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INFORMATION TO CONTRIBUTORS

(Revised May 1976)

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The Proc. Natl. Acad. Sci. USA publishes brief reports (not submitted for publication or previously published elsewhere) of the results of original research by members of the Academy or by others if the communication is sponsored by an Academy member. Articles should be as brief as adequate presentation allows, and may not exceed five printed pages. Since the PROCEEDINGS publishes papers in all branches of science represented in the Academy, it is desirable, whenever possible, for articles to be written so as to be intelligible to a wide scientific audience. Both because of the space limitations and the broad scientific audience of the PROCEEDINGS, detailed scientific papers may often be more appropriately submitted to more specialized journals.

Sometimes, preliminary findings of major importance are published in the PROCEEDINGS without full documentation; authors must indicate that the paper is a preliminary one and that a detailed report will be published elsewhere.

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No person may be author or coauthor of papers totaling more than five pages in any one issue.

Manuscripts reporting research involving human subjects should be accompanied by a copy of the document authorizing the proposed research by the responsible institutional committee. Authors are referred to the Declaration of Helsinki for further guidance.

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Five printed pages will accommodate about 5500 words. The title and the heading material usually occupy space equivalent to about 600 words. Appropriate allowance should be made for the space occupied by references, footnotes, tables, and figures with their legends. Figures will be scaled to one- or two-column width according to the size of the lettering (see Illustrations below).

Articles estimated on first receipt as longer than five pages will be returned to authors for shortening without further editorial consideration.

Illustrations
Present only such illustrative material as is essential for the point being made. Drawings made for slide projection are rarely suitable for publication. Design line drawings to fit into one- (83 mm or 20 picas) or two- (175 mm or 42 picas) column width. Use thin-stroke lettering in sizes such that after reduction the letters with ascenders (e.g., b, h) or capital letters will be between 1.5 and 2.5 mm in height. Use the legends for details, e.g., cell type used, identification of symbols. These instructions should be given to the artist or photographer who is preparing your illustrations.

All figures should be identified on the back with a soft pencil and the orientation should, if necessary, be indicated by means of an arrow and the word "top". Do not mount figures unless a complete figure is desired. Indicate the magnification of photomicrographs in the legend, or include a bar indicating scale in the figure (or both).

Legends to figures should be typed double-spaced, in numerical order, on a separate page.

When graphs (or tables) involve very large or very small numbers, and authors wish to use powers of ten, the convention of the PROCEEDINGS is that the numbers on the axis (or in the column) are the product of the original figure and the factor on the axis label (or column head). For example, if an author wishes to represent 3000 cpm with "3", the label should read "$3 \times 10^{-3}$".

Tables
Tables should be typed double-spaced throughout, numbered with arabic numerals, and provided with titles (above
the footnotes should be made by means of the symbols *, †, ‡, §, ¶, ||, in that order, followed by doubled symbols if necessary. A lengthy list of footnotes is better keyed with lowercase superscript letters or, in exceptional cases where this would be confusing, with superscript numbers.

Title page
Provide a separate title page, containing the following items:

Classification. Give any one of the sciences named in the titles of the sections of the Academy, or Biophysics, Cell Biology, Environmental Science, Immunology, Pathology, or Statistics.

Title. This should be brief, specific, and rich in informative words. Add up to five amplifying key terms to alert readers, and computers, to subjects in the article not referred to in the title. The PROCEEDINGS discourages the use of uninformative serial titles such as On Steroids, XIX. If a paper is part of a series, indicate this by a symbolized footnote on the first page, and include a reference to the immediately preceding paper of the series.

By-line. If there are several authors with different affiliations, key authors to institutions by means of symbols *, †, ‡, §, ¶. If reprint requests are to be addressed to any but the first author, indicate this by a footnote.

From-line. List the institutions and provide Zip Codes.

Footnotes. Give, as first unsymboled footnote, a list of nonstandard abbreviations (see below, under Abbreviations), if any, that have been used in the paper. Other title-page footnotes may indicate present addresses of the authors or address(es) to which reprint requests are to be sent. Do not include acknowledgments of grant support here.

Abstract
Every paper must begin with an abstract, typed on a separate page. This should state the subject and main conclusions of the article in generally intelligible terms. Avoid abbreviations. The abstract must be intelligible to a reader before he reads the paper, and suitable for reproduction by abstracting services without rewriting. It should usually not exceed 250 words.

Nomenclature
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Mathematics. Notations that are expensive to typeset should be avoided by use of the devices given on p. 7 of the American Mathematical Society's Manual for Authors (1970): for example, replace \( \frac{a}{b} \) by \( a/b \), \( e^x \) by \( \exp(x) \), \( \tau \) by \( \tau \) (denoted in manuscript by a wavy underline). Manuscripts in which this has not been done may be returned to the author.

Provide a list of special characters used in the paper for the printer's guidance, and identify all Greek, Hebrew, or script letters by means of marginal notes at their first appearance.


Chemistry. Use the American Chemical Society's Handbook for Authors (1967).


Abbreviations
Standard Abbreviations for units of measure and for certain substances, e.g., DNA, are listed in the style manuals and handbooks named above. These need not be spelled out. Some standard abbreviations and symbols whose correct form is not familiar to all authors are listed on the following pages. Rules of the IUPAC–IUB Commission on Biochemical Nomenclature are followed [see J. Biol. Chem. (1968) 241, 527 and J. Mol. Biol. (1971) 55, 299, for example, for guidance].

Nonstandard Abbreviations are defined as those not given in the handbooks' lists, even if they may be familiar to those in the field. (a) Keep them to a minimum, and only for cumbersome words that must be used more than five times in the paper. (b) Spell out nonstandard abbreviations at their first appearance in the text. (c) If possible, avoid them completely in the Abstract. (d) List them on the title page for inclusion as a footnote on the first printed page of the article. The PROCEEDINGS discourages the use of acronyms and manuscripts will be edited so that abbreviations are evocative of meaning when possible.

References
Cite references in order throughout the text by means of arabic numerals (not superscripts) between parentheses (in mathematical papers, square brackets should be used for numbered equations to avoid confusion with references and the reference number may be preceded by "ref."). Citations are to be made in this way only to papers already published or "in press" in a stated journal or other publication. Any reference to unpublished work should be made in the text or, rarely, in the form of a symbolized footnote. Reference to "personal communication" should also be made in the text; written approval by the person cited should accompany the manuscript.

The PROCEEDINGS requires inclusive pagination for articles cited and provision of titles is encouraged. References must be typed double-spaced in the style used by the PROCEEDINGS, thus (for journal articles):

Titles of journals should be abbreviated according to the American National Standard for the Abbreviation of Titles of Periodicals [see Chemical Abstracts Service Source Index (CASSI)].
Some standard and recommended abbreviations and symbols

For simplicity, one preferred abbreviation or symbol has been adopted in most cases, even though the handbooks listed below may give equally favored alternatives.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Name</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>absorbance</td>
<td>A (not OD)</td>
<td>absorbance</td>
</tr>
<tr>
<td>N-acetylglucosamine</td>
<td>GlcNAc</td>
<td>N-acetylglucosamine</td>
</tr>
<tr>
<td>asparaginyl</td>
<td>Asn</td>
<td>asparaginyl</td>
</tr>
<tr>
<td>aspartyl</td>
<td>Asp</td>
<td>aspartyl</td>
</tr>
<tr>
<td>asparaginyl or aspartyl</td>
<td>Axx</td>
<td>asparaginyl or aspartyl</td>
</tr>
<tr>
<td>5-bromodeoxyuridine</td>
<td>BrdUrd</td>
<td>5-bromodeoxyuridine</td>
</tr>
<tr>
<td>5-bromouracil</td>
<td>BrUra</td>
<td>5-bromouracil</td>
</tr>
<tr>
<td>cysteinyl</td>
<td>Cys</td>
<td>cysteinyl</td>
</tr>
<tr>
<td>deoxy (carbohydrates and nucleotides)</td>
<td>d</td>
<td>deoxy (carbohydrates and nucleotides)</td>
</tr>
<tr>
<td>deoxyribonuclease</td>
<td>DNase</td>
<td>deoxyribonuclease</td>
</tr>
<tr>
<td>deoxyribonucleic acids</td>
<td>DNA</td>
<td>deoxyribonucleic acids</td>
</tr>
<tr>
<td>2,4-dinitrophenyl</td>
<td>Dnp</td>
<td>2,4-dinitrophenyl</td>
</tr>
<tr>
<td>formylmethionyl</td>
<td>fMet</td>
<td>formylmethionyl</td>
</tr>
<tr>
<td>glucose</td>
<td>Glc</td>
<td>glucose</td>
</tr>
<tr>
<td>guanosine</td>
<td>G</td>
<td>guanosine</td>
</tr>
<tr>
<td>guanuronic acid</td>
<td>GlcUA</td>
<td>guanuronic acid</td>
</tr>
<tr>
<td>glutamic acid</td>
<td>Glu</td>
<td>glutamic acid</td>
</tr>
<tr>
<td>glutaminyl</td>
<td>Gln</td>
<td>glutaminyl</td>
</tr>
<tr>
<td>glutaryl or glutamyl</td>
<td>Glx</td>
<td>glutaryl or glutamyl</td>
</tr>
<tr>
<td>hemoglobin</td>
<td>Hb</td>
<td>hemoglobin</td>
</tr>
<tr>
<td>immunoglobulin G(M)</td>
<td>IgG(IgM)</td>
<td>immunoglobulin G(M)</td>
</tr>
</tbody>
</table>

* Similarly for other halogenated nucleosides.
† Recommended by IUPAC-IUB.
‡ Use 3-letter abbreviation when G can be ambiguous.

For references to articles in books, the following sequence should be maintained: author(s), year of publication, complete title of book, names of editors (if applicable), (name of publishers, place of publication), page numbers if necessary, thus:


It is extremely important that the final typed list of references be checked for accuracy against the original articles or photocopies of them.

Acknowledgments

Keep acknowledgments brief. Acknowledgments to persons usually precede those for grant support. They should be typed double-spaced.

Isotopes. The mass number of an atom should be written as a superior prefix: 14C, not C¹⁴; 32S, not S. Enclose the symbol for the isotope in square brackets placed immediately before the name or abbreviation of the compound: [14C]CMP (not CM[14C]); [14C]urea; [α-14C]leucine; [carboxy-14C]leucine; [α,β-14C]maleic anhydride; [L-methyl-14C]methionine, [1-14C]-glucose. The symbol U denotes uniform labeling, e.g., [U-14C]-glucose. With chemical formulas, use [14CO₂, H₂[14CO₃], etc. (no square brackets). For fully deuterated solvents use, for example, [¹-¹H]pyridine or C₄H₄D₄N.

Peptide Symbols. For peptides of known sequence, represent the CO-NH bonds by hyphens, as in Gly-Tyr-Ala. Groups of residues of unknown sequence are enclosed in parentheses and separated by commas (see J. Biol. Chem. 247, 977 and 323).

Nucleoside Symbols. Use A, C, G, I, G, T, U, X for residues of adenosine, cytidine, guanosine, inosine, pseudouridine, ribothymidine, uridine, or xanthosine (N, not X, for unknown nucleotide) in 3'-5' linkages; dA, dC, etc., for corresponding deoxy compounds. End phosphoric residues are specified by p, internal (phosphodiester) phosphoric residues by a hyphen. Synthetic polynucleotides: poly is always to be followed by parentheses, without intervening space, thus poly(A). Phosphodiester bonds are denoted by hyphens, thus poly(dA-dT) for a polymer of alternating deoxyadenosine and thymidine residues. Random or unknown order is denoted by commas, thus poly(dA,dT). Indicate noncovalent associations by a center dot, thus poly(I·poly(C), RNA·DNA hybrids.

Transfer RNAs that accept specific amino acids are designated thus: tRNAlic ("alanine tRNA"). When the tRNA is bound to an amino-acid residue, use alanyl-tRNA (or alanyl-tRNAlic if necessary) or, e.g., fMet-tRNAi.

Handbooks and style manuals


Abbreviations of Units of Measurement and of Physical and Chemical Quantities

(These abbreviations may be used without definition. They are not followed by periods.)

### Prefixes to the Names of Units

<table>
<thead>
<tr>
<th>Prefix</th>
<th>Symbol</th>
<th>Name</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>giga</td>
<td>G</td>
<td>G</td>
<td>10^9</td>
<td></td>
</tr>
<tr>
<td>mega</td>
<td>M</td>
<td>M</td>
<td>10^6</td>
<td></td>
</tr>
<tr>
<td>kilo</td>
<td>k</td>
<td>k</td>
<td>10^3</td>
<td></td>
</tr>
<tr>
<td>centi</td>
<td>c</td>
<td>c</td>
<td>10^-2</td>
<td></td>
</tr>
<tr>
<td>milli</td>
<td>m</td>
<td>m</td>
<td>10^-3</td>
<td></td>
</tr>
<tr>
<td>micro</td>
<td>μ</td>
<td>μ</td>
<td>10^-6</td>
<td></td>
</tr>
<tr>
<td>nano</td>
<td>n</td>
<td>n</td>
<td>10^-9</td>
<td></td>
</tr>
<tr>
<td>pico</td>
<td>p</td>
<td>p</td>
<td>10^-12</td>
<td></td>
</tr>
<tr>
<td>femto</td>
<td>f</td>
<td>f</td>
<td>10^-15</td>
<td></td>
</tr>
<tr>
<td>atto</td>
<td>a</td>
<td>a</td>
<td>10^-18</td>
<td></td>
</tr>
</tbody>
</table>

### Units of Concentration*

- molar (mol/liter): M
- millimolar (mmol/liter): mM (rather than 10^-3 M)
- micromolar (μmol/liter): μM (rather than 10^-6 M)
- nanomolar: nM (not μM)
- picomolar: pM (not μM)

### Other Units

- meter: m
- centimeter: cm
- millimeter: mm
- micrometer (not micron): μm (not μ)
- nanometer: nm (not μm)
- picometer: pm
- Angstrom (0.1 nm): Å
- square centimeter: cm²
- cubic centimeter: cm³
- milliliter: ml
- microliter: μl (not λ)
- gram: g
- milligram: mg
- microgram: μg (not γ)
- second: s
- minute: min

### Other Units—Continued

<table>
<thead>
<tr>
<th>Unit</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>counts per minute</td>
<td>cpm</td>
</tr>
<tr>
<td>revolutions per minute</td>
<td>rpm</td>
</tr>
<tr>
<td>curie(s)</td>
<td>Ci</td>
</tr>
<tr>
<td>equivalent</td>
<td>eq</td>
</tr>
</tbody>
</table>
| Svendberg unit of sedimentation coefficient | S
| cycle per second (hertz) | Hz     |
| degree Celsius        | °C     |
| thermodynamic temperature (kelvin) | K |
| calorie               | cal    |
| kilocalorie           | kcal   |
| joule                 | J      |

### Physical and Chemical Quantities

- retardation factor: $R_f$
- acceleration of gravity: g
- specific rotation: [α]λ′
- sedimentation coefficient: S
- sedimentation coefficient in water at 20°, extrapolated to zero concentration: $S_{20}^0$
- diffusion coefficient (usually given in cm² s⁻¹): D
- equilibrium constant: K
- Michaelis constant: $K_m$

### Other Words

- logarithm (Briggsian): log
- logarithm (natural): ln
- standard deviation of series: SD
- standard error of mean: SEM

* Terms such as milligram percent (mg%) should not be used. Weight concentrations should be given as g per ml, g per 100 ml, g per liter, etc.

† The letter M is not an abbreviation for mole; it is reserved for molar. Use mM for 10^-3 M and μM for 10^-6. Avoid designating concentrations as μmol per ml, for example. The designation should, in this case, properly be mM (i.e., millimolar). Maintain consistency in the use of units in situations where they are to be compared (e.g., do not juxtapose 10^-6 M and 10^-4 M).

‡ The PROCEEDINGS will continue to accept certain units as listed (e.g., Angstrom, calorie, minute) even though they are not part of the Système International (SI). Note that nanometer is preferred instead of millimicron or Angstrom units.

§ The PROCEEDINGS will continue to allow use even though Système International recommends s.

¶ Use °C abbreviation if ° could be ambiguous.

‖ The Système International recommends joules. When calories are used the equivalent value in joules should be given (1 calorie = 4.184 joules).