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Journal of Microbiology & Biology Education Author Guidelines

FOCUS AND SCOPE

The Journal of Microbiology & Biology Education (*JMBE*) is an online open access journal that publishes original peer reviewed articles. *JMBE* features diverse content ranging from scholarly research in biology education to curriculum content to readily adoptable classroom resources. *JMBE* welcomes submissions pertaining to scholarly teaching in undergraduate, graduate and professional (e.g., medical school), K-12, and informal education.

The scope of the journal is rooted in microbiology and its branches to other biological disciplines. *JMBE* covers articles addressing good pedagogy and design, student interest and motivation, recruitment and retention, citizen science, faculty development, and institutional transformation. *JMBE* editors provide extensive feedback, guidance, and support to authors from submission through publication.

JMBE is sponsored by the American Society for Microbiology (ASM; www.asm.org), the oldest and largest single life science membership organization in the world, and is indexed in PubMed Central, CrossRef, and DOAJ.

PUBLICATION FREQUENCY

JMBE operates under a continuous publication model, where manuscripts are made available online as soon as they become ready. When a manuscript appears online, it will be catalogued in one of three issues: Spring (April), Back to School (August), or Winter (December). These three issues make up the year's volume.

ETHICAL GUIDELINES

Scientific errors and incorrect interpretations inevitably occur in the published literature, but authors who knowingly commit fraud or other scientific misconduct seriously compromise the integrity of the scientific record and the success of future scientific research.

Authorship. Only individuals who contribute directly to the intellectual content of the paper should be listed as authors. For example, prospective author(s) have: (a) conceived and planned the work that led to the report; (b) written the paper, or reviewed successive versions and taken part in the revision process; and (c) approved the final version. Holding positions of administrative leadership and collecting and assembling data, are not, by themselves, criteria for authorship. Other persons who have made substantial, direct contributions to the work but cannot be considered authors should be acknowledged with their permission.

Previous or Duplicate Publication. Previous publication of a small fraction of the content of a paper does not necessarily preclude its being published, but members of the Editorial Board need information about previous publication when deciding how to use space in the journal efficiently; they regard failure of full disclosure by authors of possible prior publication as a breach of scientific ethics. Please send a copy

of any document that might be considered a previous publication via email to the Editor, or provide this document during the submission process as a supplementary file.

Preprint Policy. *JMBE* Editors will consider manuscripts for publication that have been posted in a recognized, not-for-profit preprint archive (such as bioRxiv), provided that upon acceptance of the manuscript for publication, the author is still able to agree to the terms of an Open Access license. It is the responsibility of authors to inform the journal at the time of submission if and where their article has been previously posted. If the manuscript is accepted for publication in *JMBE*, authors are required to update the preprint with a citation to the final published article that includes the DOI along with a link.

Conflict of Interest Notification. Conflict of interest exists when an author, reviewer, or editor has financial or personal relationships that could inappropriately bias or compromise his or her actions. Authors must (a) identify individuals who provide writing or other assistance and disclose the funding source for this assistance, (b) disclose potential conflicts to study participants (and should state in the manuscript that they have done so), and (c) describe the role of the study sponsor(s), if any, in the study design; the collection, analysis, and interpretation of the data; the writing of the report; and the decision to submit the report for publication. If the supporting source had no such involvement, the authors should so state.

Such perceived conflicts--or their absence in a study--must be disclosed by the author via the "Comments to the Editor" route when the manuscript is submitted. Additionally, either the presence or absence of perceived conflicts must be addressed in the acknowledgements section of the manuscript.

Project Funding. Sources of outside support for research must be named in the manuscript. The role(s) of the funding organization, if any, in the collection of data, its analysis and interpretation, and in the right to approve or disapprove publication of the finished manuscript must be described in the methods section of the text.

Informed Consent. The use of human subjects or other animals for research purposes is regulated by the federal government and individual institutions. Manuscripts containing information related to human or animal use should clearly state that the research has complied with all relevant federal guidelines and institutional policies.

Warranties and Exclusions. Articles published in this journal represent the opinions of the authors and do not necessarily represent the opinions of ASM. ASM does not warrant the fitness or suitability, for any purpose, of any methodology, kit, product, or device described or identified in an article. The use of trade names is for identification purposes only and does not constitute endorsement by ASM.

COPYRIGHT NOTICE

All individuals submitting materials for the *JMBE* must attest that they own the copyright and the materials are original; this includes text, figures, tables, artwork, abstracts, cover images, summaries, and supplemental materials included in the submission. Furthermore, corresponding authors must grant the ASM an irrevocable nonexclusive license to publish their work if it is accepted. Upon publication, the work becomes freely available on ASM's *JMBE* website and PubMed Central's Open Access subset for the public to copy, distribute, or display under a Creative Commons Attribution-Noncommercial-NoDerivatives 4.0 International license (License: https://creativecommons.org/licenses/by-nc-nd/4.0/; Legal Code: https://creativecommons.org/licenses/by-nc-nd/4.0/legalcode).

PEER REVIEW PROCESS

Peer Review. All manuscripts are considered to be confidential and are reviewed by the editors, members of the editorial board, or qualified ad hoc reviewers. When a manuscript is submitted, it is given

a number and sent to the editor. Always refer to this number in communications with the editor(s) and *JMBE* production staff. It is the responsibility of the corresponding author to inform the coauthors of the manuscript's status throughout the review and publication processes.

The reviewers operate under strict guidelines set forth in "Guidelines for Reviewers" and are expected to complete their reviews within two weeks after receiving the manuscript. The corresponding author is notified, about six weeks after submission, of the editor's decision to accept, reject, or require modification.

Any manuscript with a laboratory component will undergo review by *JMBE*'s Laboratory Safety Review Committee, prior to regular review. As a result, authors may be asked to make safety-related changes to their manuscript before it goes out for regular review. This review has been established to ensure that all laboratory practices comply with ASM's Guidelines for Biosafety in Teaching Laboratories and to mitigate any risk to the students, faculty, and institutions who may be adopting the activity.

Manuscript Disposition. Manuscripts may be rejected upon receipt by the Editor-in-Chief and/or Editor if they do not fit the scope of the journal or section. In this case, the manuscript will not enter the review process and the Author will be asked to review the Author Guidelines more thoroughly before resubmitting.

Once a manuscript is deemed appropriate for review, there are four possible outcomes:

Decline Submission

> This indicates that the paper is not appropriate for publication and the Author will not be requested to resubmit. The manuscript will exit the system, marked as "Archived."

Resubmit for Review

> This indicates that while the manuscript topic is engaging, there are major issues with structure, inadequate data or assessments, or another problem. The manuscript will exit the system, marked as "Archived," and the Author is requested to make extensive revisions based on Editor comments. The Author may submit a new manuscript when all reviewers' concerns have been addressed.

Revisions Required

> This indicates that the paper is acceptable, but minor revisions are necessary. The manuscript remains "Active" in the system. The author will upload a revised manuscript, along with a cover letter indicating the changes made. The revised manuscript will be reconsidered by the Editor and may be sent out for re-review, and a final decision will be made.

Accept Submission

> The manuscript matches the focus and scope of the journal and is accepted for publication. It will move forward in the production process.

Note: When preparing revised manuscripts, it is essential to carefully follow the instructions given in the Editor's letter (also see how to submit a revised manuscript to *JMBE*). In particular, provide an annotated copy of the manuscript as well as a cover letter that addresses, point-by-point, the concerns of the Reviewers. If a revision is not received within six months after requested, the file may be closed and archived.

JMBE SECTIONS

The journal features five sections:

- **Letters to the Editor** directly address articles published in this or other biology education journals.
- **Research** is for hypothesis-driven research in student learning. Documentation of sound assessment strategies that support research conclusions is required. Articles that address social science or qualitative work are also welcome.
- **Perspectives** place a particular, current topic of science education into perspective. Articles focus on a specific topic, problem, or approach of broad, general interest to science educators, but do not primarily discuss the author's own work.
- **Curriculum** includes field-tested activities that foster active learning and other best practices in education. Activities may be used in the classroom, laboratory, and/or field or online. Manuscripts in this category must include learning objectives and assessments that demonstrate students have met these objectives.
- **Tips & Tools** manuscripts promote practical tips, suggestions, classroom activities, and advice for improving biology education.

ONLINE SUBMISSION PROCEDURES

Author Tip. Review journal articles in the section to which you plan to submit and make sure your manuscript follows the style and formatting of those articles published in 2012 and beyond.

Create an Author Account. Before submitting a manuscript, create a user account and check the "Author" box in your user profile. Once this box is checked, select the "Submit a Manuscript" button to the right and follow the prompts for submission.

Submission Process. You can find additional guidance and step-by-step instructions for the submission process, as well as instructions for uploading revised manuscripts, in the "Online Submissions" section of the Author Guidelines page.

Step 1: Start Submission. Under "Journal Section," use the drop down menu to select the type of article you're submitting. Complete the submission checklist and use the optional "Comments to the Editor" section to report any previous or duplicate publication and/or conflict of interest (see Ethical Guidelines). Select Save/Continue to proceed to the next section.

Step 2: Submission Metadata. The first and last name, affiliation, and email address are required for each author. You may also add an optional biographical statement. Complete the title, abstract fields, and indicate funding sources if applicable.

Step 3: Submission Upload. Three steps are required to upload your manuscript: 1) Click Browse to open a Choose File window and locate the manuscript on your computer. 2) Click Open. 3) Click Upload, which uploads the file from your computer to *JMBE*'s website and renames it following the journal's system. View the file by clicking on the file name. If necessary, upload a new or revised file, deleting the current one.

Step 4: Save. After clicking Upload, the upload window clears; click Save/Continue to move to the next step.

Step 5: Supplemental Files. Supplemental files might include samples of student work, instructor versions for exercises, research instruments, data sets, information sources, etc. If the author(s) did not create all of the supplemental materials (including images), include permission for reuse from the original

source.

Step 6: Confirmation. Review the submission for completeness, then **click Finish Submission to confirm the upload.**

ONLINE SUBMISSION CHECKLIST

As part of the submission process, you must indicate your manuscript's compliance with all of the following items. Your submission may be returned to you if you don't adhere to these guidelines.

1. **ONLINE SELF-DIAGNOSIS TOOL:** Use this tool to understand the scope and level of assessment required by each section and determine if your manuscript is ready for submission. Diagnose Your Manuscript.
2. **GUIDELINES FOR MANUSCRIPT TITLES:** Use these guidelines to help increase your manuscript's discoverability online, thus leading to a wider audience and increased citations.
3. **JMBE HOW TO SERIES:** Watch this short video tutorial, which provides an overview of *JMBE* and its sections, a walk-through of the submission process, and tips for a successful submission. Steps for Submitting a Manuscript to the Journal.
4. **CONTENT ADHERES TO AUTHOR GUIDELINES:** Confirm that the text meets ***JMBE*'s** formatting requirements as outlined in the General Guidelines and applicable Section Guidelines.
5. **LABORATORY BIOSAFETY GUIDELINES:** Confirm that any laboratory procedures and/or practices outlined in the submission adhere to the ASM Guidelines for Biosafety in Teaching Laboratories. Also indicate in your manuscript how those procedures and/or practices adhere to the ASM Guidelines for Biosafety in Teaching Laboratories.
6. **PREVIOUS OR DUPLICATE PUBLICATION:** Confirm that your submission has not been previously published, nor is it before another journal for consideration; or provide an explanation in "Comments to the Editor."
7. **DOCUMENT FORMAT:** Confirm that the file is in Microsoft Word, text is double-spaced, uses a 10-point Times New Roman font or equivalent, employs italics rather than underlining (except for URL addresses), includes line numbers, and that figures and tables are placed at the end of the text, rather than embedded within.
8. **WEBSITE LINKING:** Confirm that all URL addresses in the text are activated and ready to click.
9. **FIGURES AND TABLES:** Confirm that figures and tables are numbered and include a heading followed by a period. **Permissions are required to reproduce or modify images, figures (including maps), and tables within the submitted manuscript and any associated supplemental materials**.
10. **IMAGES:** Confirm that 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 included. Images are at least 3 inches and no greater than 5 inches in the greatest dimension.
11. **SUPPLEMENTAL MATERIALS:** Confirm that supplemental materials are uploaded as **one Word doc file**. All materials are designated as Appendix 1, Appendix 2, etc., within the manuscript text and listed at the end of the manuscript as well. 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*.
12. **REFERENCES:** Confirm that references are listed in the order in which they are cited in the manuscript (citation-sequence reference system) and formatted according to ASM Style.
13. **INFORMED CONSENT:** Confirm that manuscripts containing information related to human or animal use clearly state that the research has complied with all relevant federal guidelines and institutional policies.
14. **AUTHOR FEES:** Indicate your awareness that JMBE charges author fees for the publication of manuscripts submitted on or after January 1, 2018. No payment is required at the time of submission. If your article is accepted, you will be expected to pay the author fee or apply for a waiver. For more information, see *JMBE*'s editorial policies and a letter from the Editor in Chief.

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.

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.

- **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 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*.

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.

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 discloses 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.

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.

JMBE ▪ 1752 N Street NW, Washington, DC 20036
(202) 942-9314 ▪ jmbe@asmusa.org
http://jmbesubmissions.asm.org

Preparing a Perspectives Section Manuscript

GENERAL GUIDELINES

Perspectives articles are aimed at placing into broader view a particular, current topic or problem of specific interest to science educators. Topics include, but are not limited to:

- Assessment methods
- Student engagement
- Curricular changes
- Faculty development
- K-20, graduate, and/or professional education
- Approaches to various educational challenges
- Current advances and future directions in science education

The manuscript should: (1) identify the education problem or challenge and present referenced data to substantiate the issue; (2) describe previous scholarly attempts to address the problem; (3) although not the impetus for the article, discuss how the author's study or work addresses the problem or challenge and helps resolve the issue; and (4) offer a viewpoint as to the next steps to be taken. With rare exceptions, Perspectives articles should have no more than two authors.

Manuscript length: 1,000 to 3,000 words, 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.

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.

- **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).

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> 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.

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> 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 — The introduction should provide an overview of the topic, the impetus for writing the perspective, and the intended audience.

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*.

Perspectives Section Review Criteria

Criteria	Acceptable as submitted; no change or simple corrections (1)	Needs modifications or improvements (2)	Fundamental revisions or additions required (3)
Interest	Manuscript clearly focuses on a current topic of universal/broad interest to microbiology/biology education community.	Manuscript lacks a clear focus or emphasizes a topic of little interest to the microbiology/biology education community.	Manuscript fails to address a topic of interest to the microbiology/biology education community.
Impact	Manuscript adds to and extensively deepens or expands our understanding of issues in microbiology/biology teaching and learning.	Manuscript largely reviews and reiterates commonly known information concerning microbiology/biology educators.	Little or no new information is presented, and the issues are not related to microbiology/biology teaching and learning.
Significance	Manuscript focuses on a rapidly emerging area of, or an issue of substantive importance to microbiology/biology educators.	Manuscript identifies or discusses an issue of importance to some microbiology/biology educators.	Manuscript discusses an issue of little significance to microbiology/biology educators.
Credibility	The viewpoint is substantiated with credible evidence.	Manuscript contains some gaps in substantiating the viewpoint.	Manuscript contains claims that are not verified, producing a very weak viewpoint.
Clarity & Organization	Manuscript is clear, well organized, and concise.	Manuscript needs clarification on certain points.	Manuscript is unclear, unorganized, and wordy.

Preparing a Curriculum Section Manuscript

GENERAL GUIDELINES

Curriculum articles describe innovative, field-tested activities that may be used in the classroom, laboratory, and/or field or online. The activities are ready for adoption by instructors teaching biology so detailed instructions for students and directions for instructor preparation and use are important components of all curriculum articles. To facilitate ready use of the activity all institution specific references (e.g., course numbers, facilities) should be absent. Curriculum articles also:

- List learning objectives
- Use high-impact pedagogical practices that engage students in thinking beyond knowledge and comprehension (e.g., about application, analysis, synthesis, and evaluation)
- Describe previous use of the activity in the classroom or laboratory
- Include examples of student data and/or outcomes expected from the activity
- Provide suggestions for determining student learning
- Provide adequate support materials (e.g., references to background information, student worksheets, answer keys, sources of materials, etc.)
- Present results of assessment of student achievement, demonstrating that the stated learning objectives have been met
- Suggest possible modifications and/or extensions

Manuscript length: 1,000 to 4,000 words in length, including the abstract and excluding the references. Word limit does not include supplemental materials (e.g., student instruction handouts, directions for preparation, and student learning assessment materials).

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 and to read several *JMBE* Curriculum articles 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.

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.

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MANUSCRIPT HEADINGS AND SUBHEADINGS

INTRODUCTION — The introduction should provide sufficient background information to allow the reader to evaluate the applicability of the curriculum activity to their needs. It should provide the rationale for design of the curriculum activity and enough information to allow the reader to evaluate the activity without referring to previous publications. It should also indicate whether the exercise is a classroom, laboratory, field, and/or online activity. In addition to this background information, introductions are expected to contain the following subsections: intended audience, learning time, prerequisite student knowledge, and learning objectives.

> ***Intended audience.*** Indicate the intended audience for the activity. For example: microbiology/biology majors, allied health majors, biotechnology majors, science education majors, or non-majors.

Learning time. Indicate the approximate class or lab time required and/or any follow-up in one or more subsequent periods. Also describe any time required outside of the regularly scheduled class or lab periods.

Prerequisite student knowledge. Indicate prerequisite knowledge and skills that students should have before completing this activity.

Learning objectives. Provide a list of clearly stated learning objectives. Learning objectives must describe student behaviors that are observable, measurable, and testable. They may start with the phrase "Upon completion of this activity, students will…." Accepted submissions will include assessment results that directly test these stated learning objectives.

PROCEDURE — The procedure section includes all information needed to allow instructors to repeat the activity with their classes. It includes the following subsections: materials, student instructions, faculty instructions, suggestions for determining student learning, sample data, and safety issues.

Materials. Provide a clear and complete list of materials, indicating whether they are readily available or need special ordering. Materials should be organized in terms of "items per student," "items per group," and "items per lab." Multi-unit activities should indicate the materials needed for each unit. Include recipes or references for all media and solutions. Materials may be provided as a supplemental file (please indicate this availability in the text of the main document).

Student instructions. Provide a clear and complete set of instructions for students to perform this activity. Most activities include handout-ready student instructions as a supplemental file (please indicate this availability in the text of the main document). Instructions should not contain information that would be relevant only to your class (e.g., class number, date, etc.).

Faculty instructions. Summarize the steps of the procedure for the faculty member's benefit and include any explanations that are needed to help the faculty make the activity work smoothly. Include all preparation steps and any special clean-up or follow through required. Include any hints, tricks, or pitfalls to avoid. Also appreciated are suggestions for acquiring hard-to-get materials or special items. Please try to include those things that you do automatically, which someone else may not know but will contribute to the success of the activity. These instructions will not be handed out to students. Please keep in mind that not all instructors have the same background as you - many *JMBE* readers are looking for activities outside their own area of expertise and rely on detailed faculty instructions to ensure the success of the activity. Faculty instructions may be provided as a supplemental file (please indicate this availability in the main text of the document).

Suggestions for determining student learning. Share the assessment methods that you have used to determine if students have achieved your stated learning objectives and the methods you use to assign grades. Examples include assignments and exam questions. Rubrics or grading keys should also be provided (please indicate this availability in the main text of the document if these items are included as supplemental files).

Sample data. Provide examples of student work and/or expected student outcomes to help provide faculty with a fuller sense of the range of outcomes for the activity. Possibilities include text submitted by students, data gathered, photographs or short movie clips, etc. Remove any identifying information. Sample data may be provided as a supplemental file (please indicate this availability in the main text of the document).

Safety issues. Address all safety issues faculty and students need to know when attempting this activity, using the ASM Guidelines for Biosafety in Teaching Laboratories as a reference. Safety concerns may include (but 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.

DISCUSSION — The discussion section should highlight the activity's effectiveness in achieving the stated learning objectives, and provide evidence of student learning. The discussion may elaborate on how the activity may be adapted to different course situations or different student audiences. The discussion should include the following subsections: field testing, evidence of student learning, and potential modifications.

Field testing. Please indicate course conditions in which you have used this activity (number of semesters, size of class, audience, etc.). If appropriate, include the results from any informal assessments or surveys of this activity as an indication of student and faculty responses to the activity.

Evidence of student learning. Tell us how you know that this exercise is effective. Provide results from assessments that demonstrate student learning across stated learning objectives. Appropriate examples of evidence include pre-/post-testing, normalized learning gains, and/or post activity assignments /questions with statistics of student performance toward different objectives. Perceived learning as measured by student attitude surveys, while effective in demonstrating student interest, are not appropriate as evidence of student learning.

Possible modifications **(optional).** Outline ways your activity can be modified or extended to broaden its appeal for faculty in other settings or facing alternate curriculum goals. For longer activities, elaborate on alternate timelines to adapt the activity to different course schedules.

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.

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Curriculum 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			
Impact	The activity is innovative and includes at least one high impact practice, e.g. peer collaboration, oral and/or written communication, problem solving, active learning, etc.	Activity includes some new methods and approaches and marginal active engagement of students.	Activity does not include any novel methods or approaches and students are not actively engaged.
Depth	The activity actively engages students in thinking beyond knowledge and comprehension such as application, critical thinking, synthesis, analysis, or evaluation.	The activity requires students to understand core concepts; it encourages students to apply skills to new situations.	The activity fosters basic understanding but does not involve applications of knowledge to new situations.
Outcomes	The learning objectives describe measurable behaviors and outcomes. The activity as conceived and presented is designed to support the learning outcomes.	The learning objectives as stated are difficult to measure. The activity as conceived and presented could include additional outcomes and/or does not support the stated learning outcomes.	Learning outcomes are absent or not measurable and not represented by the activity as it is conceived and presented.
Coherence			
Time Management & Student Prerequisites	Intended audience provided and not institution specific. Activity preparation times and student meeting times provided (number of minutes/hours or class periods). Prerequisites student knowledge provided.	Intended audience unclear or incomplete and/or institution specific. Activity preparation times and student meeting times are suggested but require clarification. Prerequisite student knowledge incomplete or requires clarification.	Intended audience not provided. Preparation times and student meeting times vague and/or unrealistic or not provided. Prerequisite student knowledge unrealistic or not provided.
Preparatory Support	Materials list is clear, complete, and well organized as amount required per student, per group, or per lab. Sources for materials are suggested and	Materials list is essentially complete, but lacks important details. Sources for some key items not suggested. Recipes and storage	Materials list is incomplete and/or items are expensive, difficult to obtain, or pose safety hazards. Sources for items not suggested and recipes

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	recipes and storage instructions are provided as necessary.	instructions vague or incomplete.	and storage instructions absent.
Safety Guidelines	Safety issues (microorganisms, toxicity, flammables, corrosives, combustibles, etc.) are identified and described.	Safety issues absent for some materials (microorganisms, toxicity, flammables, corrosives, combustibles, etc.).	Safety information absent or incorrect.
Competence	**Acceptable as submitted (1)**	**Needs modifications (2)**	**Fundamental revisions required (3)**
Student Procedures	Instructions are provided in the form of a student handout. Procedures are clear, complete, well organized, and presented at the appropriate level. Institution specific references absent.	Instructions and procedures are essentially complete, but may be unclear or need minor modifications. Instructions are not in the form of a student handout. Contains institution specific references.	Instructions and procedures are incomplete or unclear. Procedures are provided at an inappropriate level. Student handout is clearly needed but not included.
Instructor Procedures	Instructions are organized, succinct, and include explanations or clarifications that allow the activity work smoothly. Institution specific references absent.	Instructions and procedures are essentially complete, but may be unclear or need minor modifications. Contains institution specific references.	Instructions and procedures are incomplete or unclear. Specific methods or steps require additional clarifications.
Student Evaluation	Suggestions for determining student learning are well described and methods are appropriate and effectively measure the stated learning outcomes. Sample grading rubrics provided if appropriate.	Assessment methods are suggested but require clarification and/or do not measure whether students have met the learning outcomes. Sample grading rubrics provided but require clarification or rubrics are absent.	Suggested assessment methods are inappropriate for the activity or not provided. Sample grading rubrics absent.
Support Materials	Adequate support materials (e.g. references, student worksheets, answer keys) are provided.	Support materials (e.g. references, student worksheets, answer keys) vague or incomplete.	Support materials (e.g. references, student worksheets, answer keys) of poor quality or not provided.

Ethics	Acceptable as submitted (1)	Needs modifications (2)	Fundamental revisions required (3)
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			
Sample Data	Included are useful examples of actual student data and/or expected outcomes of the activity.	Included are examples of actual student data and/or expected outcomes of the activity that are incomplete or require clarification	Examples of actual student data and/or expected outcomes of the activity not provided.
Assessment	The activity has been field tested at least twice and revised accordingly. Assessment methods are appropriate (e.g. more than student perception of learning) and are well connected to the stated learning outcomes.	The activity has been field tested once and revised accordingly. Assessment methods are suggested but are inappropriate (e.g. only student perception of learning) and/or are not well connected to the stated learning outcomes.	No reported field-testing. Assessment methods are absent. Assessment methods are not well connected to the stated learning outcomes.
Claims and Conclusions	Claims and conclusions are believable. Assessment data demonstrate activity is highly effective in meeting the learning objectives.	Claims and conclusions exaggerated or understated. Assessment data demonstrates activity has marginal effectiveness in meeting the learning objectives.	Claims and conclusions are not believable or are misleading. Evidence from field tests does not demonstrate effectiveness of activity to meet the stated objectives.

Organization and 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.
Modifications and Extensions	Appropriate modifications and extensions are suggested that broaden the activity to other audiences, themes, or applications.	Appropriate modifications are suggested that broaden the usefulness of the activity, but require clarification.	No modification or extensions are listed, although the activity clearly would benefit by their inclusion.
Supplemental Materials	Supplemental materials represent useful material that enhances the submission. Institution specific references absent.	Additional supplemental material would be useful and/or supplemental materials require clarification. Contain institution specific references.	Necessary supplemental materials absent and/or included supplemental materials seemingly not relevant to the quality of the activity. Contain institution specific references.

Overall Common Problems that Require Major Revision:

1. Activity is not novel, or closely duplicates a previously published activity.
2. Abstract is not concise or comprehensive.
3. Expected outcomes are not provided.
4. Results of field testing are not included; evidence of student learning is not provided.
5. Safety issues are not addressed.
6. Activity does not allow active learning (i.e., it is a 'cookbook' exercise).

Preparing a Tips & Tools Section Manuscript

GENERAL GUIDELINES

Manuscripts in this section describe practical, technical, and feasible advice for improving teaching and learning in the science classroom or laboratory. Brief, novel, ready-to-use best practices for teaching scientific concepts are welcome. Articles in this section present quick ideas and practices that have not been rigorously tested. Assessment of the topic is encouraged but NOT required.

Topics for Tips & Tools may include but are not limited to:

- Novel classroom, laboratory, or field activities
- Independent project ideas
- Service learning ideas
- Class management approaches
- Assessment tools
- Career education
- Outreach activities

Manuscript length: 800 to 1,100 words in length, not including the abstract or references, with the goal of the text and figures fitting on two printed pages. The abstract must be submitted as part of the original manuscript, but will be published in the article metadata only. Supplemental materials (e.g., student instruction handouts, directions for preparation, and the like) may be submitted and are not included in the word limit.

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

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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 — Introductory material should include the audience for which the tip is intended, and whether the it is specific to the classroom or laboratory (or both). A brief description is appropriate. A literature review of similar projects or activities is recommended.

PROCEDURE — The body of the article should describe materials and methods, and information on how to make the advice work in the classroom or laboratory. Helpful hints or caveats for the instructor and students are desirable.

> ***Safety issues.*** Address all safety issues faculty and students need to know when attempting this activity, using the ASM Guidelines for Biosafety in Teaching Laboratories as a reference. Safety concerns may include (but 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.

CONCLUSION — Preliminary results of field testing of the activity should be included in the conclusion. Examples of assessment may include pre/posttests or surveys, exam questions, concept inventory results, or student comments.

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. Note: When an activity or tip has been presented elsewhere, even in preliminary form (for example a poster at a conference such as the American Society for Microbiology Conference for Undergraduate Educators), it is imperative to note such prior publication in an acknowledgement or reference, as appropriate. Thus search results for *JMBE* may produce two results, one as a conference proceeding, and another as a manuscript.

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*.

Tips & Tools Section Review Criteria

Criteria	Acceptable as submitted; no change or simple corrections (1)	Needs modifications or improvements (2)	Fundamental revisions or additions required (3)
Relevance	Tips pertain to topics of general interest in microbiology, biology, and science education. Tips present innovative and engaging ways to improve best practices.	Manuscript largely reviews old information; relationship of tips & tools to teaching and learning needs to be clarified.	No new information is presented. Article is not appropriate for Tips & Tools section of *JMBE*.
Practicality	Tips are practical and useful; tips can be implemented in a science classroom or laboratory.	Tips are generally good, but need modification before they can be readily used in a classroom.	Tips fall outside the scope of microbiology/biology/science education.
Materials & Methods	Materials and methods are clearly presented and easy to follow.	Materials and methods need modifications or improvements.	Materials and methods are insufficient or lacking.
Clarity & Organization	Article is clear, well organized, and concise.	Article is clear and well organized, but requires modification, including but not limited to clarification of minor points. Article is too long to fit on two journal pages.	Article is unclear, disorganized, and wordy.
Credibility	Tips are credible and verifiable.	Tips have gaps in information but are mostly credible; information is difficult to verify.	Information in manuscript cannot be verified.
Safety	Activities adhere to laboratory safety guidelines.	Activities are generally safe, but safety guidelines are not consistently followed.	Activities may be risky; safety guidelines are ignored.
Guidelines	Article follows all submission guidelines.	Article follows three or more of the submission guidelines.	Submission guidelines are ignored.

JMBE ▪ 1752 N Street NW, Washington, DC 20036
(202) 942-9314 ▪ jmbe@asmusa.org
http://jmbesubmissions.asm.org