SCOPE

Applied and Environmental Microbiology (AEM) publishes descriptions of all aspects of applied microbial research, basic research on microbial ecology, and research of a genetic and molecular nature that focuses on microbial topics of practical value. Research must address salient microbiological principles, fundamental microbial processes, or basic questions in applied or environmental microbiology. Topics that are considered include microbiology in relation to foods, agriculture, industry, biotechnology, public health, plants, and invertebrates and basic biological properties of bacteria, fungi, algae, protozoa, and other simple eukaryotic organisms as related to microbial ecology. Manuscripts should report new and significant findings that advance the understanding of microbiology and upon which other scientists may build.

The microbial ecology section covers a wide range of topics on the ecology of microorganisms, including culture-independent molecular assessments that provide new insights into (i) the structure-function relationships of microorganisms, (ii) the impact of in situ conditions on community structure, and (iii) the effect of changes in microbial community composition on ecosystem function. Archival phylogenetic snapshots that do not provide such insights are not acceptable for publication in AEM.

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Manuscripts submitted to the mycology section should be clearly of a microbiological nature and may deal with basic biology, biochemistry, genetics, or physiology of fungi, molds, yeasts, or algae. Papers dealing purely with taxonomy or phylogeny, with fungal or algal structure, or with metabolism/alteration of metabolites/toxins by animal, plant, or insect cells, tissues, or organisms are not suitable. Documentation of the distribution/occurrence of toxins or metabolites in natural samples (foods, cereals, grains, soils, etc.) is suitable if the work includes studies involving the isolation, occurrence, or enumeration of the responsible microbes in these samples. The chemical or biochemical elucidation of metabolite or toxin structures is suitable if the work includes aspects of the enzymology or biosynthesis of these compounds.

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ASM publishes a number of different journals covering various aspects of the field of microbiology. Each journal has a prescribed scope which must be considered in determining the most appropriate journal for each manuscript. The following guidelines may be of assistance.

(i) AEM will consider manuscripts describing properties of enzymes and proteins that are produced by either wild-type or genetically engineered microorganisms and that are significant or have potential significance in industrial or environmental settings. Studies dealing with basic biological phenomena of enzymes or proteins or in which enzymes have been used in investigations of basic biological functions are more appropriate for the Journal of Bacteriology.

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(iii) Papers on the biology of bacteriophages and other viruses are more appropriate for the Journal of Virology or the Journal of Bacteriology. AEM does, however, consider manuscripts dealing with viruses in relation to environmental, public health, or industrial microbiology.

(iv) Manuscripts dealing with the immune system or with topics of basic medical interest or oral microbiology are more appropriate for Infection and Immunity. Reports of clinical investigations and environmental biology applied to hospitals should be submitted to the Journal of Clinical Microbiology.

(v) AEM and Eukaryotic Cell (EC) accept manuscripts on population dynamics and the ecology of eukaryotic microbes. Studies of microbial communities and of microbial populations with identified economic or ecological significance, e.g., plant pathogens or symbionts, are usually more appropriate for AEM. Studies of single species of eukaryotes, especially “model” organisms or those without identified economic or ecological importance, are usually more appropriate for EC.

(vi) Manuscripts dealing with the purification and char

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To best serve its readership, the journal must accept only those papers that are most significant to the field of applied and environmental microbiology. Thus, the editors will reject manuscripts that, while scientifically sound, represent only incremental extensions of other studies, are mainly confirmatory, or do not pursue a question in sufficient depth.

Questions about these guidelines may be directed to the editor in chief of the journal being considered.

If transfer to another ASM journal is recommended by an editor, the corresponding author will be contacted.

Note that a manuscript rejected by one ASM journal on scientific grounds or on the basis of its general suitability for publication is considered rejected by all other ASM journals.

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A corresponding author who has included an e-mail address in his “corresponding author” footnote will have limited access (10 downloads, total) to the PDF file of his published article. An e-mail alert will automatically be sent to him on the day the issue is posted. It will provide a URL, which will be required to obtain access, and instructions. An article may be viewed, printed, or stored, provided that it is for the author’s own use.

Should coauthors or colleagues be interested in viewing the paper for their own use, the corresponding author may provide them with the URL; a copy of the article may not be forwarded electronically. However, they must be made aware of the terms and conditions of the ASM copyright. (For details, go to http://www.journals.asm.org/misc/terms.shtml.) Note that each such download will count toward the corresponding author’s total of 10. After 10 downloads, access will be denied and can be obtained only through a subscription to the journal (either individual or institutional) or after the standard access control has been lifted (i.e., 4 months after publication).

HOW TO SUBMIT MANUSCRIPTS

All submissions to AEM must be made electronically via the Rapid Review online submission and peer review system at the following URL: www.rapidreview.com/ASM2/author.html. (E-mailed submissions will not be accepted.) First-time users must create an Author account, which may be used for submitting to all ASM journals. Instructions for creating an Author account are available at the above URL under the Create Account button. Step-by-step instructions for submitting a manuscript via Rapid Review are available from the account holder’s My Manuscripts page. Information on file types acceptable for electronic submission can be found under the More About File Formats button.

PDFs of submitted manuscripts are retained in Rapid Review for 1 to 2 years, after which they are deleted.

ORGANIZATION AND FORMAT

On receipt at ASM, an accepted manuscript undergoes an automated preediting, cleanup, and tagging process specific to the particular article type. To optimize this process, manuscripts must be supplied in the correct format and with the appropriate sections and headings.

Type every portion of the manuscript double spaced (a minimum of 6 mm between lines), including figure legends, table footnotes, and References, and number all pages in sequence, including the abstract, figure legends, and tables. Place the last two items after the References section. Manuscript pages should have line numbers; manuscripts without line numbers may be editorially rejected by the editor, with a suggestion of resubmission after line numbers are added. The font size should be no smaller than 12 points. It is recommended that the following sets of characters be easily distinguishable in the manuscript: the numeral zero (0) and the letter “oh” (O); the numeral one (1), the letter “el” (l), and the letter “eye” (I); and a multiplication sign (×) and the letter “ex” (x). Do not create symbols as graphics or use special fonts that are external to your word processing program; use the “insert symbol” function. Set the page size to 8½ by 11 inches (ca. 21.6 by 28 cm). Italicize or underline any words that should appear in italics, and indicate paragraph lead-ins in bold type.

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 Instructions.

Manuscript Submission Checklist:

- Double space all text, including references and figure legends
- Number pages
• Number lines
• Present statistical treatment of data where appropriate
• Format references in ASM style
• Indicate journal section for manuscript publication
• Provide accession numbers for all sequences or sequence alignments important for evaluation of the manuscript as supplemental material or make the material available on a website for access by the editor and reviewers
• Confirm that genetic and chemical nomenclature conforms to instructions
• Include as supporting material in-press and submitted manuscripts that are important for judgment of the present manuscript

Long-Form Papers

Long-form papers should include the elements described in this section.

**Title, running title, and byline.** Each manuscript should present the results of an independent, cohesive study; thus, numbered series titles are not permitted. Exercise care in composing a main title. Avoid the main title/subtitle arrangement, complete sentences, and unnecessary articles. On the title page, include the title, running title (not to exceed 54 characters and spaces), name of each author, address(es) of the institution(s) at which the work was performed, each author’s affiliation, and a footnote indicating the present address of any author no longer at the institution where the work was performed. Place an asterisk after the name of the author to whom inquiries regarding the paper should be directed (see “Correspondent footnote” below).

**Study group in byline.** A study group, surveillance team, working group, consortium, or the like (e.g., the Active Bacterial Core Surveillance Team) may be listed as a coauthor in the byline if its contributing members satisfy the requirements for authorship and accountability as described in these Instructions. The names (and institutional affiliations if desired) of the contributing members may be given in a footnote keyed to the study group name in the byline or as a separate paragraph in Acknowledgments.

If the contributing members of the group associated with the work do not fulfill the criteria of substantial contribution to and responsibility for the paper, the group may not be listed in the author byline. Instead, it and the names of its contributing members may be listed in the Acknowledgments section.

**Correspondent footnote.** The complete mailing address, a single telephone number, a single fax number, and a single e-mail address for the corresponding author should be included on the title page of the manuscript. This information will be published in the article as a footnote to facilitate communication, and the e-mail address will be used to notify the corresponding author of the availability of proofs and, later, of the PDF file of the published article.

**Abstract.** Limit the abstract to **250 words or fewer** and concisely summarize the basic content of the paper without presenting extensive experimental details. Avoid abbreviations and references, and do not include diagrams. When it is essential to include a reference, use the same format as shown for the References section but omit the article title. Because the abstract will be published separately by abstracting services, it must be complete and understandable without reference to the text.

**Introduction.** The introduction should supply sufficient background information to allow the reader to understand and evaluate the results of the present study without referring to previous publications on the topic. The introduction should also provide the hypothesis that was addressed or the rationale for the present study. Use only those references required to provide the most salient background rather than an exhaustive review of the topic.

**Materials and Methods.** The Materials and Methods section should include sufficient technical information to allow the experiments to be repeated. When centrifugation conditions are critical, give enough information to enable another investigator to repeat the procedure: make of centrifuge, model of rotor, temperature, time at maximum speed, and centrifugal force ($\times g$ rather than revolutions per minute). For commonly used materials and methods (e.g., media and protein concentration determinations), a simple reference is sufficient. If several alternative methods are commonly used, it is helpful to identify the method briefly as well as to cite the reference. For example, it is preferable to state “cells were broken by ultrasonic treatment as previously described (9)” rather than to state “cells were broken as previously described (9).” This allows the reader to assess the method without constant reference to previous publications. Describe new methods completely, and give sources of unusual chemicals, equipment, or microbial strains. When large numbers of microbial strains or mutants are used in a study, include tables identifying the immediate sources (i.e., sources from whom the strains were obtained) and properties of the strains, mutants, bacteriophages, plasmids, etc.

A method, strain, etc., used in only one of several experiments reported in the paper may be described in the Results section or very briefly (one or two sentences) in a table footnote or figure legend. It is expected that the sources from whom the strains were obtained will be identified.

**Results.** In the Results section, include only the results of the experiments; reserve extensive interpretation of the results for the Discussion section. Present the results as concisely as possible in **one** of the following:
text, table(s), or figure(s). Avoid extensive use of graphs to present data that might be more concisely presented in the text or tables. For example, except in unusual cases, double-reciprocal plots used to determine apparent \( K_m \) values should not be presented as graphs; instead, the values should be stated in the text. Similarly, graphs illustrating other methods commonly used to derive kinetic or physical constants (e.g., reduced-viscosity plots and plots used to determine sedimentation velocity) need not be shown except in unusual circumstances. Limit photographs (particularly photomicrographs and electron micrographs) to those that are absolutely necessary to show the experimental findings. Number figures and tables in the order in which they are cited in the text, and be sure to cite all figures and tables.

Discussion. The Discussion should provide an interpretation of the results in relation to previously published work and to the experimental system at hand and should not contain extensive repetition of the Results section or reiteration of the introduction. In short papers, the Results and Discussion sections may be combined.

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.) The usual format is as follows: “This work was supported by Public Health Service grant CA-01234 from the National Cancer Institute.”

Recognition of personal assistance should be given as a separate paragraph, as should any statements disclaiming endorsement or approval of the views reflected in the paper or of a product mentioned therein.

Appendixes. Appendixes, which contain additional material to aid the reader, are permitted. Titles, authors, and References sections that are distinct from those of the primary article are not allowed. If it is not feasible to list the author(s) of the appendix in the byline or the Acknowledgments section of the primary article, rewrite the appendix so that it can be considered for publication as an independent article, either long-form or short-form style. Equations, tables, and figures should be labeled with the letter “A” preceding the numeral to distinguish them from those cited in the main body of the text.

References. (i) References listed in the References section. The References section must include all journal articles (both print and online), books and book chapters (both print and online), patents, theses and dissertations, published conference proceedings, meeting abstracts from published abstract books or journal supplements, letters (to the editor), and company publications, as well as in-press journal articles, book chapters, and books (publication title must be given). Arrange the citations in alphabetical order (letter by letter, ignoring spaces and punctuation) by first author and number consecutively. Provide the names of all the authors for each reference. All listed references must be cited parenthetically by number in the text. Since title and byline information that is downloaded from PubMed does not show accents, italics, or special characters, authors should refer to the PDF files or hard-copy versions of the articles and incorporate the necessary corrections in the submitted manuscript. Abbreviate journal names according to BIOSIS Serial Sources (The Thomson Corporation, Philadelphia, PA, 2006).

Follow the styles shown in the examples below for print references.

5. Falagas, M. E., and S. K. Kasiakou. 2006. Use of international units when dosing colistin will help decrease confusion related to various formulations of the drug around the world. Antimicrob. Agents Chemother. 50:2274–2275. (Letter.) *(Letter or “Letter to the editor” is allowed but not required at the end of such an entry.)*
Microbial growth on C₁ compounds. Proceedings of the 4th International Symposium. American Society for Microbiology, Washington, DC.

10. Odell, J. C. April 1970. Process for batch cultivating. U.S. patent 484,363,770. {Include the name of the patented item/process if possible; the patent number is mandatory.}


14. Stratagene. 2006. Yeast DNA isolation system: instruction manual. Stratagene, La Jolla, CA. {Use the company name as the author if none is provided for a company publication.}

*A reference to an in-press ASM publication should state the control number (e.g., AEM00577-07) if it is a journal article or the name of the publication if it is a book.

Online references must provide the same information that print references do, but some variation is allowed. For online journal articles, posting or revision dates may replace the year of publication, and a DOI or URL may be provided in addition to or in lieu of volume and page numbers. Some examples follow.


NOTE: A posting or accession date is required for any online reference that is periodically updated or changed.

(ii) References cited in the text. References to unpublished data, manuscripts submitted for publication, unpublished conference presentations (e.g., a report or poster that has not appeared in published conference proceedings), personal communications, patent applications and patents pending, computer software, databases, and websites (home pages) should be made parenthetically in the text as follows.

... similar results (R. B. Layton and C. C. Weathers, unpublished data).

... system was used (J. L. McInerney, A. F. Holden, and P. N. Brighton, submitted for publication).

... as described previously (M. G. Gordon and F. L. Rattner, presented at the Fourth Symposium on Food Microbiology, Overton, IL, 13 to 15 June 1989). {For nonpublished abstracts, posters, etc.}

... this new process (V. R. Smoll, 20 June 1999, Australian Patent Office). {For non-U.S. patent applications, give the date of publication of the application.}


... using ABC software (version 2.2; Department of Microbiology, State University [http://www.stu.micro]).

URLs for companies that produce any of the products mentioned in your study or for products being sold may NOT be included in the article. However, company URLs that permit access to scientific data related to the study or to shareware used in the study are permitted.

(iii) References related to supplemental material. References that are related only to supplemental material hosted by ASM or posted on a personal/institutional website should not be listed in the References section of an article; include them with the supplemental material itself.

(iv) Referencing publish-ahead-of-print manuscripts. Citations of ASM Accepts manuscripts should look like the following example.


If an author of an article cites an ASM Accepts manuscript in his paper but wishes at the proof stage to change the reference entry to that for the published article, the following style should be used:

Wang, G. G., M. P. Pasillas, and M. P. Kamps. 15 May 2006. Persistent transactivation by Meis1 replaces Hox function in myeloid leukemogenesis mod-

Other journals may use different styles for their publish-ahead-of-print manuscripts, but citation entries must include the following information: author name(s), posting date, title, journal title, and volume and page numbers and/or DOI. The following is an example:


Short-Form Papers

The short-form format is intended for the presentation of brief observations that do not warrant full-length papers. Submit short-form papers in the same way as full-length papers. They receive the same review, they are not published more rapidly than full-length papers, and they are not considered preliminary communications.

The title, running title (not to exceed 54 characters and spaces), byline, and correspondent footnote should be prepared as for the long-form paper. Each short-form paper must have an abstract of no more than 50 words. Do not use section headings in the body of the paper; combine methods, results, and discussion in a single section. Paragraph lead-ins are permissible. The text should be kept to a minimum and, if possible, should not exceed 1,000 words; the number of figures and tables should also be kept to a minimum. Materials and methods should be described in the text, not in figure legends or table footnotes. Present acknowledgments as in long-form papers, but do not use a heading. The References section is identical to that of long-form papers.

Minireviews

Minireviews are brief (limit of 6 printed pages exclusive of references) biographical profiles, historical perspectives, or summaries of developments in fast-moving areas. They must be based on published articles; they may address any subject within the scope of AEM.

Minireviews may be either solicited or proffered by authors responding to a recognized need. Irrespective of origin, Minireviews are subject to review and should be submitted via Rapid Review. The cover letter should state whether the article was solicited and by whom.

Minireviews do not have abstracts. In the Abstract section of the submission form, put “Not Applicable.” The body of the Minireview may either have section headings or be set up like a short-form paper (see above).

Meeting Reviews

Meeting Reviews are brief summaries of recent scientific meetings that cover topics within the scope of AEM. Reviews should be timely and focus on major themes, new developments, emerging trends, and significant unanswered questions presented and discussed at the meeting. Sufficient background should be provided to make the report useful to the general reader. The author must provide written assurance from the relevant individuals that permission to cite their presented material has been granted.

Meeting Reviews, which may be solicited or proffered by authors, are subject to editorial review and should be submitted via Rapid Review.

Guest Commentaries

Guest Commentaries are communications written in response to invitations issued by the editors and concern relevant topics in microbiology that are not necessarily covered by Minireviews. They should raise issues of interest to the scholarly community, initiate or focus discussion, and propose needed position or consensus statements by the Academy of Microbiology, the National Academy of Sciences, and other leadership groups in research and education. Reviews of the literature, methods and other how-to papers, and responses targeted at a specific published paper are not appropriate. Guest Commentaries are subject to review.

The length may not exceed 4 printed pages, and the format is like that of a Minireview (see above). Commentaries should be submitted via Rapid Review.

Letters to the Editor

Letters to the Editor are intended only for comments on articles published previously in the journal and must cite published references to support the writer’s argument.

Letters may be no more than 500 words long and must be typed double spaced. Refer to a recently published Letter for correct formatting. Note that authors and affiliations are listed at the foot of the Letter. Provide only the primary affiliation for each author.

All Letters to the Editor must be submitted electronically, and the manuscript type (Comment Letter) must be selected from the drop-down list in the submission form. The cover letter should state the volume and issue in which the article commented on was published, the title of the article, and the last name of the first author. In the Abstract section of the submission form, put “Not applicable.” Letters to the Editor do not have abstracts. The Letter must have a title, which must appear on the manuscript and on the submission form. Figures and tables should be kept to a minimum.

The Letter will be sent to the editor who handled the article in question. If the editor believes that publication is warranted, he will solicit a reply from the corresponding author of the article and make a recommendation to the editor in chief. Final approval for publication rests with the editor in chief.
Please note that some indexing/abstracting services do not include Letters to the Editor in their databases.

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The Erratum section provides a means of correcting errors that occurred during the writing, typing, editing, or printing (e.g., a misspelling, a dropped word or line, or mislabeling in a figure) of a published article. Submit Errata via Rapid Review (see “How To Submit Manuscripts,” above). In the Abstract section of the submission form (a required field), put “Not Applicable.” Upload the text of your Erratum as an MS Word file. Please see a recent issue for correct formatting.

Authors’ Corrections

The Author’s Correction section provides a means of correcting errors of omission (e.g., author names or citations) and errors of a scientific nature that do not alter the overall basic results or conclusions of a published article (e.g., an incorrect unit of measurement or order of magnitude used throughout, contamination of one of numerous cultures, or misidentification of a mutant strain, causing erroneous data for only a portion [noncritical] of the cultures, or misidentification of a mutant strain, causing tude used throughout, contamination of one of numerous (e.g., an incorrect unit of measurement or order of magnitudes) and errors of a scientific nature that do not alter the correctings of omission (e.g., author names or citations) and errors of a scientific nature that do not alter the overall basic results or conclusions of a published article (e.g., an incorrect unit of measurement or order of magnitude used throughout, contamination of one of numerous cultures, or misidentification of a mutant strain, causing erroneous data for only a portion [noncritical] of the study). Note that the addition of new data is not permitted.

For corrections of a scientific nature or issues involving authorship, including contributions and use or ownership of data and/or materials, all disputing parties must agree, in writing, to publication of the Correction. For omission of an author’s name, letters must be signed by the authors of the article and the author whose name was omitted. The editor who handled the article will be consulted if necessary.

Submit an Author’s Correction via Rapid Review (see “How To Submit Manuscripts,” above). In the submission form, select Erratum as the manuscript type; there is no separate selection in Rapid Review for Authors’ Corrections, but your Correction will be published as such if appropriate. In the Abstract section of the submission form (a required field), put “Not Applicable.” Upload the text of your Author’s Correction as an MS Word file. Please see a recent issue for correct formatting. Signed letters of agreement must be supplied as supplemental material (scanned PDF files).

Retractions

Retractions are reserved for major errors or breaches of ethics that, for example, may call into question the source of the data or the validity of the results and conclusions of an article. Submit Retractions via Rapid Review (see “How To Submit Manuscripts,” above). In the Abstract section of the submission form (a required field), put “Not Applicable.” Upload the text of your Retraction as an MS Word file. Letters of agreement signed by all of the authors must be supplied as supplemental material (scanned PDF files). The Retraction will be assigned to the editor in chief of the journal, and the editor who handled the paper and the chairman of the ASM Publication Board will be consulted. If all parties agree to the publication and content of the Retraction, it will be sent to the Journals Department for publication.

We strongly recommend that before returning their modified manuscripts, authors check the acceptability of their digital images for production by running their files through Rapid Inspector, a tool provided at the following URL: http://rapidinspector.cadmus.com/mw. Rapid In-

ILLUSTRATIONS AND TABLES

Digital files that are acceptable for production (see below) must be provided for all illustrations on return of the modified manuscript. (On initial submission, the entire paper may be submitted in PDF format.)

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* Color graphics must be saved and printed in the CMYK mode, not RGB.
* ASM accepts only black-and-white, not color, graphics created with Kalei-
dagraph, Adobe Photoshop 5.0 LE, Prism 3 by GraphPad, and PowerPoint.

spector is an easy-to-use Web-based application that identifies file characteristics that may render the image unusable for production.

Illustrations may be continuous-tone images, line drawings, or composites. Color graphics may be submitted, but the cost of printing in color must be borne by the author. Suggestions about how to reduce costs and ensure accurate color reproduction are given below.

The preferred format for tables is MS Word; however, WordPerfect and Acrobat PDF are also acceptable (see the section on Tables below).

**Image Manipulation**

Computer-generated images may be processed only minimally. Processing (e.g., changing contrast, brightness, or color balance) is acceptable only if applied to all parts of the image, as well as to the controls, equally, and descriptions of all such adjustments and the tools used (both hardware and software) must be provided in the manuscript. Unprocessed data and files must be retained by the authors and be provided to the editor on request.

**Illustrations**

**File types and formats.** As mentioned above, illustrations may be supplied as PDF files for reviewing purposes only on initial submission; in fact, we recommend this option to minimize file upload time. At the modification stage, production quality digital files must be submitted: TIFF or EPS files from supported applications or PowerPoint files (black and white only). Except for figures produced in PowerPoint, all graphics submitted with modified manuscripts must be bitmap, grayscale, or CMYK (not RGB). Halftone images (those with various densities or shades) must be grayscale, not bitmap.

Color PowerPoint files are not accepted because the application, designed for developing on-screen computer presentations, uses the RGB color mode whereas the printing process uses the CMYK color mode. Colors that are represented in a PowerPoint image may not be reproducible on a printing press. Although black-and-white Microsoft PowerPoint files are accepted, we do not recommend the use of PowerPoint. PowerPoint requires users to pay close attention to the fonts used in their images (see the section on Fonts below). If instructions for fonts are not followed exactly, images prepared for publication are subject to missing characters, improperly converted characters, or shifting/obscuring of elements or text in the figure. Use of PowerPoint is therefore not recommended for either color or black-and-white illustrations. Acceptable file types and formats for production are given in the charts above. More-detailed instructions for preparing illustrations are available at http://cjs.cadmus.com/da. Please review this information before preparing your files. If you require additional information, please send an e-mail inquiry to digitalart@cadmus.com.

**Minimum resolution.** It is extremely important that a high enough resolution is used. Any imported images must be at the correct resolution before they are placed. Note, however, that the higher the resolution, the larger the file and the longer the upload time. Publication quality will not be improved by using a resolution higher than the minimum. Minimum resolutions are as follows:

- 300 dpi for grayscale and color
- 600 dpi for lettering
- 1,200 dpi for line art
- 600 dpi for combination art (lettering and images)

**Size.** All graphics MUST be submitted at their intended publication size; that is, the image uploaded should be 100% of its print dimensions so that no reduction or enlargement is necessary. Resolution must be at the required level at the submitted size. Include only the significant portion of an illustration. White space must be cropped from the image, and excess space between panel labels and the image must be eliminated.

- Maximum width for a 1-column figure: 3½ inches (ca. 8.4 cm)
- Maximum width for a 2-column figure: 6% inches (ca. 17.4 cm)
- Minimum width for a 2-column figure: 4½ inches (10.8 cm)
- Maximum height: 9½ inches (23.0 cm)

**Contrast.** Illustrations must contain sufficient contrast to withstand the inevitable loss of contrast and detail inherent in the printing process. See also the section on color illustrations below.

**Labeling and assembly.** All final lettering, labeling, tooling, etc., MUST be incorporated into the figures. It cannot be added at a later date. If a figure number is included, it must appear well outside the boundaries of the image itself. (Numbering may need to be changed at the copyediting stage.) Each figure must be uploaded as a separate file, and any multipanel figures must be assembled into one file; i.e., rather than uploading a separate file for each panel in a figure, assemble all panels in one piece and supply them as one file.

**Fonts.** To avoid font problems, set all type in one of the following fonts: Helvetica, Times Roman, European PI, Mathematical PI, or Symbol. All fonts other than these five must be converted to paths (or outlines) in the application with which they were created. For proper font use in PowerPoint images, refer to the Cadmus digital art website, http://cjs.cadmus.com/da/instructions/ppt_disclaimer.jsp.

**Compression.** Images created with Macintosh applications may be compressed with StuffIt. Images created with Windows applications may be compressed with WINZIP or PKZIP.
Color illustrations. The cost of printing in color must be borne by the author. The current color cost per figure may be accessed from the submission form in Rapid Review. For accepted manuscripts, the total cost of the color will be included in the acceptance letter sent out by ASM. Adherence to the following guidelines, in addition to the general ones below, will help to minimize costs and to ensure color reproduction that is as accurate as possible.

Because of the requirements of print production, color illustrations must be in the CMYK (cyan, magenta, yellow, black) color space. The “normal” color mode for most computer software is RGB (red, green, blue), which is also the color space of your computer monitor. Since CMYK is a smaller color space (meaning it can define fewer colors), colors often shift when an RGB file is converted to CMYK. In particular, figures showing red or green fluorescence and those with a significant range of colors may be difficult or impossible to reproduce during the printing process.

Color illustrations must be supplied in the CMYK color mode, as either (i) CMYK TIFF images with a resolution of at least 300 pixels per inch (raster files, consisting of pixels) or (ii) Illustrator-compatible EPS files with CMYK color elements (vector files, consisting of lines, fonts, fills, and images). See the charts above for a list of supported applications.

We cannot accept any Microsoft Office files (PowerPoint, Word, Excel) for color illustrations because they are restricted to the RGB color space.

Drawings

Submit graphs, charts, complicated chemical or mathematical formulas, diagrams, and other drawings as finished products not requiring additional artwork or typesetting. No part of the graph or drawing may be handwritten. All elements, including letters, numbers, and symbols, must be easily readable, and both axes of a graph must be labeled. Keep in mind that the journal is published both in print and online and that the same electronic files submitted by the authors are used to produce both.

When creating line art, please use the following guidelines:

1. All art MUST be submitted at its intended publication size. For acceptable dimensions, see the Size section on p. 14.

2. Avoid using screens (i.e., shading) in line art. It can be difficult and time-consuming to reproduce these images without moiré patterns. Various pattern backgrounds are preferable to screens as long as the patterns are not imported from another application. If you must use images containing screens,
   • Generate the image at line screens of 85 lines per inch or lower.
   • When applying multiple shades of gray, differentiate the gray levels by at least 20%.
   • Never use levels of gray below 20% or above 70% as they will fade out or become totally black upon scanning and reduction.

3. Use thick, solid lines that are no finer than 1 point in thickness.

4. No type should be smaller than 6 points at the final publication size.

5. Avoid layering type directly over shaded or textured areas.

6. Avoid the use of reversed type (white lettering on a black background).

7. Avoid heavy letters, which tend to close up, and unusual symbols, which the printer may not be able to reproduce in the legend.

8. If colors are used, avoid using similar shades of the same color and avoid very light colors.

In figure ordinate and abscissa scales (as well as table column headings), avoid the ambiguous use of numbers with exponents. Usually, it is preferable to use the Système International d’Unités (SI) symbols ($\mu$ for $10^{-6}$, m for $10^{-3}$, k for $10^{3}$, M for $10^{6}$, etc.). A complete listing of SI symbols can be found in the International Union of Pure and Applied Chemistry (IUPAC) publication Quantities, Units and Symbols in Physical Chemistry (Blackwell Science, Oxford, United Kingdom, 1993); an abbreviated list is available at http://www.iupac.org/reports/1993/homann/index.html. Thus, a representation of 20,000 cpm on a figure ordinate is to be made by the number 20 accompanied by the label kc.p.m.

When powers of 10 must be used, the journal requires that the exponent power be associated with the number shown. In representing 20,000 cells per ml, the numeral on the ordinate would be “2” and the label would be “$10^4$ cells per ml” (not “cells per ml $\times 10^{-4}$”). Likewise, an enzyme activity of 0.06 U/ml would be shown as 6 accompanied by the label $10^{-2}$ U/ml. The preferred designation would be 60 mU/ml (milliunits per milliliter).

Presentation of Nucleic Acid Sequences

Nucleic acid sequences of limited length which are the primary subject of a study may be presented freestyle in the most effective format. Longer nucleic acid sequences must be presented as figures in the following format to conserve space. Print the sequence in lines of approximately 100 to 120 nucleotides in a nonproportional (monospace) font that is easily legible when published with a line length of 6 inches (ca. 15.2 cm). If possible, lines of nucleic acid sequence should be further subdivided into blocks of 10 or 20 nucleotides by spaces within the sequence or by marks above it. Uppercase and lowercase letters may be used to designate the exon-intron structure, transcribed regions, etc., if the lowercase letters remain legible at a 6-inch (ca. 15.2-cm) line length. Number the sequence line by line; place numerals, representing the first base of each line, to the left of the lines. Minimize spacing between lines of
sequence, leaving room only for annotation of the sequence. Annotation may include boldface, underlining, brackets, boxes, etc. Encoded amino acid sequences may be presented, if necessary, immediately above or below the first nucleotide of each codon, by using the single-letter amino acid symbols. Comparisons of multiple nucleic acid sequences should conform as nearly as possible to the same format.

Figure Legends

Legends should provide enough information so that the figure is understandable without frequent reference to the text. However, detailed experimental methods must be described in the Materials and Methods section, not in a figure legend. A method that is unique to one of several experiments may be reported in a legend only if the discussion is very brief (one or two sentences). Define all symbols used in the figure and define all abbreviations that are not used in the text.

Tables

Tables that contain artwork, chemical structures, or shading must be submitted as illustrations in an acceptable format at the modification stage. The preferred format for regular tables is MS Word; however, WordPerfect and Acrobat PDF are also acceptable. Note that a straight Excel file is not currently an acceptable format. Excel files must be either embedded in a Word or WordPerfect document or converted to PDF before being uploaded. If your modified manuscript contains PDF tables, select “for reviewing purposes only” at the beginning of the file upload process.

Tables should be formatted as follows. Arrange the data so that columns of like material read down, not across. The headings should be sufficiently clear so that the meaning of the data is understandable without reference to the text. See the Abbreviations section (p. 20) of these Instructions for those that should be used in tables. Explanatory footnotes are acceptable, but more extensive table “legends” are not. Footnotes should not include detailed descriptions of the experiment. Tables must include enough information to warrant table format; those with fewer than six pieces of data will be incorporated into the text by the copy editor. Table 1 is an example of a well-constructed table.

TABLE 1. Distribution of protein and ATPase in fractions of dialyzed membranesa

<table>
<thead>
<tr>
<th>Membrane</th>
<th>Fraction</th>
<th>ATPase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>U/mg of</td>
</tr>
<tr>
<td></td>
<td></td>
<td>protein</td>
</tr>
<tr>
<td>Control</td>
<td>Depleted membrane</td>
<td>0.036</td>
</tr>
<tr>
<td></td>
<td>Concentrated supernatant</td>
<td>0.134</td>
</tr>
<tr>
<td>E1 treated</td>
<td>Depleted membrane</td>
<td>0.034</td>
</tr>
<tr>
<td></td>
<td>Concentrated supernatant</td>
<td>0.11</td>
</tr>
</tbody>
</table>

a Specific activities of ATPase of nondepleted membranes from control and treated bacteria were 0.21 and 0.20, respectively.

Cover Photographs and Drawings

AEM publishes photographs and drawings on the front cover. Invitations are issued to authors whose manuscripts are returned for modification or whose manuscripts have been accepted for publication in AEM; material should be related to the work presented in the AEM manuscript. Unsolicited photos will be considered in hard-copy format (two copies) only; if an unsolicited photo is chosen for the cover, the author may be asked to submit digital files. No material submitted for consideration will be returned to the author. Authors will be notified only if their cover art is selected. Copyright for the chosen material must be transferred to ASM. A short description of the cover material will be included at the end of the table of contents or the author index of the issue. Technical specifications for submission are available from the cover editor, Matthew R. Parsek (e-mail: matthew-parsek@uiowa.edu).

NOMENCLATURE

Chemical and Biochemical Nomenclature

The recognized authority for the names of chemical compounds is Chemical Abstracts (CAS, Columbus, OH) and its indexes. The Merck Index, 14th ed. (Merck & Co., Inc., Whitehouse Station, NJ, 2006), is also an excellent source. For biochemical terminology, including abbreviations and symbols, consult Biochemical Nomenclature and Related Documents (Portland Press, London, United Kingdom, 1992), available at http://www.chem.qmul.ac.uk/iupac/bibliog/white.html, and the instructions to authors of the Journal of Biological Chemistry and the Archives of Biochemistry and Biophysics (first issues of each year).

Do not express molecular weight in daltons; molecular weight is a unitless ratio. Molecular mass is expressed in daltons.

For enzymes, use the recommended (trivial) name assigned by the Nomenclature Committee of the International Union of Biochemistry (IUB) as described in Enzyme Nomenclature (Academic Press, Inc., New York, NY, 1992) and at http://www.chem.qmul.ac.uk/iubmb/enzyme/. If a nonrecommended name is used, place the proper (trivial) name in parentheses at first use in the abstract and text. Use the EC number when one has been assigned, and express enzyme activity either in katal (preferred) or in the older system of micromoles per minute.

Nomenclature of Microorganisms

Binary names, consisting of a generic name and a specific epithet (e.g., Escherichia coli), must be used for all microorganisms. Names of categories at or above the genus level may be used alone, but specific and subspecific epithets may not. A specific epithet must be preceded by a generic name, written out in full the first time it is used in a paper. Thereafter, the generic name should be abbreviated to the initial capital letter (e.g., E. coli).
provided there can be no confusion with other genera used in the paper. Names of all taxa (kingdoms, phyla, classes, orders, families, genera, species, and subspecies) are printed in italics and should be italicized (or underlined) in the manuscript; strain designations and numbers are not. Vernacular (common) names should be in lowercase roman type (e.g., streptococcus, brucella). For Salmonella, genus, species, and subspecies names should be rendered in standard form: Salmonella enterica at first use, S. enterica thereafter; Salmonella enterica subspp. arizonae at first use, S. enterica subsp. arizonae thereafter. Names of serovars should be in roman type with the first letter capitalized: Salmonella enterica serovar Typhimurium. After the first use, the serovar may also be given without a species name: Salmonella serovar Typhimurium. For other information regarding serovar designations, see Antigenic Formulas of the Salmonella Serovars, 8th ed. (M. Y. Popoff, WHO Collaborating Centre for Reference and Research on Salmonella, Institut Pasteur, Paris, France, 2001). For a summary of the current standards for Salmonella nomenclature and the Kaufmann-White criteria, see the article by Brenner et al. (J. Clin. Microbiol. 38:2465-2467, 2000), the opinion of the Judicial Commission of the International Committee on Systematics of Prokaryotes (Int. J. Syst. Evol. Microbiol. 55:519-520, 2005), and the article by Tindall et al. (Int. J. Syst. Evol. Microbiol. 55:521-524, 2005).

The spelling of bacterial names should follow the Approved Lists of Bacterial Names (Amended) & Index of the Bacterial and Yeast Nomenclatural Changes (V. B. D. Skerman et al. ed., ASM Press, Washington, DC, 1989) and the validation lists and notification lists published in the International Journal of Systematic and Evolutionary Microbiology (formerly the International Journal of Systematic Bacteriology) since January 1989. In addition, two sites on the World Wide Web list current approved bacterial names: Bacterial Nomenclature Up-to-Date (http://www.dsmz.de/microorganisms/main.php?contentleft_id=14) and List of Prokaryotic Names with Standing in Nomenclature (http://www.bacterio.cict.fr). If there is reason to use a name that does not have standing in nomenclature, the name should be enclosed in quotation marks in the title and at its first use in the abstract and the text and an appropriate statement concerning the nomenclatural status of the name should be made in the text. “Candidatus” species should always be set in quotation marks.

For guidelines regarding new names and descriptions of new genera and species, see the articles by Tindall (Int. J. Syst. Bacteriol. 49:1309–1312, 1999) and Stackebrandt et al. (Int. J. Syst. Evol. Microbiol. 52:1043–1047, 2002). To validate new names and/or combinations, authors must submit three copies of their published article to the International Journal of Systematic and Evolutionary Microbiology.

It is recommended that a strain be deposited in at least two recognized culture collections in different countries when that strain is necessary for the description of a new taxon (Int. J. Syst. Evol. Microbiol. 50:2239–2244, 2000).


Names used for viruses should be those approved by the International Committee on Taxonomy of Viruses (ICTV) and published in Virus Taxonomy: Eighth Report of the International Committee on Taxonomy of Viruses (C. M. Fauquet et al. ed., Elsevier Academic Press, San Diego, CA, 2005). In addition, the recommendations of the ICTV regarding the use of species names should generally be followed: when the entire species is discussed as a taxonomic entity, the species name, like other taxa, is italic and has the first letter and any proper nouns capitalized (e.g., Tobacco mosaic virus, Murray Valley encephalitis virus). When the behavior or manipulation of individual viruses is discussed, the vernacular (e.g., tobacco mosaic virus, Murray Valley encephalitis virus) should be used. If desired, synonyms may be added parenthetically when the name is first mentioned. Approved generic (or group) and family names may also be used.

Microorganisms, viruses, and plasmids should be given designations consisting of letters and serial numbers. It is generally advisable to include a worker’s initials or a descriptive symbol of locale, laboratory, etc., in the designation. Each new strain, mutant, isolate, or derivative should be given a new (serial) designation. This designation should be distinct from those of the genotype and phenotype, and genotypic and phenotypic symbols should not be included. Plasmids are named with a lowercase “p” followed by the designation in uppercase letters and numbers. To avoid the use of the same designation as that of a widely used strain or plasmid, check the designation against a publication database such as Medline.

Genetic Nomenclature

To facilitate accurate communication, it is important that standard genetic nomenclature be used whenever possible and that deviations or proposals for new naming systems be endorsed by an appropriate authoritative body. Review and/or publication of submitted manuscripts that contain new or nonstandard nomenclature may be delayed by the editor or the Journals Department so that they may be reviewed by the Genetics and Genomics Committee of the ASM Publications Board.

Before submission of manuscripts, authors may direct questions on genetic nomenclature to the committee’s chairman: Maria Costanzo (e-mail: maria@genome.stanford.edu). Such a consultation should be mentioned in the manuscript submission letter.

Bacteria. The genetic properties of bacteria are de-
scribed in terms of phenotypes and genotypes. The phenotype describes the observable properties of an organism. The genotype refers to the genetic constitution of an organism, usually in reference to some standard wild type. The guidelines that follow are based on the recommendations of Demerec et al. (Genetics 54:61–76, 1966).

(i) Phenotypic designations must be used when mutant loci have not been identified or mapped. They can also be used to identify the protein product of a gene, e.g., the OmpA protein. Phenotypic designations generally consist of three-letter symbols; these are not italicized, and the first letter of the symbol is capitalized. It is preferable to use Roman or Arabic numerals (instead of letters) to identify a series of related phenotypes. Thus, a series of nucleic acid polymerase mutants might be designated Pol1, Pol2, Pol3, etc. Wild-type characteristics can be designated with a superscript plus (Pol+) and, when necessary for clarity, negative superscripts (Pol−) can be used to designate mutant characteristics. Lowercase superscript letters may be used to further delineate phenotypes (e.g., Strr for streptomycin resistance). Phenotypic designations should be defined.

(ii) Genotypic designations are also indicated by three-letter locus symbols. In contrast to phenotypic designations, these are lowercase italic (e.g., ara his rps). If several loci govern related functions, these are distinguished by italicized capital letters following the locus symbol (e.g., araA araB araC). Promoter, terminator, and operator sites should be indicated as described by Bachmann and Low (Microbiol. Rev. 44:1–56, 1980), e.g., lacZp, lacAt, and lacZo.

(iii) Wild-type alleles are indicated with a superscript plus (ara+ his+). A superscript minus is not used to indicate a mutant locus; thus, one refers to an ara mutant rather than an ara− strain.

(iv) Mutation sites are designated by placing serial isolation numbers (allele numbers) after the locus symbol (e.g., araA1 araA2). If it is not known in which of several related loci the mutation has occurred, a hyphen is used instead of the capital letter (e.g., ara-23). It is essential in papers reporting the isolation of new mutants that allele numbers be given to the mutations. For Escherichia coli, there is a registry of such numbers: E. coli Genetic Stock Center, Department of Biology, Yale University, New Haven, CT 06511-5188. For the genus Salmonella, the registry is Salmonella Genetic Stock Center, Department of Biology, University of Calgary, Calgary, Alberta T2N 1N4, Canada. For the genus Bacillus, the registry is Bacillus Genetic Stock Center, Ohio State University, Columbus, OH 43210.

(v) The use of superscripts with genotypes (other than + to indicate wild-type alleles) should be avoided. Designations indicating amber mutations (Am), temperature-sensitive mutations (Ts), constitutive mutations (Con), cold-sensitive mutations (Cs), production of a hybrid protein (Hyb), and other important phenotypic properties should follow the allele number [e.g., araA230(Am) hisD21(Ts)]. All other such designations of phenotypes must be defined at the first occurrence. If superscripts must be used, they must be approved by the editor and defined at the first occurrence in the text.

Subscripts may be used in two situations. Subscripts may be used to distinguish between genes (having the same name) from different organisms or strains, e.g., hisE.coli or hisK12 for the his genes of E. coli or strain K12 in another species or strain, respectively. An abbreviation may also be used if it is explained. Similarly, a subscript is also used to distinguish between genetic elements that have the same name. For example, the promoters of the gln operon can be designated glnAp1 and glnAp2. This form departs slightly from that recommended by Bachmann and Low (e.g., desClp).

(vi) Deletions are indicated by the symbol Δ placed before the deleted gene or region, e.g.,ΔpopA432, Δ(araP- aceE)419, or Δhis(dhuA hisJ hisQ)1256. Similarly, other symbols can be used (with appropriate definition). Thus, a fusion of the ara and lac operons can be shown as Φ(ara-lac)95. Likewise, Φ(araB’-lacZ+’96 indicates that the fusion results in a truncated araB gene fused to an intact lacZ gene, and Φ(malE-lacZ)97(Hybs) shows that a hybrid protein is synthesized. An inversion is shown as IN(rrnD-rrnE)1. An insertion of an E. coli his gene into plasmid pSC101 at zero kilobases (0 kb) is shown as pSC101 ΔΩ(0kb::K-12hisB)4. An alternative designation of an insertion can be used in simple cases, e.g., galT236::Tn5. The number 236 refers to the locus of the insertion, and if the strain carries an additional gal mutation, it is listed separately. Additional examples, which utilize a slightly different format, can be found in the papers by Campbell et al. and Novick et al. cited below. It is important in reporting the construction of strains in which a mobile element was inserted and subsequently deleted that this fact be noted in the strain table. This can be done by listing the genotype of the strain used as an intermediate in a table footnote or by making a direct or parenthetical remark in the genotype, e.g., (F−). ΔMu cts, or mlp::ΔMu cts::lac. In setting parenthetical remarks within the genotype or dividing the genotype into constituent elements, parentheses and brackets are used without special meaning; brackets are used outside parentheses. To indicate the presence of an episome, parentheses (or brackets) are used (λ, F+). Reference to an integrated episome is indicated as described above for inserted elements, and an exogenone is shown as, for example, W3110/F8(gal+).

Conventions for naming genes. It is recommended that (entirely) new genes be given names that are mnemonics of their function, avoiding names that are already assigned and earlier or alternative gene names, irrespective of the bacterium for which such assignments have been made. Similarly, it is recommended that, whenever possible, homologous genes present in different organisms receive the same name. When homology is not apparent or the function of a new gene has not been established, a provisional name may be given by one of the following methods. (i) The gene may be named on the basis of its map location in the style yaaA, analogous to the style used for recording transposon insertions (zef) as discussed below. A list of such names in use for *E. coli* has been published by Rudd (Microbiol. Mol. Biol. Rev. 62: 985–1019, 1998). (ii) A provisional name may be given in the style described by Demerec et al. (e.g., usg, gene upstream of *folC*). Such names should be unique, and names such as *orf* or *genX* should not be used. For reference, the *E. coli* Genetic Stock Center’s database includes an updated listing of *E. coli* gene names and gene products. It is accessible on the Internet (http://cgscbiology.yale.edu/cgsc.html). The Center’s relational database can also be searched via Telnet; for access, send a request to berlyn@cgscbiology.yale.edu. A list can also be found in the work of Riley (Microbiol. Rev. 57:862–952, 1993). For the genes of other bacteria, consult the references given above.

“Mutant” versus “mutation.” Keep in mind the distinction between a *mutation* (an alteration of the primary sequence of the genetic material) and a *mutant* (a strain carrying one or more mutations). One may speak about the mapping of a mutation, but one cannot map a mutant. Likewise, a mutant has no genetic locus, only a phenotype.

“Homology” versus “similarity.” For use of terms that describe relationships between genes, consult the articles by Theissen (Nature 415:741, 2002) and Fitch (Trends Genet. 16:227–231, 2000). “Homology” implies a relationship between genes that share a common evolutionary origin; partial homology is not recognized. When sequence comparisons are discussed, it is more appropriate to use the term “percent sequence similarity” or “percent sequence identity,” as appropriate.

Strain designations. Do not use a genotype as a name (e.g., “subsequent use of *letu6* for transduction”). If a strain designation has not been chosen, select an appropriate word combination (e.g., “another strain containing the *letu6* mutation”).

“Natural” versus “artificial” transformation. Natural transformation is a process whereby the recipient cell has the inherent capacity to take up and integrate exogenous DNA into its genome. As such, natural transformation is part of the biology of the recipient cell line and should not be confused with processes through which integration of DNA is forced upon recipient cells.

Viruses. The genetic nomenclature for viruses differs from that for bacteria. In most instances, viruses have no phenotype, since they have no metabolism outside host cells. Therefore, distinctions between phenotype and genotype cannot be made. Superscripts are used to indicate hybrid genomes. Genetic symbols may be one, two, or three letters. For example, a mutant strain of *λ* might be designated *λ* Aam11 int2 red114 cI857; this strain carries mutations in genes *cl*, *int*, and *red* and an amber-suppressible (am) mutation in gene *A*. A strain designated *λ* att134 imm21 would represent a hybrid of *ϕ* which carries the immunity region (*imm*) of phage 21 and the attachment (*att*) region of phage 434. Host DNA insertions into viruses should be delineated by square brackets, and the genetic symbols and designations for such inserted DNA should conform to those used for the host genome. Genetic symbols for phage *λ* can be found in reports by Szymbalski and Szymbalski (Gene 7:217–270, 1979) and Echols and Murialdo (Microbiol. Rev. 42: 577–591, 1978).

Eukaryotes. For information about the genetic nomenclature of eukaryotes, see the Instructions to Authors for *Eukaryotic Cell* and *Molecular and Cellular Biology*.

Transposable elements, plasmids, and restriction enzymes. Nomenclature of transposable elements (insertion sequences, transposons, phage Mu, etc.) should follow the recommendations of Campbell et al. (Gene 5: 197–206, 1979), with the modifications given in section vi above. The Internet site where insertion sequences of eubacteria and archaea are described and new sequences can be recorded is http://www.is.biotoul.fr/is.html.

The system of designating transposon insertions at sites where there are no known loci, e.g., *zef*123::Tn5, has been described by Chumley et al. (Genetics 91:639–655, 1979). The nomenclature recommendations of Novick et al. (Bacteriol. Rev. 40:168–189, 1976) for plasmids and plasmid–specified activities, of Low (Bacteriol. Rev. 36:587–607, 1972) for F’ factors, and of Roberts et al. (Nucleic Acids Res. 31:1805–1812, 2003) for restriction enzymes, DNA methyltransferases, homing endonucleases, and their genes should be used when possible. The nomenclature for recombinant DNA molecules constructed in vitro follows the nomenclature for insertions in general. DNA inserted into recombinant DNA molecules should be described by using the genetic symbols and conventions for the organism from which the DNA was obtained.

Tetracycline resistance determinants. The nomenclature for tetracycline resistance determinants is based on the proposal of Levy et al. (Antimicrob. Agents Chemother. 43:1523–1524, 1999). The style for such determinants is, e.g., TetB; the space helps distinguish the determinant designation from that for phenotypes and proteins (TetB). The above-referenced article shows the correct format for genes, proteins, and determinants in this family.
ABBREVIATIONS AND CONVENTIONS

Verb Tense

ASM strongly recommends that for clarity you use the past tense to narrate particular events in the past, including the procedures, observations, and data of the study that you are reporting. Use the present tense for your own general conclusions, the conclusions of previous researchers, and generally accepted facts. Thus, most of the abstract, Materials and Methods, and Results will be in the past tense, and most of the introduction and some of the Discussion will be in the present tense.

Be aware that it may be necessary to vary the tense in a single sentence. For example, it is correct to say “White (30) demonstrated that XYZ cells grow at pH 6.8.” “Figure 2 shows that ABC cells failed to grow at room temperature,” and “Air was removed from the chamber and the mice died, which proves that mice require air.” In reporting statistics and calculations, it is correct to say “The values for the ABC cells are statistically significant, indicating that the drug inhibited . . .”

For an in-depth discussion of tense in scientific writing, see p. 191–193 in How To Write and Publish a Scientific Paper, 6th ed.

Abbreviations

General. Abbreviations should be used as an aid to the reader rather than as a convenience to the author, and therefore their use should be limited. Abbreviations other than those recommended by the IUPAC-IUB (Biochemical Nomenclature and Related Documents, 1992) should be used only when a case can be made for necessity, such as in tables and figures.

It is often possible to use pronouns or to paraphrase a long word after its first use (e.g., “the drug” or “the substrate”). Standard chemical symbols and trivial names or their symbols (folate, Ala, Leu, etc.) may also be used.

It is strongly recommended that all abbreviations except those listed below be introduced in the first paragraph in Materials and Methods. Alternatively, define each abbreviation and introduce it in parentheses the first time it is used; e.g., “cultures were grown in Eagle minimal essential medium (MEM).” Generally, eliminate abbreviations that are not used at least three times in the text (including tables and figure legends).

Not requiring introduction. In addition to abbreviations for Système International d’Unités (SI) units of measurement, other common units (e.g., bp, kb, and Da), and chemical symbols for the elements, the following should be used without definition in the title, abstract, text, figure legends, and tables: DNA (deoxyribonucleic acid); cDNA (complementary DNA); RNA (ribonucleic acid); cRNA (complementary RNA); RNase (ribonuclease); DNase (deoxyribonuclease); rRNA (ribosomal RNA); mRNA (messenger RNA); tRNA (transfer RNA); AMP, ADP, ATP, dAMP, ddATP, GTP, etc. (for the respective 5’ phosphates of adenosine and other nucleosides) (add 2’, 3’, or 5’- when needed for contrast); ATPase, dGTPase, etc. (adenosine triphosphatase, deoxyguanosine triphosphatase, etc.); NAD (nicotinamide adenine dinucleotide); NAD+ (nicotinamide adenine dinucleotide, oxidized); NADH (nicotinamide adenine dinucleotide, reduced); NADP (nicotinamide adenine dinucleotide phosphate); NADPH (nicotinamide adenine dinucleotide phosphate, reduced); NADP+ (nicotinamide adenine dinucleotide phosphate, oxidized); poly(A), poly(dT), etc. (polyadenylic acid, polydeoxythymidylic acid, etc.); oligo(dT), etc. (oligodeoxythymidylic acid, etc.); UV (ultraviolet); PFU (plaque-forming units); CFU (colony-forming units); MIC (minimal inhibitory concentration); Tris [tris(hydroxymethyl)aminomethane]; DEAE (diethylaminoethyl); EDTA (ethylenediaminetetraacetic acid); EGTA [ethylene glycol-bis(β-aminoethyl ether)-N,N,N',N'-tetraacetic acid]; HEPES (N-2-hydroxyethylpiperazine-N'-2-ethanesulfonic acid); PCR (polymerase chain reaction); and AIDS (acquired immunodeficiency syndrome). Abbreviations for cell lines (e.g., HeLa) also need not be defined.

The following abbreviations should be used without definition in tables:

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>amt (amount)</td>
<td>SE (standard error)</td>
</tr>
<tr>
<td>approx (approximately)</td>
<td>SEM (standard error of the mean)</td>
</tr>
<tr>
<td>avg (average)</td>
<td>sp act (specific activity)</td>
</tr>
<tr>
<td>concn (concentration)</td>
<td>sp gr (specific gravity)</td>
</tr>
<tr>
<td>diam (diameter)</td>
<td>temp (temperature)</td>
</tr>
<tr>
<td>expt (experiment)</td>
<td>tr (trace)</td>
</tr>
<tr>
<td>exptl (experimental)</td>
<td>ht (height)</td>
</tr>
<tr>
<td>fl (float)</td>
<td>vol (volume)</td>
</tr>
<tr>
<td>mol (mole)</td>
<td>vs (versus)</td>
</tr>
<tr>
<td>mol wt (molecular weight)</td>
<td>wk (week)</td>
</tr>
<tr>
<td>no. (number)</td>
<td>wt (weight)</td>
</tr>
<tr>
<td>prepn (preparation)</td>
<td>yr (year)</td>
</tr>
<tr>
<td>SD (standard deviation)</td>
<td></td>
</tr>
</tbody>
</table>

Reporting Numerical Data

Standard metric units are used for reporting length, weight, and volume. For these units and for molarity, use the prefixes m, μ, n, and p for 10−3, 10−6, 10−9, and 10−12, respectively. Likewise, use the prefix k for 103.

Avoid compound prefixes such as mμ or μμ. Parts per million (ppm) may be used when that is the common measure for the science in that field. Units of temperature are presented as follows: 37°C or 324 K.

When fractions are used to express such units as enzymatic activities, it is preferable to use whole units, such as g or min, in the denominator instead of fractional or multiple units, such as μg or 10 min. For example, “pmol/min” is preferable to “nmol/10 min,” and “μmol/g” is preferable to “nmol/μg.” It is also preferable that an unambiguous form, such as exponential notation, be used; for example, “μmol g−1 min−1” is preferable to “μmol/g/min.” Always report numerical data in the applicable SI units.

Representation of data as accurate to more than two significant figures must be justified by presentation of appropriate statistical analyses.

For a review of some common errors associated with statistical analyses and reports, plus guidelines on how to
avoid them, see the article by Olsen (Infect. Immun. 71:6689–6692, 2003).

For a review of basic statistical considerations for virology experiments, see the article by Richardson and Overbaugh (J. Virol. 79:669–676, 2005).

Statistics

If biological variation within a treatment (coefficient of variation, the standard deviation divided by the mean) is small (less than 10%) and the difference among treatment means is large (greater than 3 standard deviations), it is not necessary to report statistics. If the data do not meet these criteria, however, the authors must include an appropriate statistical analysis (e.g., Student’s t test, analysis of variance, Tukey’s test, etc.). Statistics should represent the variation among biological units (e.g., replicate incubations) and not just the variation due to method of analysis.

Phylogenetic trees based on nucleotide or amino acid sequence alignments must be supported by appropriate statistical analyses of tree stability (e.g., bootstrap analysis), and nonsupported branches (e.g., bootstrap coefficients below 50%) should be collapsed. A copy of the alignment should be available for examination by the editor or the reviewers upon request.

For a review of some common errors associated with statistical analyses and reports, plus guidelines on how to avoid them, see the article by Olsen (Infect. Immun. 71:6689–6692, 2003).

For a review of basic statistical considerations for virology experiments, see the article by Richardson and Overbaugh (J. Virol. 79:669–676, 2005).

Equations

In mathematical equations, indicate the order of operations clearly by enclosing operations in parentheses, brackets, and braces, in that order: \((a + b) \times c\) or \(a + (b \times c)\), \(100 \times \{(a/b) \times c\} + d\) or \(100 \times \{a\{(b \times c) + d\}\}\). Italicize (or underline) variables and constants (but not numerals), and use roman type for designations: \(E_n, E_h, M_r, K_m, K_s\), \(a + 2b = 1.2\) mM, \(Ca^{2+} V_{max} = \exp(1.5x + y)\), \(BOD = 2.7x^2\).

Isotopically Labeled Compounds

For simple molecules, isotopic labeling is indicated in the chemical formula (e.g., \(^{14}\text{CO}_2\), \(^3\text{H}_2\), and \(\text{H}^{35}\text{SO}_4\)). Brackets are not used when the isotopic symbol is attached to the name of a compound that in its natural state does not contain the element (e.g., \(^{32}\text{S}-\text{ATP}\)) or to a word that is not a specific chemical name (e.g., \(^{131}\text{I}-\text{labeled protein}, {^{14}\text{C-amino acids, and}^{3}\text{H-ligands}}\).

For specific chemicals, the symbol for the isotope introduced is placed in brackets directly preceding the part of the name that describes the labeled entity. Note that configuration symbols and modifiers precede the isotopic symbol. The following examples illustrate correct usage.

\[\text{[}^{14}\text{C}\text{]urea} \quad \text{UDP-[U-}^{14}\text{C}]\text{glucose} \quad \text{E. coli } \left[{^{32}\text{P}}\right]\text{DNA}\]

\[\text{[}2,3-^{3}\text{H}]\text{serine} \quad \text{fructose } 1,6-\left[{^{1}\text{32}}\text{P}\right]\text{bisphosphate} \quad \text{[}^{\gamma-}^{3}\text{P}]\text{ATP}\]

AEM follows the same conventions for isotopic labeling as the Journal of Biological Chemistry, and more-detailed information can be found in the instructions to authors of that journal (first issue of each year).