Mini-assignments

#### *Title*

Requiring the title very early in the semester emphasizes to students that this truly is a semester-long project. Sometimes students cluster in the topics they choose, but if I caution against those popular topics (typically mitochondria and ribosomes) and challenge the students to choose the less common option if they have multiple interests, I get a better variety of topics. A mini-workshop attendee suggested using a sign-up sheet with a specific number of spots available under each topic, which would be an effective way to guarantee variety. I also use this first mini-assignment to emphasize the importance of timely submission of work. Putting the paper on my desk 1 minute after class starts results in a grade penalty. A late penalty on this very small point value assignment will not hurt a final grade, but helps to make the expectation clear.

#### *Course Contract*

The course contract and plagiarism training using a Cornell University website are described above in the “Be vigilant about plagiarism” section. Requiring the course contract guarantees a discussion about plagiarism at the very beginning of the paper writing process. It also levels the playing field. No one can say they did not know what plagiarism was, because they have signed a form documenting their training and understanding. To be clear, students still struggle with plagiarism, but I am certain they have had at least one exposure to a reliable and detailed description of plagiarism.

#### *Outline*

Outlines with a wide range of format and detail can all be useful for students. The goal of this mini-assignment is to get students to work on the paper early, to think about the structure of the paper, and to start determining how to focus their research. Students are sometimes unclear on the concept of an outline. It is not unusual for one or two students per semester to simply turn in full paragraphs. I use individual comments on outlines to help point out common errors and suggest structural rearrangements.

### *Annotated Bibliography*

Few students have completed an annotated bibliography for a class before completing this assignment. The annotated bibliography assignment was inspired by the annotations in *Current Opinion* journals. It is a very useful way to require that students have read some of their sources at an early point in the term. For an annotation, I expect students to write about a paragraph detailing what information is in the source and how they plan to use the source in their final paper. The assignment thus links together the ideas of gathering specifics about their organelle and remembering the overall structure of the paper. Students must explicitly indicate which of their sources are primary on their bibliographies, allowing relatively early intervention for students who have not completely understood the distinction.

### *Draft of Two Sections*

The draft is the mini-assignment which I have altered the most over time. At previous times I have required a full draft, made submission of a draft optional, and required a draft of any two sections desired. Currently, I require a draft of the *Current Research* section and one other section of the student's choosing, plus the *Literature Cited* section. In the *Current Research* section, I require detailed information about some methods, results, and conclusions for at least one of the primary sources. Many students struggle with what level of detail to use for this section and how to write about a specific research article in their own words. Requiring this particular section has allowed for intervention for struggling students before the final due date. Requiring another section forces students to have more of the paper done at this point, but gives them some choice in where to focus their efforts.

### *Considerations from Mini-Workshop Discussion*

A large part of my mini-workshop presentation at ABLE 2014 was devoted to discussion with attendees about their techniques, reflections, and suggestions for making in-depth scientific literature research and culminating writing assignments a positive tool for learning biology. One specific suggestion was the use of a book on scientific writing (such as *A Short Guide to Writing about Biology* by Jan Pechenik) in all biology courses, giving consistency to writing expectations in the department. Another important point regarding the enhancement of writing in biology courses in general is the fact that our students will be pre-judged based on their writing abilities. Students with well-written job, scholarship, and school application materials will have a huge advantage; helping students develop their writing will ultimately contribute to their success, which reflects back on us in increasingly data-driven forms. Many instructors utilize a variety of excellent writing assignments and have much useful advice for improving student learning and scientific writing skills. I hope this short paper built from of my ABLE mini-workshop contributes to ongoing discussions that improve both student writing in biology and the process of teaching students the skills they need to be successful scientists who communicate effectively.

## **Acknowledgements**

I would like thank the many students who have written organelle papers in my Cell Biology class. Working with them and seeing their progress is inspirational. I also thank the attendees at my mini-workshop at ABLE 2014 at the University of Oregon for their lively discussion and engaging ideas, only a few of which I was able to incorporate here.

## **Literature Cited**

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## **About the Author**

Pamela L. Connerly is an Associate Professor of Biology at Indiana University Southeast, where she teaches Cell Biology, Molecular Biology, Biology Seminar, and Introduction to Biological Sciences. She works with many talented undergraduate researchers to find and characterize novel bacteriophages that infect the bacterial host *Caulobacter crescentus* and related species.

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### Citing This Article

Connerly, P. L. 2015. Making Research Papers Less Painful. Article 28 in *Tested Studies for Laboratory Teaching*, Volume 36 (K. McMahon, Editor). Proceedings of the 36th Conference of the Association for Biology Laboratory Education (ABLE). <http://www.ableweb.org/volumes/vol-36/?art=28>

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