

Preparing a Research Section Manuscript

GENERAL GUIDELINES

Research articles typically report original, hypothesis-driven, scholarly research that addresses teaching and learning and other facets of science education. Articles that address social science or qualitative work are also welcome. Potential topics may include, but are not limited to, the following:

- Evidence-based learning activities and courses that have been rigorously evaluated through the systematic collection and analysis of assessment data
- Rigorous assessments of teaching delivery methods and/or approaches that enhance student learning in the sciences
- Scholarly work that describes how science students learn
- Student attitudes, motivations and other factors in STEM retention
- Validation of the outcomes of a particular strategy or program
- Student perceptions of value, self-efficacy, or understanding
- Evidence-based studies of program effectiveness or engagement in science education
- Assessment of learning activities, courses, and programs organized according to national standards and curriculum guidelines (e.g., recommended core curricula from ASM, HAPS, or APS for microbiology, anatomy, or physiology education, respectively, or concept inventories in biology, genetics, nature of science, and more)

Manuscript length: 1,500 to 4,000 words in length, including the abstract and excluding the references.

Manuscript Review Criteria. Reviewers are provided a rubric to guide their assessment of a manuscript (see below). Authors are highly encouraged to review the rubric prior to submission.

Editorial Style. For examples of ASM journals style conventions, review manuscripts in your intended section before submitting your manuscript. ASM copyeditors and the *JMBE* production staff reserve the privilege of editing manuscripts to conform to ASM stylistic conventions and these Author Guidelines. Authors who are unsure of proper English usage should have their manuscripts checked by someone proficient in the English language. Manuscripts may be editorially rejected, without review, on the basis of poor English or lack of conformity to the standards set forth in these Author Guidelines.

Copyediting. After final acceptance, a manuscript will be copyedited to conform to the editorial style of the ASM Style Manual for Journals (American Society for Microbiology, 2011, in-house document) and *How to Write and Publish a Scientific Paper*, 6th ed. (Greenwood Press, Westport, CT, 2006), as interpreted and modified by the editors and the *JMBE* production staff. It is the responsibility of the corresponding author to read the copyedited manuscript he or she will receive, and to answer all queries fully.

MANUSCRIPT COMPOSITION AND FORMATTING

File Format. The submission file should be in Microsoft Word.

Document Format. The text should be double-spaced; using a 10-point Times New Roman font or equivalent; employ italics, rather than underlining (except for URL addresses); include line numbers; and have figures and tables placed at the end of the text, rather than embedded within.

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Website Linking. All URL addresses in the text should be activated and ready to click.

Figures and Tables. Figures and tables are numbered and include a heading followed by a period. **Permissions are required to reproduce or modify figures and tables within the submitted manuscript and any associated supplemental materials.**

Images. All images are uploaded as Supplemental Files in JPG or GIF format with 300 dpi (color or grayscale). Monochrome images have been saved in grayscale mode; color images are in RGB. No BMP, RTF, or TIF images are permitted. Images should be at least 3 inches and no greater than 5 inches in the greatest dimension. **Permissions are required to reproduce or modify images within the submitted manuscript and any associated supplemental materials.**

Cover Pages. The following information should be included as part of the manuscript submission:

Title Page. Includes: information in the title that [increases discoverability](#) (see below); authors' names, highest academic/professional degree(s), and institutional affiliation(s); contact information for the corresponding author; source(s) of support for the work presented in the article; running head or foot line of approximately 40 characters; and number of figures, tables, and supplemental materials.

Conflict of Interest Notification Page. As outlined in the "General Guidelines" section, a Conflict of Interest Notification Page must immediately follow the manuscript's title page. To prevent ambiguity, authors must state explicitly whether potential conflicts do or do not exist.

Abstract and Keyword Page. Limit the abstract to 250 words or less and concisely summarize the basic content of the paper without presenting extensive details. Avoid abbreviations and references and do not include diagrams. When it is essential to include a reference, use the same format as for the References section but omit the article title. The abstract must be complete and understandable without reference to the text. In addition to the abstract, include 3 to 10 key words or short phrases that describe the manuscript contents.

MANUSCRIPT TITLE GUIDELINES

Creating a title that conveys the purpose of your work can be one of the most difficult parts of scientific writing. Before digital archiving, "eye-catching" titles were preferred because they could draw a reader to the abstract. In today's research environment, keywords in titles and abstracts are the most important indicator that a paper will be read. Remember: if it can't be found (and quickly!), it won't be utilized. Below are some guidelines and an activity to help you craft a title.

The *JMBE* Editorial Board recommends that you consider these questions as you develop a title for your submission:

- **What organism/research method/activity style/key concept is central to your paper?** Make sure this appears in your title.

- **What action is your manuscript calling for?** What do you want the reader to do after reading your manuscript (i.e. revise policy, use it in their classroom, etc.)? Make sure that similar action verbs are reflected in your title or abstract.

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- **What keywords would you use to search for your article?** Make a list of the top five keywords and then use them in a search. Are the papers that you find in a similar vein to yours? If yes, make sure to incorporate these keywords appropriately in your title.

- **Is your title ambiguous or misleading?** Ask someone who is not familiar with your paper to read just the title of your manuscript and have them tell you what they think it is about. If they misinterpret your title, have them clarify which words were confusing. Remember: someone searching for your paper may not have your expertise.

- **Don't get too carried away.** While you want your title to describe your paper accurately, it might not be attractive to today's reader if it is more than one line long. Remember that there is an abundance of resources available to today's reader, and if they don't find your title and understand the content quickly, they will not read it!

Now take the test!

Consider the following fictitious titles, which are based upon published submissions. Which one do you think would attract the most search hits? What makes the other titles ineffective?

Giving the Undergraduate Laboratory Meaning and Purpose
Exploding Cells and Dynamic Colors: Creating Engaging Laboratories in the Science Classroom
Laboratory Exercises that Promote Student Engagement and Learning about Osmosis

Answer:

While not particularly "original," the third title is the best in terms of keywords that will guide a reader to the manuscript. It states the topic of the laboratory, and indicates what the reader can gain from reading the manuscript (ways to engage and promote student learning).

Giving the Undergraduate Laboratory Meaning and Purpose
> Is this a discussion of HOW to give a lab meaning and purpose or WHY it is important? Both? What is covered in this laboratory? This is the vaguest title, and is likely to be passed over because it is not specific or clear enough to draw in a reader.

Exploding Cells and Dynamic Colors: Creating Engaging Laboratories in the Science Classroom
> While "eye-catching," it isn't clear whether this is a "how to" article or an overview of the author's experience. It also remains vague on what students actually learn in the laboratories.

MANUSCRIPT HEADINGS AND SUBHEADINGS

INTRODUCTION — This section provides the literature-based background or context of the research area, the significance of the problem, the purpose of the study couched in terms of the research question or objective, and the rationale for and statement of the research hypothesis.

METHODS — This section includes information pertinent to the selection and description of the participants; technical information regarding the operational methods, apparatus/instrumentation, and procedures so as to allow replication of the study; and sufficiently detailed statistical methods, inclusive of confidence interval and effect size calculations when possible to augment null hypothesis significance testing.

Safety issues. If the research study includes a laboratory component, address all safety issues using the [ASM Guidelines for Biosafety in Teaching Laboratories](#) as a reference. Safety concerns may include (but

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are not limited to): biosafety level of strains used; chemical considerations; UV; environmental unknowns; etc. If there are no safety issues, state why this is so.

RESULTS — This section provides quantitative results via descriptive and/or inferential statistics as well as qualitative results where appropriate. The results should adhere to a logical and coordinated sequencing of text, tables, and illustrations, with an effort to avoid unnecessary repetition in the narrative of the data displayed in tables and illustrations.

DISCUSSION — The discussion focuses on new and important features of the study as well as the justifiable conclusions that follow from them. Rather than repeating data or other information from the earlier introduction or results sections, this section succinctly summarizes the main findings of the study; exploring plausible explanations or mechanisms of the findings; comparing and contrasting the results with other pertinent studies acknowledged earlier in the report; stating the limitations and delimitations of the study; and exploring the implications of the study's findings for future research and biology education practice.

ACKNOWLEDGMENTS — The source of any financial support received for the work being published must be indicated in the acknowledgments section. It will be assumed that the absence of such an acknowledgment is a statement by the authors that no support was received.

REFERENCES —References should be listed in the order in which they appear in the manuscript (citation-sequence reference system). Arabic numerals in parentheses serve to identify references in text, tables, and legends. Please review the [ASM Style Guide for References](#), and refer to journal articles published in 2012 and beyond. *JMBE* strongly encourages authors to use professional literature citations from recognized genres of scholarly publications such as peer-reviewed journal articles and authored or edited books. The appeal to electronic encyclopedias and/or online knowledge-sharing tools should be made only in those circumstances where more generally recognized scholarly sources are unavailable and/or incompatible with the author's intent. When such is the case, these citations must be embedded parenthetically in the manuscript's narrative as opposed to being included as entries in the References section.

SUPPLEMENTAL MATERIALS (If applicable) — Include any necessary information that does not fit easily into the categories above as appendices. Supplemental materials should be uploaded as one Word doc file. Designate all materials as Appendix 1, Appendix 2, etc., within the manuscript text and list the appendices at the end of the manuscript as well. **Permissions are required to reproduce or modify images, figures (including maps), and tables within the supplemental materials.** A formatted and linked Table of Contents will be provided for supplemental materials once the manuscript and associated supplemental materials have been accepted for publication in *JMBE*.

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Research Section Review Criteria

Criteria	Acceptable as submitted; no change or simple corrections (1)	Needs modifications or improvements (2)	Fundamental revisions or additions required (3)
Worthwhileness			
Hypothesis	The hypothesis is clear, stating the problem.	The hypothesis is not clear.	Hypothesis is absent.
Impact	The study augments or deepens understanding of the field or takes field in new direction.	The study adds to or deepens the field of knowledge, but only mildly.	The study does not add to or deepen the field of knowledge.
Assessment	Appropriate assessment of learning outcomes is included.	Assessment is present, but inappropriate or wrongly interpreted.	Assessment is incomplete or poorly evaluated.
Coherence			
Research Methods & Techniques	The research methods and techniques appropriately evaluate the research hypothesis.	The research methods and techniques weakly evaluate the research hypothesis.	The research methods and techniques employed to evaluate the research hypothesis are not appropriately matched.
Analysis Techniques	The analysis techniques employed are well matched to the research hypothesis.	The analysis techniques employed are somewhat matched to the research hypothesis.	The analysis techniques employed to evaluate and answer the hypothesis are not appropriately matched.
Competence			
Data Collection	The study was conducted by effective application of appropriate data collection, analysis, and interpretation techniques.	The study lacks clarity with regard to the process of data collection, analysis and interpretation and/or application of these methods.	Data collection, analysis and interpretation have not been conducted appropriately.
Following Research Guidelines	The researcher(s) followed existing guidelines (as defined within the relevant discipline) for conducting interviews, designing instruments, reducing data, selecting samples, etc.	Needs articulation with regard to whether the researcher(s) followed existing guidelines for conducting interviews, designing instruments, reducing data, selecting samples, etc.	Established guidelines for conducting interviews, designing instruments, reducing data, selecting samples, etc. were not followed.

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Openness	Acceptable as submitted (1)	Needs modifications (2)	Fundamental revisions required (3)
Biases & Assumptions	Conduct of study appears to be free of personal biases and assumptions or self-discloses any assumptions/biases that underlie the investigation.	Unclear about potential personal biases and assumptions or inadequately discloses any assumptions/biases that underlie the investigation.	Fails to address whether there are personal biases and assumptions or fails to disclose any assumptions/ biases that underlie the investigation.
Theoretical Basis & Research Methodology	Clearly identifies conceptual/ theoretical basis for the study and describes the research methods and techniques used in sufficient detail for public scrutiny (including how data were collected, analyzed and used to make interpretations).	Unclear as to conceptual/theoretical basis for the study and/or inadequately describes the research methods and techniques used in sufficient detail for public scrutiny (including how data were collected, analyzed and used to make interpretations).	Fails to identify conceptual/theoretical basis for the study and/or fails to describe the research methods and techniques used in sufficient detail for public scrutiny (including how data were collected, analyzed and used to make interpretations).
Ethics			
Use of Human Subjects	The manuscript demonstrates appropriate data collection and/or the use of human subjects, such as informed consent and confidentiality.	The manuscript inadequately demonstrates appropriate data collection and/or the use of human subjects, such as informed consent and confidentiality.	The manuscript fails to demonstrate appropriate data collection and/or the use of human subjects, such as informed consent and confidentiality.
Acknowledgement	The authors have completely and properly cited the work of others from the primary literature.	The authors incompletely or improperly cite the work of others from the primary literature.	The authors have failed to cite the work of others from the primary literature.
Credibility			
Credible Sources	The hypothesis is supported by credible sources.	The hypothesis is logical, but not easily supported by credible sources.	The hypothesis is not supported by credible sources.
Claims & Conclusions	Claims and conclusions are believable.	Claims and conclusions are exaggerated or understated.	Claims and conclusions are not believable or are misleading.
Arguments & Interpretations	Arguments and interpretations are able to be verified so as to support conclusions.	Arguments and interpretations cannot be substantiated or refuted.	Arguments and interpretations do not support conclusions.

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Organization & Other Qualities	Acceptable as submitted (1)	Needs modifications (2)	Fundamental revisions required (3)
Organization	The manuscript is clear, concise and well organized.	The manuscript is not clear or concise, but is well organized, OR the manuscript is concise, but not clear or well organized.	The manuscript is not clear, not concise and not well organized.

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