The Scholarly Paper

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The Scholarly Paper is the final piece of scholarship demanded of the MLFSC candidate. The Scholarly Paper is usually a review of the research literature devoted to an area of current scientific interest. This work demonstrates the candidate’s ability to define a specific scientific problem or area of interest, accurately and concisely summarize and explain the state of current research on the subject, and indicate directions for future investigations. The subject of this work is current, relevant, and significant. The final document is brief, concise, and superbly written.

Constructing this document need not be a daunting task. This brief summary is a guide to selecting an appropriate topic, locating and evaluating the current research literature, and writing and preparing the final document for submission. In addition, it contains a strategy for completing the actual writing phase of this process.

This project should be viewed by the candidates as an opportunity to explore and develop an area of interest and to demonstrate their abilities as scientists and science teachers. Every degree recipient will view the final product of this effort with pride and a sense of accomplishment. It will also bring closure to the academic journey to the MLFSC degree.

Selecting a Suitable Topic

First, find a topic of interest. Second, focus on a small but significant aspect of the research area, preferably by formulating a question you can address from the research literature. A third suggestion relating to this early stage of the process is also important: contact the MLFSC Associate Program Director, Dr. Bretton Kent at bkent@umd.edu and request a faculty adviser for the project. Then contact the adviser via email and discuss your topic as it develops. Utilize this resource! Make this contact early, certainly no later than the first week of the term in which you intend to submit the paper! A good faculty adviser brought on board in the early formulation stages of the project will save you countless hours of labor.

You may select literally ANY area of interest from the current reviewed scientific literature as the topic for the Scholarly Paper. You should spend some time thinking about your specific interests within your broad academic discipline. In the early stages of this process, do not restrict yourself to areas you have already accumulated background information or covered in detail in a course. The key to identifying a suitable topic: be sure you are interested in it and would like to learn more about the research behind the story.

Begin your search for information in textbooks and review articles. This will give you the general knowledge and understanding that will be required when you delve into the research literature. The bibliographic section at the back of a textbook chapter will also reference a few seminal papers in the chosen area. Locate and read these original research papers and the more general review papers. These readings do not represent the most recent
work in the field, but do give you place to begin. You can now focus your interests and more clearly and more narrowly define and delineate the subject of your paper.

Narrowing the scope of the topic occurs only after you have perused much of the literature. The major initiatives in the field should be clear to you. You can then focus on a well defined research question. For example, deciding to write on the general topic of active transport mechanisms in the mammalian intestine would be overwhelming. A dense, thick volume does not contain sufficient space for the required verbiage! Rather you should think about the transport of a specific solute in this organ or about the abnormalities of the transport of a solute as a causative component of a disease. Perhaps you can formulate a specific question relating to the topic, \textit{i.e.,} “What is the ion transport mechanism that is implicated in cholera?”

While some MLFSC candidates begin with a topic that is too broad, others focus on a topic that is too specific and not appropriate for a degree supervised by Maryland’s faculty. This can occur in any area, but is particularly true of teachers that focus on a very narrow aspect of disease in humans. As a research university, Maryland’s Life Sciences departments have a broad range of research faculty. However Life Sciences does not include a medical school faculty and therefore has a limited capacity to sponsor and review papers related to human health. In the example of cholera presented in the preceding paragraph, an appropriately focused final paper would describe and discuss the research literature surrounding chloride ion transport mechanisms, and would then extend the discussion to include the disease.

\textbf{Using the Research Literature}

The bulk of the information contained in your Scholarly Paper will be taken from the original research literature, \textit{i.e.} scientific research journals, museum publications, research reports in books, conference papers, etc.. These research articles constitute primary sources. Secondary sources include review articles, textbooks, and popular magazines. They provide some background summary information and interpretation by other investigators. However the original research reports provide the core information for your scholarly paper.

Thanks to the services provided by the UM Library via the Internet, searching the literature is relatively easy. As an MLFSC student, you have access to several search engines and research literature. Simply go to the Library Resources page within the On Line Studies SPOC site at: \url{http://www.onlinestudies.umd.edu/library.html}

The Research Port, Interlibrary Loan, and other listed services enable you to identify and obtain most of the research articles you will need. Students living within reach of a research oriented university or institution usually can gain access to the institution’s library and its services by providing proof of registration in this graduate degree program.

Searching the literature requires a reliable search engine and important key words. NIH’s Medline, the Web of Science, Agricola, and other sites hosted by organizations sponsoring or publishing work in your area of interest make this task relatively easy. Employing the right key words in your search is important. No, make that critical! You must think about key words appearing the title of research papers, so do not be too restrictive or too
general. Include the terms that would be impossible to omit from a title of a paper on your subject. Then expand the search and do it a second time.

In your primary sources, you will find other relevant primary sources listed as references. If you aren’t selective and do not make summary notes of your findings, you could end up reading for several months. Make notes about the key points of every article you read as you read them. If you do not do this, you will continue to copy papers and eventually find yourself buried in articles with no idea of how many are relevant or important.

Employ a specific strategy or procedure when taking notes. For each article, you must first enter the complete reference citation. Next you can take down important details. Finally, include a brief summary that indicates the main ideas and relevance of the paper. Without this summary, you will have difficulty assembling your notes during the writing process.

Determining if a source is creditable can be difficult. Be sure the journal or web site is sponsored by a reputable scientific organization, publishes material only after it has met the standards of peer review, and is current. If you are in doubt, contact your faculty mentor. If the Journal is available through the UM on-line library it should be considered reliable. Journal selection is done in conjunction with faculty experts.

Your secondary sources give you the background information to introduce and develop your research question in the early pages of your paper. The primary sources provide the up to date information that addresses the details of your question.

Writing Style

The Scholarly Paper tells a story, a story laden with details, concepts, and terminology. A well written review paper presents the relevant details in a clear, concise, organized fashion. Producing such a document is not that difficult if the novice author understands a few important stylistic rules that apply to science writing and has a strategy for editing the various drafts.

Step one in this process is to acquire one or more important resources. Find and read one or both of the following books:

Strunk, W and White EB (any edition!) The Elements of Style MacMillan Publishing Company, N.Y.

Safire, W 2005 How Not To Write W. W. Norton Co., Inc. N.Y.

Either one of these very brief texts are read in a few hours but are worthy of a lifetime of study. Every student should own these two little volumes and read them at least twice a year. My students and I typically struggle through five or more drafts before producing an acceptable Scholarly paper. I spend most of my editorial effort correcting style and grammar. Proper use of one or both of these two books would save everyone involved a lot of time.

With apologies to the Strunk, White, and Safire, I highlight and summarize just a few of the most often violated critical rules governing style:
• Use the active voice.
• Omit needless words.
• Put statements in the positive form.
• In a paragraph, put your Cadillacs in the front row.
• In a sentence, put the emphatic words at the end.
• In this document, use a formal writing style.

Of course the other chapters on punctuation, rules of usage, and style are very useful for authors who have not recently produced a scientific document. Failure to review the topics covered in these books doom the author to many hours of fruitless labor and far too many draft versions.

Most writers have difficulty editing their own work. After laboring over the presentation of the details, authors are too close to the work and cannot apply a subjective eye to the style and meaning. Thus I suggest two more strategies that my students find helpful. First, always edit a printed version of the document. Most folks cannot edit on screen text. Second, after completing a paragraph or a section of the paper, go back and underline the subject and verb of each sentence. Examine each verb to be sure it:

• Is in the correct tense;
• Agrees with the number of the subject;
• Is in the active voice;
• Is concrete and definite.
• Is appropriate for the subject.

Finally go through the document and remove each and every example of the following wordy, weak, empty words and phrases:

• in terms of
• the ability to
• based on
• studies show that/so and so has shown that/suggested that
• data indicate that
• by means of
• are able to
• function by
• it is believed that/believe that
• appear to be
• underlie
• is thought to be
• interacts with
• associated with
• is involved with
• what happened was...
• is known to
• the fact that
• much like
• it helps to
For example, instead of writing, “Studies show that…”, simply state the fact and place the reference and date at the end in parentheses. Many Scholarly papers include a string of sentences that begins, ”Schmedlap et al. (2006) have shown that…." Forget advertising Schmedlap and his group; just state the fact and put Schmedlap where he belongs, at the end of the sentence in parentheses. Also notice the number of weak, meaningless verbs in the list above. Remove them and use concrete verbs that accurately describe the action of the subject!

My discussion of inappropriate terminology is incomplete without a comment on inappropriate adjectives. One must avoid most judgmental, subjective adjectives when describing scientific results. “amazing”, brilliant”, and other such terms are clearly inappropriate when applied to a result or hypothesis in this context. Weed them out of your paper.

Finally examine the style utilized by the authors of some of your referenced review articles. The ones that are clear and informative will adhere to the above suggestions and rules.

Technical Requirements

The MLFSC Program does not place minimum or maximum page limits on the Scholarly Paper. The document should only be as long it has to be to effectively relate and document the story. Most well done papers are 15 to 20 double spaced pages plus references and figures. Always use traditional fonts (e.g., Times, Times New Roman, Arial, or similar fonts) printed in 12 point size. The final document is submitted in either Microsoft Word or pdf format.

There are two major sources of technical guidelines governing the format of the final document. The Council of Science Editors (CSE) provides the correct format for citing references cited in the text and listing them in the list of cited references. (Alternatively, your faculty mentor may prefer you adhere to the citation guidelines utilized by the Proceedings of the National Academy of Sciences, or PNAS. In PNAS, the author sequentially numbers the references in order of appearance in the text and then lists them in the References Cited section in numerical order. Authors of Scholarly Papers for MLFSC degrees must include full titles in each listed reference.) The University of Maryland Thesis and Dissertation Style Guide describe the desired format, fonts, and layout of the final document: (http://www.gradschool.umd.edu/publications/).

Before you begin writing, please consult this resource to obtain information about acceptable margins, pagination, and other related details.

The CSE guidelines for citing authors and references can be ordered directly from the publishers (http://www.councilscienceeditors.org/publications/style.cfm) or are conveniently summarized at:

http://www.bedfordstmartins.com/online/cite8.html

PNAS guidelines for citations may be found at:

http://www.pnas.org/misc/iforc.shtml#prep
Within the body of the text, include a citation each and every time you utilize information that came from a published source. Briefly, references cited in the text should have one of the following CSE formats:
(Schmedlap 2006)
(Schmedlap et al. 2006)
(Shmedlap and Higgins 2006)
Schmedlap (2006)

The References section of your paper is an alphabetical listing (by the last name of the first author) of the sources from which you gathered the background information. A listing of a cited paper from the Journal of Irreproducible Results in the References section at the end of the paper would appear as:


Please examine the complete list from one of the sources listed above and at the end of the document to obtain the correct format for various types of sources. References listed in the References section must include every author (up to the first 10!) and complete titles. CSE also lists acceptable journal title abbreviations.

Graphs and figures may be included when necessary. If the pathway, process, or idea is best illustrated by a visual representation or the figure allows the author to save words, then the graph, table, or image may be included. Each graph or figure should be placed on a separate, numbered page. The page is placed in the correct position in the document to avoid needless turning of pages.

Each Figure or Table is labeled with a title, has labeled and scaled axes, and is accompanied by an explanatory figure legend. Correctly constructed tables and figures are able to stand alone. A reader should be able to correctly interpret the information contained in a Table or Figure by looking at only that page. A sample figure is presented as Fig 1. In the text, figures are numbered consecutively, e.g., Fig 4. Tables are also labeled consecutively using Roman numerals, e.g., Table IV.

The Writing Process

Every student is initially overwhelmed by the prospect of generating the Scholarly Paper. So many details, style issues, and pages! How does one get started? I have a few simple suggestions for minimizing the time and effort required to produce your paper.

First, recognize that once you begin putting ideas into the computer, you are trapped. Many authors think that if they just get something down, they can edit and organize the document later. In my opinion and experience, this is a major error. Once you, “get it down”, you will find it nearly impossible to recognize problems with organization and style. Often you cannot hit the Delete key, remove a poorly constructed and disorganized section and begin anew.
Instead of just beginning to write, try another approach, *i.e.*, the Higgins Wall Method of Writing. Take a number of weeks to think about the story. Each time you find an important idea in a reference, jot it down on a sticky note or 3” x 5” note card. Do not worry about the wording, just be sure the idea is clear and you know which reference from which it was taken. Early in this process, find a vacant wall in your office or home. Now place these notes on the wall in some order that makes sense to you at the time. Repeat this process for short periods of time over the course of a few weeks until all the ideas are on your wall in the order of your story. When you have finished the note making and the story is complete, you have your outline and the details on the wall in front of you.

The strength of this method lies in one simple idea: separate the research and generation of the ideas from the writing process. You cannot write well while you are concerned with the scientific details. Generate the details and story first, then do the “word-smithing”.

Only two things now remain: writing the Abstract and the title. The Abstract is a 3 to 6 sentence summary of the content and major point of your review article. Since it is the first thing read by an interested reader, it must be perfect in both style and content. Clear and concise it tells the reader what to expect and incites his interest. The Abstract appears on a separate, unnumbered page before the body of the text.

On the top of the Abstract page and on the Title page of the document, you must include a title. The title should be brief but instructive. Do not write, “The Effects of Slides Presented in lecture on Student Apathy.” Rather write, “Increased Slides Shown in Lecture Increase Student Apathy.” Examine the UM Graduate School web site for the format for a title page. Add it to the front of the document and your first draft is finished.

Now that you have completed the first draft and edited it as described above, it is time to call upon a few friends. Ask them to read the document for clarity, style, completeness, and organization. Only after these folks return their comments to you, do you then send off the first draft to your faculty mentor.

**Plagiarism**

The University of Maryland has maintained a zero tolerance policy on plagiarism and does not accept ignorance of the appropriate ethical standards as a legitimate excuse. Every student is expected to understand the proper procedures for acknowledging and citing the work of others. Please refer to the following web sites and examine the regulations regarding citing the work of others and the definitions and types of plagiarism:

http://www.lib.umd.edu/UES/plag_stud_what.html

www.ac.wwu.edu/~soc/plagiarism.PDF

Inclusion of extensive passages enclosed by quotation marks is not appropriate for the Scholarly Paper. Although technically this may not constitute plagiarism, it fails to satisfy a major requirement of this component of the degree program, *i.e.*, to assemble, organize,
synthesize, and present a concise synopsis of current information contained in the research literature. One does not find excerpts from other authors in a scientific review.

Paraphrase and summarize. When is doubt, cite.

**Selected References**


Pechenik, JA 2001 *A Short Guide to Writing About Biology* Addison Wesley Longman, N.Y.


Safire, W. 2005 *How Not To Write* W. W. Norton Co., Inc. N.Y.

Figure 1. A representative figure as it should appear in a Scholarly Paper.

Fig 1. Apathy levels of students increases as a function of the slides projected per lecture. Test subjects were observed over the course of 3 weeks in Dr. Higgins’s Mammalian Physiology lecture (BSCI 440) and the number of nods/off per student were recorded. Results = mean ± S.D.; N = 180)
A table as it should appear in an MLSFC Scholarly Paper.

**Table I.** Student apathy as a function of seating position in the classroom.

<table>
<thead>
<tr>
<th>Student Location (Row #)</th>
<th>Male Apathy (nod offs/hour)</th>
<th>Female Apathy (nod offs/hour)</th>
<th>Total Apathy (nod offs/hour)</th>
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<tr>
<td>1</td>
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<td>1</td>
<td>3</td>
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<tr>
<td>2</td>
<td>4</td>
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<td>8</td>
<td>61</td>
<td>33</td>
<td>94</td>
</tr>
</tbody>
</table>

The students in BSCI 440 (Mammalian Physiology) seated in the 8 rows of chairs in the classroom were observed for 60 minutes during three different lecture periods and the nod offs/hr recorded. Results expressed as the mean.