

The American Physiological Society: Instructions for Preparing Your Manuscript

This document will take you through all the major steps of preparing your manuscript for submission to the American Physiological Society Journals, from how best to format and organize the paper itself, to how to create digital images suitable for print and web publication, to advice on how to present supplemental data files such as video clips and long tables. The full, HTML version of these *Instructions* is located at www.the-aps.org/publications/i4a/prep_manuscript.htm, and is linked to additional information on PDFs, image file formats, etc.

These instructions pertain to all of the *American Journal of Physiology* sections, as well as the *Journal of Applied Physiology*, the *Journal of Neurophysiology*, and *Physiological Genomics*. Please note that *Advances in Physiology Education*, *Physiology* (invited only), and *Physiological Reviews* (invited only) have specific instructions that you should review if you are submitting to them.

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The American Physiological Society (APS) Journals seek definitive papers that present the entire contents of a research project. In general, all data from a group of subjects, animals, or samples should be presented together in a single paper. If this cannot be done, then the manuscript should be cross-referenced. Identical subject, animal, and sample numbers should be used in the different manuscripts to identify their commonality.

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Except in reviews and invited editorials, the APS Journals will not accept submissions in which, other than in abstracts of less than 400 words, a significant portion of the data in the form of figures and/or tables has been published elsewhere. For the APS guidelines regarding duplicate and/or prior publication, see the *APS Ethical Policies and Procedures* at <http://www.the-aps.org/publications/journals/apsethic.htm>.

Authorship Changes

Changes to authorship are handled differently depending on when the error is noticed, i.e., on the stage of publication of the paper.

After Submission but Before Acceptance

If you realize that changes to authorship (e.g., altering the order of authorship or adding/removing a name) are needed, please follow these steps:

- Download the Change of Authorship Form (at http://www.the-aps.org/publications/journals/pub_author_form.pdf).
- Have ALL authors sign it.
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If you have realized that an author's name was misspelled in such way as to affect finding the article in PubMed or through other searches, notify the Peer Review office so that the article can be fixed by amending the Articles in PresS edition. Please note: this is the ONLY case when the Articles in PresS edition will be corrected. Follow the steps above when submitting the correction. Other authorship corrections can still be made for the final print and online editions (see paragraph below).

During Production of the Final Print and Online Editions

Changes to authorship (e.g., altering the order of authorship; adding/removing a name; adding or changing an initial) can still be made during production. You will need to follow these steps:

- Download the Change of Authorship Form (at http://www.the-aps.org/publications/journals/pub_author_form.pdf).
- Have ALL authors sign it.
- Fax, mail, or e-mail the signed form to the Journal Editorial office (301-634-7243).

After the Final Edition has been Published in Print and Online

Any changes to authorship can only be made through a corrigendum to the print edition. The online version will have a permanent link to the corrigendum. Follow the steps in the previous section (*During Production of the Final Print and Online Editions*) when submitting the changes.

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The “submitted” date for a manuscript is the date when the manuscript was submitted to *APS Central* online peer review system (<http://www.apscentral.org>). The “accepted” date is the date when the official letter of acceptance is sent out (usually via e-mail) from the Review Editor. For specific requirements, see details at <http://www.the-aps.org/publications/i4a/acceptance.htm>.

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See the inside back cover of this journal for the APS Ethical Policy (or go to http://www.the-aps.org/publications/i4a/prep_manuscript.htm#apsethic).

Use of Humans and/or Animals in Experiments

The research described in papers submitted to any of the APS publications that involve the use of human beings, including healthy volunteers, must adhere to the principles of the Declaration of Helsinki (see <http://www.wma.net/e/policy/b3.htm>), as well as in Title 45, US Code of Federal Regulations, Part 46, Protection of Human Subjects, Revised November 13, 2001, effective December 13, 2001 (see <http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.htm>). Research involving animals must adhere to APS's *Guiding Principles in the Care and Use of Animals*. APS insists that all investigations involving humans or animals reported in its publications be conducted in conformity with these principles, and that a statement of protocol approval from an IRB or IACUC or equivalent is included in the methods section of the paper. In describing surgical procedures, the type and dosage of the anesthetic agent should be specified. Curarizing agents are not anesthetics; if these were used, evidence must be provided that anesthesia of suitable grade and duration was employed. Manuscripts reporting the results of experiments on human subjects, including healthy volunteers, must include a statement that informed consent was obtained. Editors/Associate Editors are expected to refuse papers in which evidence of the adherence to these principles is not apparent. They reserve the right to judge the appropriateness of the use of animals and humans in experiments published in the

journals. Differences of opinion will be adjudicated by the Publications Committee.

Registering of clinical trials is a requirement for peer review and publication for any study that uses clinical trials. There must be a statement in the Methods section that states where the clinical trial was registered (for example, see the registration site sponsored by the United States National Library of Medicine, at <http://www.clinicaltrials.gov>).

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The American Physiological Society Publications require all papers submitted to any of the APS Journals and involving the use of human fetuses, fetal tissue, embryos, and embryonic cells to adhere to the US Public Law 103-41, effective August 1991. Please read the *APS Policy Regarding Publication of Research on Human Fetuses, Fetal Tissue, Embryos, and Embryonic Cells* (see http://www.the-aps.org/publications/journals/fetal_tissue_policy.htm) and the criteria that must be met by all researchers submitting their work to the APS Journals.

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Authors of research and other articles are required at the time of submission to disclose to the APS Publications Office any potential conflict of interest (e.g., consultancies, stock ownership, equity interests, patent-licensing arrangements, lack of access to data, or lack of control of the decision to publish). In such cases, the author(s) will be asked to fill out a Conflict of Interest Disclosure form. The information provided in the form, unless already disclosed in the submitted article, will be held in confidence while the paper is under review. If the article is accepted for publication, information on the potential conflict of interest—including a lack of control of the decision to publish—will be included in the Disclosures section, following the Acknowledgments section.

Standards

All authors of articles submitted to APS journals should submit their relevant data to all appropriate data repositories, such as the National Center for Biotechnology Information (NCBI) and the European Bioinformatics Institute (EBI).

MIAME Standard for Microarray Data

The American Physiological Society has adopted the microarray data standard developed by the Microarray Gene Expression Data society (MGED; <http://www.mged.org>) and requests that all authors using microarray data analysis in their research submit a complete data set to one of three databases prior to manuscripts submission: the NCBI Gene Expression Omnibus (GEO; <http://www.ncbi.nlm.nih.gov/projects/geo>); the EMBL-EBI ArrayExpress repository (<http://www.ebi.ac.uk/arrayexpress>); or the Center for Information Biology Gene Expression (CIBEX) database (<http://cibex.nig.ac.jp/index.jsp>). Also, provide the set of login credentials (user name and password) that will let referees access the data set during review, if it is set up as a private resource.

HUGO Gene Nomenclature

In accordance with the HUGO Gene Nomenclature Committee (HGNC), the APS requests that authors obtain approval for new human and mouse gene symbols by contacting either Dr. Elspeth Bruford for human genes (e-mail: hgnc@genenames.org) or Lois Maltais for mouse genes (e-mail: nomen@informatics.jax.org). Additional information on gene nomenclature guidelines is available from the HGNC (<http://www.gene.ucl.ac.uk/nomenclature/>).

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File Formats for Online Submission and Print

Please submit a Microsoft Word (.doc) file or a Rich Text Format (.rtf) file to APS Central (<http://www.apscentral.org>). Separate files must be submitted for all discrete elements of the manuscript [e.g., separate files for each figure and table, a separate file for the complete text of the manuscript (including abstract, all main text, bibliography, figure legends and table legends, etc.)].

The APS Central system will concatenate the various files into a single document for review. If the paper is accepted, the separate files will be moved forward into the final print production process.

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APS accepts manuscripts in one of two formats: double-spaced in wide, one-column format, or single-spaced in two-column format. If you choose two-column format and wish to embed the figures into the text, please also include separate figure files for production (see sections on Figures, below). The pages should be numbered in the upper right-hand corner (beginning with the first page of text).

Arrange as follows (all should begin on separate pages):

- title page
- abstract and keywords on the same page
- main text (introduction; Materials and/or Methods, or Experimental Procedures; Results; Discussion, with conclusions)
- text footnotes
- acknowledgments
- references
- figure legends
- tables

Be sure the text is clear and concise, conforming to accepted standards of American English style and usage. Avoid jargon, clichés, and laboratory slang. See *Manuscript Sections*, below, for further description.

Abbreviations, Symbols, and Terminology

All abbreviations must be explicitly defined at first usage. However, internationally accepted biochemical abbreviations such as ADP, NADH, and P_i do not need to be defined; other abbreviations need only be defined at first mention. Please consult the list of accepted abbreviations for our journals (<http://www.the-aps.org/publications/journals/abbrv.pdf>). Other abbreviations need only be defined at first mention. For word usage, symbols, etc., authors are referred to *Scientific Style and Format: The CBE Manual for Authors, Editors, and Publishers* (6th ed., 1994). For chemical and biochemical terms and abbreviations, consult the recommendations of the IUPAC-IUB Combined Commission on Biochemical Nomenclature. Isotope specification must conform to the IUPAC system. Authors are referred to the following articles for style in specialized fields: “Glossary on respiration and gas exchange” (*J Appl Physiol* 34: 549–558, 1973); and “Glossary of terms for thermal physiology” (*J Appl Physiol* 35: 941–961, 1973).

Special Symbols

For special characters not available on the standard 104-key keyboard (e.g., Greek characters, mathematical symbols, figure symbols), use the Symbol font or use the “Insert Symbol” function in Microsoft Word; do **not** use math font or image files (e.g., GIF) within the text for special characters or text constructions. Please also note that we cannot process files prepared in LaTeX.

Spelling and Compounding

Authors should follow *Webster’s Third New International Dictionary or Merriam Webster’s Collegiate Dictionary*, 11th edition, for spelling and compounding. The APS Journals use American English rules for spelling.

Citing Unpublished Observations and Personal Communications

Citations of submitted papers still in preparation, in peer review, or of other unpublished materials cannot be included in the reference list, which may only list published work. Such citations can, however, be provided in parentheses in text as “unpublished observations” (e.g., “J. M. K. Smith, unpublished observations”). The APS Journals discourage the use of personal communications. However, if they are used, the author(s) must have in their file a letter granting permission from the communicant and stating that the person whose opinion is cited has seen and approved the actual wording of the citation. If requested, the author will send the letter to the APS Publications office. For both unpublished observations and personal communications provide the cited person’s last name and all initials.

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Proprietary (trademarked) names should be capitalized, with the spelling carefully checked. The chemical or generic name should precede the trade name or abbreviation of a drug the first time it appears.

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Unique Materials and Data Banks

Work published in the APS Journals must necessarily be independently verifiable. Authors describing results derived from the use of antibodies, recombinant plasmids and cloned DNAs, mutant cell lines or viruses, and other similarly unique materials are expected to make such materials available to qualified investigators on request. Authors should also submit published nucleic acid/amino acid sequences to a widely accessible data bank. Sequence data for the United Protein Database (UniProt) should be submitted directly to UniProt using SPIN, a new web-based tool for submitting protein sequences (see <http://www.pir.uniprot.org/>). Also, for other special types of submissions (e.g., genomes, bulk submissions), additional submission protocols are available from the following organizations:

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See also *MIAME Standard for Microarray Data* (above) and *Data Supplements* (below).

Manuscript Sections

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All submissions must contain a title page, however brief the article may be. The title page must contain the title of the article; author(s) name(s); all departments and institutions in which the work was done; an abbreviated title for the running head; the name, e-mail address, and address for correspondence.

Title

Make the title informative. Avoid unnecessary words like “Studies in . . .” The title must not exceed 160 characters, including spaces between words.

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List all authors' names and their first names or initials exactly as they should be known, **in the order of importance of their contribution to the study**. Do not include any specific titles (e.g., PhD, MD, and Prof. are not needed). “Group authorship” is allowed, with the name of a group (such as a consortium or program) to be listed as an author, with members of the

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List all departments and institutions in which the work was done, with city and state or country. Identify each author's affiliation by superscript numbers matched to the appropriate institution. Affiliation must reflect the organization(s) supporting the author(s) while the work was done. This may differ from the current affiliations of the author(s), which will be listed in such cases in the Acknowledgments section as the present addresses of the authors.

Running head

The running head is an abbreviated version of the title, which will appear at the top of every page subsequent to the first page. Running heads must not exceed 55 characters including spaces between words.

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A full address for correspondence will be published and must be included, **with a current, valid e-mail address** for the corresponding author. This address will be published on the title page. Please note that a valid e-mail address is essential to participate in the APS electronic proofing service called “Rapid Proof.” Also, provide phone and fax numbers for use while your article is in production. If the contact information to be used during production differs from that to be included in the final article, indicate this explicitly. To contact APS during the submission and peer review and/or during production after acceptance, go to the APS website (www.the-aps.org) and choose the appropriate journal's web page.

Abstract

An informative one-paragraph abstract of not more than 250 words must accompany each manuscript. It must state concisely what was done and why (including species and state of anesthesia), what was found (in terms of data, if space allows), and what was concluded. Note that longer abstracts are usually cutoff at the end when displayed on Medline.

Keywords

Include three to five words or short phrases, relevant to the article, that do not appear in the title or running head. (**NOTE:** Authors submitting to the *Journal of Neurophysiology* are not required to provide keywords.)

Introduction

Provide a brief overview of the scope and relevance of the study, especially with regard to previous advancements in related fields.

Materials and Methods

(Sometimes called “Experimental Procedures”). Describe techniques, cell/animal models used, and lists of reagents, chemicals, and equipment, as well as the names of manufacturers and suppliers, so that your study can be most easily replicated by others. Also in this section, describe the statistical methods that were used to evaluate the data. If your research involved the use of microarrays, see *MIAME Standard for Microarray Data* (above), and insert in this section the URL pointing to your microarray data. If clinical trials were used, a statement of registration is required; also, for all investigations involving humans or animals, a statement of protocol approval from an IRB or IACUC, or an equivalent statement, must be included (see *Use of Humans and/or Animals in Experiments* above). See *Abbreviations, Symbols, and Terminology* (above) for style information.

Results

Provide the experimental data and results as well as the particular statistical significance of the data. Regarding the use of statistics, including reporting standard error (SE) and standard deviation (SD) values, an Editorial (“Guidelines for reporting statistics in journals published by the American Physiological Society”) was published in all August 2004 issues of the APS Journals. The Editorial is freely available (see, for example, <http://physiolgenomics.physiology.org/cgi/content/full/18/3/249>), and the authors are encouraged to consult it.

Discussion

(Sometimes combined with the results in a section called “Results and Discussion”). Explain your interpretation of the data, especially compared with previously published material cited in the References.

Acknowledgments

List the people indirectly involved with the research whom you may wish to thank. This is also the appropriate place to thank anyone for technical assistance. Also, current addresses of authors (which may differ from those in the affiliation line) may be included here.

Do not include “promissory notes.” APS Journal policy is against inclusion of implicit or explicit promises that future work will be published.

Do not include dedications. Dedications of articles are not permitted.

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List the grants, fellowships, and donations that funded (partially or completely) the research. However, industry sponsored grants should be listed under *Disclosures*.

Disclosures

Authors of research articles are required at the time of submission to disclose to the APS Publications Office any potential conflict of interest (e.g., consultancies, stock ownership, equity interests, patent-licensing arrangements, lack of access to data, or lack of control of the decision to publish). In such cases, the author(s) will be asked to fill out a Conflict of Interest Disclosure form. The information provided in the form, unless already disclosed in the submitted article, will be held in confidence while the paper is under review. If the article is accepted for publication, information on the potential conflict of interest—including a lack of control of the decision to publish—will be included in the Disclosures section, following the Acknowledgments section. The Disclosures section will also include acknowledgments of industry-sponsored grants that supported the research.

References

Authors are responsible for accuracy of citations. References must be limited to directly pertinent **published** works or papers that have been **accepted for publication**. An abstract, properly identified as “Abstract”, may be cited only when it is the sole source.

References should be double-spaced, arranged alphabetically by author, and numbered serially. The reference number should be placed in parentheses at the appropriate place in the text.

Important Note: The reference list should not include citations of submitted papers still in preparation, in peer review, or of other unpublished materials. Such information may be provided in parentheses in the text as “unpublished observations” (e.g., “J. M. K. Smith, unpublished observations”).

The APS Journals discourage the use of “personal communications.” However, if they are used, the author(s) must have in their file a letter granting permission from the communicant and send it to the APS Publications Office if requested.

For both unpublished observations and personal communications provide the cited person’s last name and all initials.

Note for references in the *Journal of Neurophysiology*

References for the *Journal of Neurophysiology* should be double-spaced and arranged alphabetically by author. The appropriate author name and year for each reference should be included in parentheses at the proper point in the text using the following style:

- One author (Brown 1982).
- Two authors (Brown and Smith 1982).
- Three or more authors (Brown et al. 1982).

If more than two references are cited by different authors, separate entries with a semicolon (Brown 1982; Smith 1983). If more than two references are cited by the same first author (or single author), use “et al.” where appropriate plus the date, even if the subsequent authors are not the same in all the references (Brown et al. 1982, 1983, 1986–1988). Note the use of commas between two consecutive years or nonconsecutive years and dashes for ranges (Brown et al. 1982, 1983, 1986–1988). If more than two references with the same year and author(s) are cited, use lowercase letters after the year (Brown 1982a,b). Lowercase letters will be inserted in the same-year references in the reference list.

Although the *Journal of Neurophysiology* does not require that the reference list be numbered, the examples given below are shown with numbers because that is the style for most APS Journals. In all other respects, the reference style used in the example below is the same across all journals.

The style of citation should be as follows, with journal name abbreviated as in Medline, PubMed, and Index Medicus. APS offers a selection of output styles available for a variety of citation management software (<http://www.the-aps.org/publications/journals/styles.htm>).

Examples

Journal Articles

1. Villalobos AR, Parmelee JT, Renfro JL. Choline uptake across the ventricular membrane of neonate rat choroid plexus. *Am J Physiol Cell Physiol* 276: C1288–C1296, 1999.

Book References

1. Pollock DM. Endothelin receptor subtypes and tissue distribution. In: *Endothelin Molecular Biology, Physiology, and Pathology*, edited by Highsmith RF. Totowa, NJ: Humana, 1998.

APS Handbook of Physiology Series

Large textbooks require very specific citation information. For example, the APS Handbooks series contains a huge amount of information, and the inclusion in the citation of the section, volume, part, and chapter is essential to aid the reader in finding the information quickly (please note that the APS chooses not to list editors for the APS Handbooks).

1. Kaufman MP, Forster HV. Reflexes controlling circulatory, ventilatory, and airway responses to exercise. In: *Handbook of Physiology. Exercise: Regulation and Integration of Multiple Systems. Control of Respiratory and Cardiovascular Systems*. Bethesda, MD: Am. Physiol. Soc., 1996, sect. 12, pt. II, chapt. 10, p. 381–447.

Articles Published on the Web

Many reports are being published primarily, if not exclusively, on the World Wide Web. Such articles should be cited in the “online” style as shown below.

Format:

Author/editor (if known). (Revision or copyright date, if available). Title of page [Publication medium]. Page publisher. URL (Protocol://Site/Path/File) [Access date].

1. Dudoit S, Yang YH, Callow MJ, Speed TJ. Statistical methods for identifying differentially expressed genes in replicated cDNA microarray experiments [Online]. Dept. of Statistics, Univ. of California at Berkeley. <http://www.stat.berkeley.edu/users/terry/zarray/Html/matt.html> [3 Sept. 2000].

Note that the date may be general or specific, to the day.

Some citations may have portions published in print and other relevant portions reposted online. However, if directions to the online portions are available in the printed work, this sort of citation should be avoided.

1. Joachims T. Making large-scale SVM learning practical. In: *Advances in Kernel Methods: Support Vector Learning*, edited by Schölkopf B, Burges C, and Smola A. MIT Press, 1999. [The software is available at http://www.-ai.cs.uni-dortmund.de/SOFTWARE/SVM_LIGHT/svm_light.eng.html]

2. Spellman PT, Sherlock G, Zhang MQ, Iyer VR, Anders K, Eisen MB, Brown PO, Botstein D, Futcher B. Comprehensive identification of cell cycle-regulated genes of the yeast *Saccharomyces cerevisiae* by microarray hybridization. *Mol Biol Cell* 9: 3273–3297, 1998. [The data are available at <http://cellcycle-www.stanford.edu>]

DOIs and Early Publication in Articles in Press

Current technology allows publication of an article in several editions. For example, the final, citable draft of an accepted article may be posted to a web site, pending final copyediting and page layout/design. This initial post to the web qualifies as publication, but eventually the article will reach the readership in a final, polished form.

The APS publishes peer-reviewed articles upon acceptance, as Articles in PresS. These articles may be cited and establish publication's priority before they appear in final print and online forms. (Please note the required use of a "digital object identifier"—DOI—in this citation.)

1. **Scarafia LE, Winter A, Swinney DC.** Quantitative expression analysis of the cellular specificity of HECT-domain ubiquitin E3 ligases. *Physiol Genomics* (April 26, 2001). doi:10.1152/physiolgenomics.00075.2001.

However, once this article has reached its final stage of publication, it will be cited with its new publication data, as follows:

1. **Scarafia LE, Winter A, Swinney DC.** Quantitative expression analysis of the cellular specificity of HECT-domain ubiquitin E3 ligases. *Physiol Genomics* 4: 147–153, 2001. First published April 26, 2001; doi:10.1152/physiolgenomics.00075.2001.

Technical Documents, Congress Proceedings, etc.

Technical documents, congress proceedings, and some other sorts of material may often be published by the specific institution that sponsored the research.

1. **Efron R, Tibshirani B, Goss V, Chu G.** *Microarrays and Their Use in a Comparative Experiment* (Technical Report). Palo Alto, CA: Department of Statistics, Stanford University, 2000.

Corrigenda/Errata

If an article required a correction, after first publication, this should be noted in the citation of the original article.

1. **Hallows KR, Packman CH, Knauf PA.** Acute cell volume changes in anisotonic media affect F-actin content of HL-60 cells. *Am J Physiol Cell Physiol* 261: C1154–C1161, 1991. (Corrigendum. *Am J Physiol Cell Physiol* 268: March 1995, following table of contents)
2. **Steenman M, Chen YW, Le Cunff M, Lamirault G, Varró A, Hoffman E, Léger JJ.** Transcriptomal analysis of failing and nonfailing human hearts. *Physiol Genomics* 12: 97–112, 2003. First published November 12, 2002; doi:10.1152/physiolgenomics.00148.2002. (Corrigendum. *Physiol Genomics* 18: 128, 2004)

Translations

1. **Gavrilov KA, Perel TS.** Earthworms and other invertebrates in the soil under...[in Russian]. *Pochovedenia* 8: 133–140, 1958.
2. **Gavrilov KA, Perel TS.** Earthworms and other invertebrates in the soil under...[in Russian, English summary]. *Pochovedenia* 8: 133–140, 1958.
3. **Fritsch G, Hitzig E.** Uber die Elektrische. In: *Some Papers on the Cerebral Cortex*, translated and edited by von Bomin G. Springfield, IL: Thomas, 1960, p. 73–96.
4. **Vol'Kenshtein MV.** *Molecules and Life: An Introduction to Molecular Biology*. New York: Plenum, 1970. [Transl. from the Russian.]

Many Authors

It is APS Publications policy to list all authors in a research group. That is, the use of only the first author's name, followed by "et al." is unacceptable.

However, if there is an inclusive name for the research group as a whole (for example, the "International Human Genome Sequencing Consortium," which comprises some 250 researchers), it should be used rather than listing hundreds of authors.

So, the following format is acceptable:

1. **International Human Genome Sequencing Consortium.** Initial sequencing and analysis of the human genome. *Nature* 409: 860–921, 2001.

Consult recent issues of the APS Journals for more examples.

Citing Personal Communications or Unpublished Observations

Do not include such citations in the Reference list (see Important Note, in References section above, for more information). Instead, place this sort of citation in parentheses in the body of the article where it logically belongs, following the format below. Make sure to include all initials and, for personal communications, obtain a signed letter of permission from the person(s) cited.

(A. B. C. Jones and Z. Smith, personal communication)

(J. Jones, unpublished observations)

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Footnotes

Text footnotes should be numbered consecutively throughout. They should be double-spaced and assembled on a separate page.

Types of Articles

The APS Journals publish a variety of article types in addition to the regular research papers. For descriptions of the types of articles published in a particular journal, go to that journal's page at the APS website (<http://www.the-aps.org>). A full listing of article types is also available on the Mandatory Submission Form at *APS Central*, during submission to the Journal of your interest.

If your research paper is submitted in response to a Call for Papers, please make sure to mark it as such during submission to *APS Central*.

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APS uses digital publishing methods throughout the journal production process. Your article will be published both in the print journal and online. We have several specific requirements for digital graphics formats to ensure the best possible reproduction in both media.

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Authors may be asked to prepare new figures if those submitted are not suitable for publication; this will most likely delay publication of the paper.

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Use applications capable of creating high-resolution TIFF or EPS files. These file formats ensure the highest success rate for printing and are supported by both Mac and Windows platforms and applications.

Supported Applications

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- Choose the application used to create original images.
- Follow step-by-step instructions for saving or exporting files as TIFF or EPS.
- If you do not see the application used to create your original figures, you may be able to create high-resolution PDF files using Adobe Acrobat Distiller. From these files, you can create TIFF or EPS files using Adobe Photoshop or Illustrator.

Applications use software "drivers" to convert their native-format files into the TIFF or EPS formats that we require. Each application uses its own driver to make these conversions. So, the quality and usability of the TIFF and EPS files depends on the quality of the driver used to create them. A graphic that looks and prints fine on your computer may not be usable by our graphic software such as Adobe Photoshop, Adobe Illustrator, Corel Draw, or Corel PhotoPaint. **Please Note:** If you are not using one of these major graphics authoring programs, your TIFF and EPS files may require extra processing or even be unusable.

Figure Style Guidelines

Size

Figures should be generated at the size they are to appear in the journal (printed 1:1). Figures may be printed in one of three formats:

- single column (3.5 in., or 21 picas)
- double column w/ side legend (4–5 in., or 25–30 picas)
- full page width (7 in., or 43 picas)

The maximum depth allowable is 9 in. (54 picas). If it is necessary to submit figures that require reduction, the indicated size characteristics must be achievable after resizing. Multi-paneled figures should be assembled in a layout that leaves the least amount of blank space and does not exceed 7×9 in.

Type

For serif fonts, use Times Roman or Times New Roman. For sans-serif, use Helvetica or Arial. Fonts should be used consistently throughout all figure(s). Freehand, typewritten, and dot-matrix lettering are not acceptable.

Font Sizes:

- Primary (axis labels): 8–10 points
- Secondary (key information): 7–8 points
- Tertiary (numeric values): 5–7 points
- Panel Labels (i.e., A, B, C): 12–14 points

All lettering and key information should be within the framework of the illustration, unless the figure is so filled that symbols need to be explained in the legend.

Resolution

- Line drawings: 600–1200 dpi
- Halftones: no text, 300 dpi; with text, 600 dpi
- Color graphics: 600 dpi

Line Drawings

Line art uses only black and white to convey its information. These images are typically produced in a vector-based drawing program. Save or export graphics as EPS or TIFF files at 600–1200 dpi in resolution. If figures require reduction to fit into a particular column width, all lettering, line weights, and symbols must be of a size and weight that will meet the guidelines for final size.

Halftones

Many graphics include shades of gray. These grays may be simple fills (screened dot patterns to simulate grays) or they may be subtle and complex tones in digitized photographs or intricate drawings. Save or export halftone graphics that **do not contain text** as EPS or TIFF files at 300 dpi in resolution. Halftone graphics **that contain text and symbols** should be saved or exported as EPS or TIFF files at 600 dpi in resolution.

When necessary, include an internal scale marker to account for any needed reduction. Special features on photomicrographs should be designated by letters, numerals, arrows, and other symbols that contrast with the background.

Photographs of equipment should be used sparingly; good line drawings are usually more informative.

Photographs of animals or humans are acceptable if they are the only way to show results and only with the approval of the Editor. For a photograph of a human, you will need to provide a signed permission from the photographed subject, agreeing to the publication of his or her image.

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APS encourages the use of scientifically necessary color images in its publications. For an explanation of what is considered “scientifically necessary” color see http://www.the-aps.org/publications/i4a/scientifically_necessary.htm. To ensure that your files are prepared appropriately for offset printing, please follow these guidelines:

- **NEW: Authors should create and submit all color images for print in RGB separation format** (http://www.the-aps.org/publications/i4a/cmyk_vs_rgb.htm). APS will now be following an RGB workflow for all scientifically necessary images. Online journal publication allows for the use of original RGB color images as they were captured and seen in author’s laboratories and presentations. RGB images will be preserved throughout the online publication process and displayed as the author intended.

The RGB workflow allows for the preservation of fluorescent blues, greens, and reds.

- **Note:** All color images will still have to be converted to CMYK for publication in the printed journals. The print quality should not suffer and in many cases will look much better, because the conversion will be done by our printer with much more sophisticated software than is being used in-house to do the conversions.
- **Use an illustration or graphics software program such as Adobe Photoshop or Illustrator** for creating or scanning images.
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- **Submit Acrobat PDF files in lieu of TIFF or EPS.** If the program that you are using to generate your image does not offer an EPS or TIFF format for saving or exporting, you can create high resolution PDF (portable document format) with the full version of Adobe Acrobat/Acrobat Distiller (http://www.the-aps.org/publications/i4a/pdf_hires.htm).

The information contained within a submitted color graphic file is the responsibility of the author. APS will not alter (i.e., color correct) the information contained in a submitted file. Extensive author corrections and changes at proof stage will incur additional charges.

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Use of Animals in Photographs

- Photographs of animals may be published when scientifically necessary to illustrate a setup or convey the findings of the paper.
- When a diagram is preferable to illustrate a setup, if it is not possible to obtain a drawing, the author should describe the setup in the methods section of the paper.
- Photographs to convey findings may be published when the data are conveyed in the image as in developmental biology or genetic modifications where such photographs are standard practice.
- With respect to other areas, the decision whether to publish a photograph will be based upon the editor’s determination whether the photograph is scientifically necessary.
- The journals should avoid publishing photographs that might be perceived as raising animal welfare concerns. For example, it is preferable to show only the relevant portion of the animal, photographs should not show blood or people handling the animals except close-ups where only gloved hands are seen.

Graphs

Electrocardiograms, kymograms, and oscillograms should be prepared so that the crosshatched background is eliminated. To avoid problems in processing, use non-photo blue-ruled instead of black-ruled recording paper for the originals.

Tables

Whenever possible, authors are encouraged to submit figures rather than tables. Statistical summary tables should be submitted when possible, rather than tables with many lines of individual values. Lengthy tables of data, on the Editor’s recommendation and with the approval of the author, will be deposited by the APS Publications (see *Data Supplements*, below).

Submitted tables should adhere to the following guidelines:

- Each table should appear on a separate page of the manuscript.
- Tables must not duplicate material in text or figures.
- Tables should be numbered consecutively with Arabic numerals and prepared with the size of the journal page in mind: 3.5 in. wide, single column; 7 in. wide, double column.

- Each table should be double-spaced.
- Each table should have a brief title; explanatory notes should be in the legend, not in the title.
- Horizontal and vertical rules should be omitted.
- Nonsignificant decimal places in tabular data should be omitted.
- Short or abbreviated column heads should be used and explained if necessary in the legend.
- Statistical measures of variations, SD, SE, etc., must be identified. (Example: "Values are means \pm SE.")
- Table footnotes should be listed in order of their appearance and identified by standard symbols: *, †, ‡, § for four or fewer; for five or more, consecutive superior lowercase letters should be used.

Mathematical Equations and Modeling

Mathematical aspects of articles normally should be addressed to the many readers of the Journal who are not mathematicians. The presentation should include the mathematical strategy, the assumptions on which the mathematics are based, and a summary of the meaning of the final mathematical statement and its limitations.

Equations

Mathematical equations should be simplified as much as possible and carefully checked.

Use the slant line (/) for simple fractions $(a + b)/(x + y)$ in the text rather than the built-up fraction $\frac{a + b}{x + y}$, which should only be used if the equation is offset from the text.

Use subscripts or superscripts wherever feasible and appropriate, because they often simplify the equations by eliminating the need for extraneous operations: R_A/R_D instead of $RA \cdot RD$ or $(RA)(RD)$.

Use circles for pools in compartmental or flow-type models and whole arrows for interconnections or flows (not arrows with half-heads, as in reversible chemical equations).

Do not use nonstandard mathematical notations; e.g., do not use computer symbols in equations (* for multiplication or ** for exponentiation).

Use lowercase letters for time-varying symbols in compartmental model equations, preferably $q(t)$ for masses, $c(t)$ for concentrations, with subscripts as needed.

Our convention for numerical subscripts for rate constants (k_{21}) is the same as that used in most life sciences but opposite to that currently used in pharmacokinetics; i.e., our k_{ij} is the fractional rate of transfer from compartment j to compartment i (or to compartment i from compartment j , if you prefer). Our notation is consistent with standard nomenclature in applied mathematics for matrices and matrix manipulation algorithms in commercial software packages for scientific/mathematical computations involving matrices. However, the author(s) may use a different convention if it is clearly defined in the manuscript.

Symbols should be defined as they first appear in the text, and a Glossary should also be included in articles with many different symbols, specifying the units (dimensions) as well as each definition. The Glossary will usually precede the Methods section.

APS style allows punctuation in displayed equations.

Mathematical Models

Presentation of the model(s) must be sufficiently clear to allow physiologists with limited experience in modeling to follow the model development, limitations, and physiological relevance. Assumptions concerning the importance of physiological processes included in the model should be clearly stated.

If the model equation(s) require solution, the method of solution should be described in sufficient detail to permit readers to duplicate the solution in their own laboratories. Algorithms from commercial software libraries should be so

identified. Details of the solution strategy may be summarized in an Appendix (for an example, see <http://jap.physiology.org/cgi/reprint/96/1/65.pdf>).

For simulations, sources or estimation methods for all parameter values should be presented and the numerical values given in the text or a table. A sensitivity analysis must be performed for important parameters (covering ranges of values relevant to the manuscript) to determine how the model predictions are affected by numerical parameter values.

If the model is used to estimate parameter values, measures of the uncertainties associated with the estimated parameter values should be presented.

For models intended for use in a predictive setting, validation of the model with a data set not used for model parameter estimation (i.e., cross-validation) is recommended. Sensitivity analysis or parameter uncertainty determination is an important component of modern modeling practice that allows assessment of the validity of a model.

Results obtained with the model(s) should be compared with appropriate physiological data, either from literature or from new experiments. Simulation results may be examined for prediction of changes or trends in physiological variables similar to those reported for in vitro or in vivo studies. The discussion should include information on the physiological significance of the model study, limitations of the model, and suggestions for new modeling and/or experimental studies.

Data Supplements

Video files, extensive tables of data, and other supplemental material that cannot be feasibly published in the printed journal may be submitted for inclusion in the online journal (without charge to the author). Such material must be submitted for peer review along with the finished manuscript and must meet the approval of the journal Editor.

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Authors are responsible for compiling their own digital video. Files should be in MPEG or Quicktime format and should be no more than 10 megs in size. Authors may be requested to resubmit their videos with shorter running time, smaller frame size, or lower resolution in order to conform to the recommended file size. Authors should include a written caption with each video file, explaining what is happening in the video.

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Long data tables should be submitted in Microsoft Excel or in Microsoft Word table format. Each table should include a title explaining what the table shows. Tables published online may look different than how they were originally submitted due to the limits of the HTML format.

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