

# Analytical Biochemistry

## Extended guide for authors

**Analytical Biochemistry** is an international journal that publishes original articles on methods and methodology of interest to the biological sciences and all fields that impinge on biochemical investigation. In addition to the expected techniques that apply to biochemical preparations and analysis, the following should be considered as within the scope of the journal:

- Cell biology and cell, tissue, and organ culture methods that are of general application.
- Membrane preparations and signaling systems.
- Procedures of interest in the field of recombinant technology and molecular genetics.
- Purification of enzymes and other proteins, but only if the methods are both novel and applicable generally; i.e., the interest is in a means of purification rather than in the protein that is being purified.
- Immunological techniques, both analytical and preparative, if they are of general applicability by biochemists. Immunoassays are included but only if a unique approach is introduced rather than the application of an established method to a substance not previously assayable.
- Pharmacological and toxicological research techniques that offer a biochemical approach.

These instructions contain information on the preparation and submission of manuscripts and are arranged as follows:

1. General information.
2. Form and style: 2.1, title page; 2.2, abstract; 2.3, text; 2.4, references; 2.5, footnotes; 2.6, tables; 2.7, figures and illustrations; 2.8, powers in tables and figures.
3. Nomenclature: 3.1, chemical and mathematical usage, general; 3.2, biochemical nomenclature; 3.3, nomenclature of organisms; 3.4, naming compounds; 3.5, prefixes; 3.6, isotope experiments and isotopically labeled compounds; 3.7, spectrophotometric data; 3.8, equilibrium and velocity constants; 3.9, molecular weight and mass; 3.10, composition of solutions and buffers; 3.11, kinetic constants; 3.12, abbreviations and symbols; 3.13, covalent structure of proteins.

### 1. General information

Manuscripts of two types are considered: full-length **Articles** and short contributions of about two printed pages, including tables and figures, that fall under the heading of **Notes & Tips**. **Reviews** on timely topics and **Prospectives** on methods at a stage of development at which they are “likely to come about” are generally

invited, although unsolicited outlines or manuscripts will be considered.

#### 1.1. Submission of manuscripts

It is a condition of publication that all manuscripts must be written in clear and grammatical English and be submitted to the *Analytical Biochemistry* Web site at <http://ees.elsevier.com/yabio>. Each manuscript must be accompanied by an electronic cover letter outlining the basic findings of the paper and their significance. PDFs of all related manuscripts under consideration for publication must also be included with the submitted manuscript. Minimal exceptions will be allowed. If you are unable to provide an electronic version of your paper, please contact the Editorial Office prior to submission (e-mail: [ab@elsevier.com](mailto:ab@elsevier.com); telephone: (619) 699-6813; fax: (619) 699-6700).

There are no submission fees or page charges.

Original papers only will be considered. Manuscripts are accepted for review with the understanding that the same work has not been published, that it is not under consideration for publication elsewhere, and that its submission for publication has been approved by all of the authors and by the appropriate authority at the institution where the work was carried out. Manuscripts with multiple authorship are accepted on the assumption that all authors participated meaningfully in the work and agree on the submitted version of the work. Abstracts of oral or poster presentations are not considered to constitute previous publication. Presentation of material in preliminary communications normally will not preclude publication of a full paper in **Analytical Biochemistry**, provided the full paper contains additional information that justifies its publication and does not repeat the presentation of the same data that supported the preliminary communication. **The manuscript should be accompanied by copies of all preliminary communications and of all relevant manuscripts that are in press or under editorial consideration by another journal.** All material published in **Analytical Biochemistry** represents the opinions of the authors and should not be construed to reflect the opinions of the Editors or the Publisher.

Authors may suggest desired Editorial Board members or other expert reviewers in their field as well as individuals whom they wish to have excluded from the review process. The corresponding author will receive a decision letter from the Executive Editor. *Manuscripts will not be returned to authors.* Revised manuscripts,

accompanied by a letter explaining how the paper has been revised, should be submitted to the Executive Editor indicated on the decision letter.

Upon acceptance of an article, authors will be asked to transfer copyright (for more information on copyright, see <http://authors.elsevier.com>). This transfer will ensure the widest possible dissemination of information. A letter will be sent to the corresponding author confirming receipt of the manuscript. A form facilitating transfer of copyright will be provided after acceptance.

If material from other copyrighted works is included, the author(s) must obtain written permission from the copyright owners and credit the source(s) in the article. Elsevier has preprinted forms for use by authors in these cases: contact Elsevier Global Rights Department, P.O. Box 800, Oxford OX5 1DX, UK; phone: (+44) 1865 843830, fax: (+44) 1865 853333, e-mail: [permissions@elsevier.com](mailto:permissions@elsevier.com).

Manuscripts should be written in clear and grammatical English and should conform to the general style of the journal and the specific instructions listed below. Manuscripts that are not adequately prepared will be returned to the authors, since it is not feasible for the Editors to undertake extensive revision or rewriting of manuscripts submitted. **Contributors, particularly those unfamiliar with English usage, are encouraged to seek the help of colleagues in the preparation and review of manuscripts prior to submission.** This practice will usually reduce the time required for review and avoid delays in the publication of the manuscript. Papers should be concise, but with sufficient experimental detail to permit a critical appraisal of the work. Unnecessary repetition should be avoided. **Responsibility for the accuracy of material in the manuscript, including appropriate reference to related work, lies entirely with the authors.**

Most acceptable papers require minor revision or condensation. It is in the mutual interest of both the authors and the journal that amended manuscripts be returned promptly. Any revised manuscript received by the Editorial Office more than 8 weeks after it is returned to the author will receive a new date of receipt and may be treated as a new submission.

**Analytical Biochemistry** will publish papers dealing with the purification of enzymes and other proteins, but only if the methods are both novel and applicable generally; i.e., the interest is in a means of purification rather than in the protein that is being purified. Such manuscripts should contain mainly references to assay methods rather than an extensive explanation of them. Similarly, the characterization and properties of the protein should be treated in summary form, preferably in a table. A table summarizing the extent of purification (step, volume, total protein, total activity, specific activity) is to be included. Figures illustrating vital

points may be accepted but normal elution profiles and gel patterns are discouraged.

Article proofs will be sent to the author with reprint order forms. To avoid delays in publication **proofs should be returned within 48 hours of receipt.**

Authors will be charged for extensive alterations.

## 2. Form and style

Manuscripts should be double-spaced throughout with 1-in. margins on all sides. All pages should be numbered consecutively, including references, tables, and figure legends.

### 2.1. Title page

The title page should contain the article title; author(s); affiliation(s); a short title (an abbreviated form of the title) of less than 55 characters, including letters and spaces; the name and complete mailing address (including telephone and fax numbers and e-mail address) of the person to whom correspondence and proofs should be sent; and the appropriate subject category for listing of the article in the Table of Contents.

In creating a title, omit words such as *novel*, *rapid*, *improved*, *simple*, *sensitive*, *efficient*, *convenient*, and *new*. Each is felt to be redundant and actually slows down the reader who is scanning the article titles and wants to know more about the method itself. Do substitute informative words that will give readers a more complete idea of the usefulness of the paper with regard to the limitations of their equipment or sample type. For example, what *kind* of method is being described? As a general guideline, authors should restrict the length of the title to 15 words.

The following categories are used in the Table of Contents: carbohydrates; cell biology; chromatographic techniques; DNA recombinant techniques and nucleic acids; electrophoretic techniques; enzymatic assays and analyses; immunological procedures; inorganic and metalloorganic compounds; labeling procedures; lipids, lipoproteins, and prostaglandins; membranes and receptors; metabolite determination; peptides, amino acids, and amino acid derivatives; physical techniques; protein structure and analysis; purification of proteins; special topics. Authors should indicate which one category listed above would be most appropriate, although other categories may be suggested.

The short title is intended for use in the Contents by Short Titles that appears at the front of each issue. Only standard abbreviations should be used in the article title or running title. Abbreviations noted as not requiring definition (see tables) may be considered for use in the short running title.

Serial numbers should not appear in titles, except where a group of papers, starting with I, are to be

published in the same issue. Indication that the paper is part of a larger series may be placed in a footnote to the title and should include a reference to the preceding paper.

Occasionally, confusion arises when authors are identified by surname and initials only. To minimize this possibility, it is urged that authors follow the recommendation of the IUB Committee of Editors of Biochemical Journals that either the first or second given name be spelled out in full.

Acknowledgments of financial support should be included as numbered footnotes to the title.

## 2.2. Abstract

The second page of regular articles, but not of Reviews, should contain the abstract, i.e., a brief but informative summary of the contents and conclusions of the paper. It should refer to all new information in the paper, including mention of incidental findings that may be valuable to other workers, whether or not they form the main subject of the paper. **The abstract should not exceed 200 words.** Nonessential details and information or claims not supported in the body of the paper should not be included. The abstract should be intelligible to the nonspecialist in the field and hence should avoid specialized terms and abbreviations or symbols that require definition.

*Keywords* should be listed immediately after the abstract.

## 2.3. Text

The suggested organization of an **Article** is abstract, introductory statement, Materials and Methods, Results, Discussion, Acknowledgments, and References. Some of these sections may be combined if the presentation is thereby made clearer or more effective.

The introductory statement should state the purpose of the investigation and its relation to other work in the same field, but should not include an exhaustive literature review.

The description of experimental procedures must be adequate for repetition of the work by a qualified investigator. Refer to previously published procedures employed in the work by citation of both the original description and pertinent published modifications. Do not include extensive details unless they present substantially new modifications.

Under Materials and Methods, authors should draw attention to any particular chemical or biological hazards that may be involved in carrying out the experiments described. Any relevant safety precautions should be described; if an accepted code of practice has been followed, a reference to the relevant standards should be given. It will be evident that the value of a

method, whether for analysis or preparation, is entirely dependent on the availability of all materials. Thus, the sources for critical reagents and instruments must be clearly identified.

In reports of experiments involving recombinant DNA molecules constructed in vitro and subsequently inserted into cells, reference must be made to the appropriate NIH guidelines and/or other pertinent regulations or, if comparable documents exist in the country where the work was done, these may be referenced. Significant deviations from the recommended practices should be described. If the host system has been certified as disabled by the NIH Program Advisory Committee on Recombinant DNA, that certification should be noted.

Results may be presented in tables or figures (see below), but many findings can be set forth directly in the text.

The Discussion should be concise and deal with the interpretation of the results. In some cases combining Results and Discussion into one section may provide a clearer presentation. **The Discussion should not be used as a summary.**

**Notes & Tips** is a section for manuscripts of about two printed pages but no longer than three pages. The intent is to accommodate methods that can be summarized in a shorter format allowing more rapid publication, as well as to provide helpful "kitchen tricks." The standards are the same as those for other articles. No formal organization is required and abstracts are not used, but an opening paragraph should state the problem and the means for its resolution; a brief summary statement concludes the paper.

## 2.4. References

Authors are instructed to cite all relevant prior work. Failure to do so will lead to rejection and can be actionable.

References should be cited in the text by Arabic numerals in brackets and listed at the end of the paper in numerical order, typed double-spaced on a separate sheet, under the heading References. Full titles are required for all references. Abbreviations of journal titles should conform to those of the most recent edition of *Chemical Abstracts Service Source Index*. Please note the following examples:

For a journal article:

- [1] L. Löfvenberg, L. Backman, High-performance liquid chromatography analysis of spectrin organization, *Anal. Biochem.* 292 (2001) 222–227.

For a book by one or more authors:

- [2] B. Birren, E. Lai, Pulsed Field Gel Electrophoresis: A Practical Guide, Academic Press, San Diego, 1993.

For a chapter in an edited book:

- [3] S.K. Buchanan, J.E. Walker, in: G. von Jagow, H. Schägger (Eds.), *A Practical Guide to Membrane Protein Purification*, Academic Press, San Diego, 1995, pp. 125–133.

Text citations to references written by more than two authors should be styled as, e.g., Smith et al. In the reference list, however, all authors' names (with initials) must be supplied.

If an article has been accepted for publication by a journal but has not yet appeared in print, the reference should be styled as follows:

- [4] J. Smith, *J. Mol. Biol.* (2003), in press.

Note that the date in parentheses is the anticipated publication date. It is necessary to submit copies of such papers to the Editors whenever they have any bearing on the manuscript under consideration.

The use of "in preparation," "private communication," and "submitted for publication" is not acceptable in the reference list. "Personal communication" and "unpublished work" should appear parenthetically following the individual name(s) in the text. Authors must verify the wording of any personal communication with those who supplied the information and obtain approval for the use of their names in connection with the quoted information or for the citation of unpublished work. Editors may request written evidence of such approval. Since the reference to "in press" implies that the paper has been accepted for publication, the name of the journal must be given.

Abstracts of papers presented at scientific meetings should not be cited as references unless they appear in publications included in the *Biological Abstract List of Serials*. Abstracts not citable as references must be indicated in footnotes.

If the paper submitted is one of a series, include the immediately preceding paper of the series in the references, and identify it as such, either in text or in a footnote to the title.

### 2.5. Footnotes

Footnotes in the text should be identified by superscript Arabic numerals and should be typed on a separate sheet following the References; footnotes to the title, authors' names, and affiliations should be numbered in sequence with the text footnotes. Footnotes in the tables should be identified with superscript lowercase letters, a, b, etc., and placed at the bottom of the table.

### 2.6. Tables

**Tables** should be typed on separate pages, numbered consecutively with Arabic numerals in order of mention

in the text. Only essential data or data needed to illustrate or prove a point should be included in tables. Each table should have a short explanatory title. Experimental details should be given in footnotes to the table; however, if these details are given under Materials and Methods or another table or figure, the material should not be repeated.

Except in rare cases, the same data will not be published in two forms, e.g., a table and a figure. If the author believes that such double presentation is necessary to the clarity of his or her article, a letter of explanation should be submitted with the manuscript.

Each column should carry an appropriate heading. When the use of abbreviations is necessary, follow the recommendations given in Section 3.12, Abbreviations and symbols. The units in which the data are expressed, e.g.,  $\mu\text{g/ml}$ , M, Ci/mol, should be given at the top of each column and not repeated on each line of the table. Words or numerals should be repeated on successive lines; do not use ditto marks.

Always indicate units of measure clearly. If an experimental condition, such as dosage or concentration of a compound, is the same for all of the tabulated experiments, this information should be given in a table footnote (and not in a column of identical figures).

Avoid presenting large masses of essentially similar data. When space can be saved thereby, replace lengthy tabulations by reporting mean values with some accepted measure of dispersion (standard deviation, range); an indication of the number of individual observations contributing to these statistics should be given in a footnote to the table. Statements with respect to the significance of measures should be accompanied by probability values derived from appropriate statistical tests. Define all statistical measures clearly and unambiguously.

**Do not include more significant digits in the data than are justified by the accuracy of the determinations.** For example, the value 5323 implies an accuracy of 1 part in 5000.

Authors should not use vertical rules and should limit the number of horizontal rules. They also should be aware of the format of the journal in organizing the table.

*Authors may wish to submit complex tables as camera-ready copy.* In this way, they are spared tedious proof-reading and the chance of error is reduced. Tables submitted as camera-ready copy should be typed single-spaced whenever possible.

### 2.7. Figures and illustrations

Figures are a useful and necessary means for conveying information but they do consume much space

and are too frequently difficult to interpret because of inadequate labeling or of cluttering with too much information. The ease with which all manner of line drawings can be constructed by readily available computer programs has been a positive development, but the amount of information that can be placed on the illustration should be restrained in order to avoid clutter. Graphs are best limited to the curves themselves, possibly with a letter label for each curve, and with clear designation of axes. Simple straight lines are usually handled without a figure at all, and are best described by an equation for the curve that is placed in the text; it could be accompanied by statistical evaluation of the data to allow a judgment of precision. Simple histograms should be avoided; a table or a paragraph in the text is preferred.

Preferably, graphic presentations should be enclosed on all four sides with axes labeled in what will appear as 8-point type. (See Figs. 1-4 for examples of type size and note the increased clarity that usually results from using upper- rather than lowercase letters.) **The trick is to make sure that a figure that will be reduced to between 2 and 3 inches of column space will have axes labeled by both numerals and letters that are about 8 point and no larger than 10 point after reduction.** For insets, 6-point lettering may be appropriate, and parts of a figure may be labeled with type as large as 12-point.

If, after reduction, the type in the figures would be too small or larger than the type in the text, then publication of the article may be delayed. The following examples show acceptable sizes of final-size lettering.

All figures should be cited consecutively in the text, with figure legends typed double-spaced consecutively on a separate page. Figure legends should not be typed on the same page as the figures. The legends should contain sufficient experimental detail to permit the figure

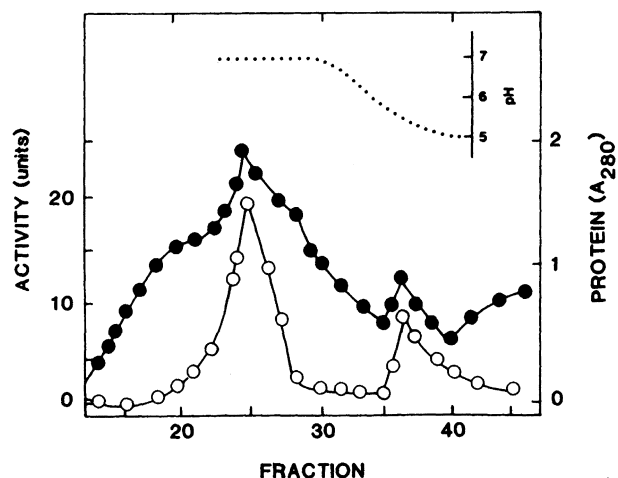


Fig. 1. Graph illustrating 8-point lettering.

↓

ProArgSerArgLysProLys  
 GTCCACCGTATCTACCCAGGTCCAGGTCTCGAAAACCAAAG  
 TGTTTTTA\*T\*TATT\*\*\*\*\*A\*\*C\*C\*AC\*\*CCGC\*\*C\*\*A

LysGluAspLysArgProArgThrAlaPheThrAlaGluGln  
 AAGAGGACAAGCGCGCCGCGCACGGCCTTTACCGCCGAGCAG  
 \*\*C\*\*G\*\*\*\*\*T\*\*A\*\*\*\*\*C\*\*G\*\*CT\*\*AG\*\*\*\*\*

GluPheGlnThrAsnArgTyrLeuThrGluGlnArgArgGln  
 GAGTCCAGACCAACAGGTACCTGACGGAGCAGCGGCCAG  
 \*\*\*\*\*A\*CGAG\*\*TCG\*\*T\*\*\*\*\*C\*\*\*\*\*G\*A\*A\*\*\*\*\*

SerLeuAsnGluSerGlnIleLysIleTrpPheGlnAsnLys  
 AGCCTCAACGAGTCACAGATCAAGATTTGGTCCAGAACAAG  
 G\*\*\*\*\*G\*\*\*\*\*C\*G\*\*\*\*\*C\*\*\*\*\*

AlaThrGlyAsnLysAsnThrLeuAlaValHisLeuMetAla  
 GCCACGGGCAACAAGAACACGCTGGCCGTGCACCTCATGGCA  
 T\*G\*\*\*\*\*TC\*\*A\*\*TC\*\*\*\*\*AC\*\*\*\*\*G\*\*G\*\*\*\*\*C

SerThrThrAlaLysGluGlyLysSerAspSerGluSTOP  
 TCCACCACAGCCAAGGAGGGCAAGTCGGACAGCGAGTAGGGC  
 A\*\*\*\*\*GTGC\*GCT\*ACCAAG\*GGA\*\*\*GGAGCTCG\*\*ATG

Fig. 2. Sequence in which 8-point lettering has been used.

|  |             |
|--|-------------|
| This is 4.5-point type: too small  | ABPTX abptx |
| This is 6-point type: lower end of acceptable, marginal  | ABPTX abpte |
| This is 8-point type: used for figure legends, tables, and references; the principal lettering on figures (e.g., axis labels on graphs, lane designations on gel half-tones) should be this size | ABPTX abptx |
| This is 9-point type: type size of abstracts   | ABPTX abptx |
| This is 10-point type: upper end of acceptable   | ABPTX abptx |
| This is 12-point type: use only as single letters (locants)  | ABPTX abptx |

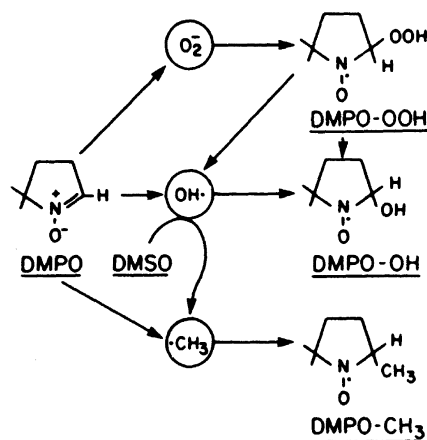


Fig. 3. Example of a scheme with 6- and 8-point lettering used, respectively, for the principal and the subordinate lettering.

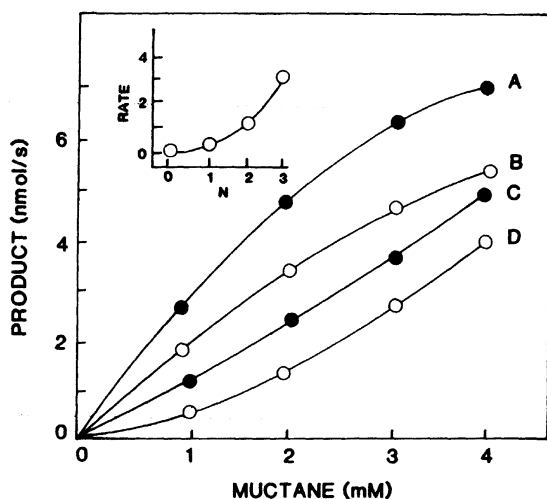


Fig. 4. Illustration with 8-point lettering used in the graph and 6-point letter used in the inset.

to be interpreted without reference to the text (unless this material has appeared with another figure or table or under Materials and Methods). Quantities and units should be indicated clearly alongside the scales of the ordinate and abscissa, e.g., Length (cm), Time (min), or Wavelength (nm). Wherever possible, data should be combined into a single figure in order to keep the number of illustrations to a minimum.

All illustrations should be in finished form ready for photoreproduction. Lettering on drawings should be of professional quality or generated by high-resolution computer graphics.

Only those parts of a photograph that are necessary to illustrate the matter under discussion should be submitted. Areas that are not essential should be cut off. Authors will receive one free page of color. However, if together with your accepted article you submit usable color figures, then Elsevier will ensure, at no additional charge, that these figures will appear in color on the Web (e.g., ScienceDirect and other sites) regardless of whether these illustrations are reproduced in color in the printed version. For color reproduction in print, you will receive information regarding the costs from Elsevier after receipt of your accepted article.

Please note: Because of technical complications that can arise in converting color figures to “gray scale” (for the printed version should you not opt for color in print), please submit in addition usable black-and-white files corresponding to all the color illustrations.

Please visit our Web site at <http://authors.com/artwork> for instructions on preparing electronic artwork.

## 2.8. Powers in tables and figures

Multipliers by powers of 10 are sometimes useful, especially in table headings and in figures, because they help avoid listing values with an inconvenient number of digits.

However, authors must exercise care in the use of such multipliers to avoid confusing the reader. To minimize this, employ, when possible, units that eliminate the need for exponents in the headings. Depending on the range of the data, a choice among the headings mM, M, or nM might be made, for example, to reduce the number of digits or exponential terms required in the table. Compound prefixes must not be used (e.g., replace  $\mu\text{mol}$  with nmol).

When this is impractical or undesirable, the quantity expressed is to be preceded by the power of 10 by which its value has been multiplied. The units in which the quantity is expressed may not be multiplied by a power of 10; however, the unit may be changed by the use of an appropriate prefix, such as m or  $\mu$ , or of another accepted scale. For example, the entry 2 under the heading “ $10^3 \text{ M}$ ” is to be interpreted as an equation:  $10^3 \text{ M} = 2$  or  $\text{M} = 0.002$ . Following this principle, listings of 0.15 under a heading “concentration (mM)” or of 150 under “concentration ( $\mu\text{M}$ )” or under “ $10^6 \times$  concentration (M)” would all express “0.00015 M.” However, the multiplier must apply to the quantity, not the unit; thus, entries such as 150 under a column heading “concentration ( $M \times 10^{-6}$ )” for “0.00015 M” are discouraged. The same principles apply to the labeling of the coordinates on figures. The simplest way of distinguishing quantities and units is to state them both, with the units given in parentheses: for example, “distance (cm)”; “concentration (M)”;  $[\text{ATP}]^{-1} (\text{mM})^{-1}$ . Here again, if an exponential multiplier is to be used, it must, for clarity, be applied to the quantity and not to the unit. Particular care in making this distinction should be exercised in the case of reciprocal quantities.

The curie (symbol Ci, not C) or the becquerel (symbol Bq) is used for radioactivity measurements; the curie is equal to  $3.7 \times 10^{10}$  dis/s or 37 GBq (1 becquerel = 1 dis/s). Thus  $1000 \text{ dpm} = 0.45 \text{ nCi} = 16.7 \text{ Bq}$ .

## 2.9. Preparation of supplementary material

Elsevier now accepts electronic supplementary material to support and enhance your scientific research. Supplementary files offer additional possibilities for publishing supporting applications, movies, animation sequences, high-resolution images, background datasets, sound clips, and more. Supplementary files supplied will be published online alongside the electronic version of your article in Elsevier Web products, including ScienceDirect (<http://www.sciencedirect.com>). To ensure that your submitted material is directly usable, please provide the data in one of our recommended file formats. Authors should submit the material in electronic format together with the article and supply a concise and descriptive caption for each file. Please note, however, that supplementary material will not appear in the printed journal. Files can be stored on 3.5-inch diskette, ZIP

disk, or CD (either MS-DOS or Macintosh). For more detailed instructions, please contact the Editorial Office (e-mail: ab@elsevier.com; telephone: (619) 699-6813; fax: (619) 699-6700).

### 3. Nomenclature

#### 3.1. Chemical and mathematical usage, general

The IUPAC rules on chemical nomenclature should be followed. The most important are:

- Sections A through F and H of the *Nomenclature of Organic Chemistry*, Pergamon Press, Oxford, 1979;
- Sections E (stereochemistry), F (natural products and related compounds), and H (isotopically modified compounds) in *Biochemical Nomenclature and Related Documents*, published by the Biochemical Society (London) for the IUBMB, 1978 (see Table 12);
- *Nomenclature of Inorganic Chemistry*, 3rd ed. (1990), and the *Compendium of Analytical Nomenclature*, 2nd ed. (1987), both from Blackwell Scientific Publications, Oxford.

*Ionic charge* should be designated as a superscript following the chemical symbol, e.g.,  $\text{Mg}^{2+}$ ,  $\text{S}^{2-}$ .

#### 3.2. Biochemical nomenclature

The tentative rules and recommendations of the IUPAC–IUBMB Commission on Biochemical Nomenclature, as well as associated documents, may be found in *Biochemical Nomenclature and Related Documents* (1978) published by the Biochemical Society (London) for the IUBMB (see Table 12).

*Enzymes*. Where an enzyme is the main subject of a paper, its source, recommended name, reaction catalyzed by the enzyme, and code number preceded by EC should be used. Enzymes that are not the main subject of the paper also may be identified at their first mention by their code numbers. Authors should consult the *Enzyme Nomenclature Recommendations (1992) of the Nomenclature Committee of the IUBMB* (Academic Press, San Diego, 1992) for the code numbers of enzymes. This listing is kept current at [www.chem.qmul.ac.uk/iubmb/enzyme](http://www.chem.qmul.ac.uk/iubmb/enzyme). New enzymes should be reported to the IUBMB Commission on Biochemical Nomenclature, which will assign the appropriate code number. Forms for this purpose may be obtained from the **Analytical Biochemistry** Editorial Office.

#### 3.3. Nomenclature of organisms

*Animals and plants*. The full binomial Latin names as well as the common names should be included for all plants and experimental animals other than common laboratory animals. The strain and, if possible, the source of plant material and laboratory animals should be stated.

*Microorganisms*. In the title, in the abstract, and at the first mention in the text, microorganisms should be given their full binomial Latin names, in italics. Each organism should preferably have been obtained from or deposited with a recognized collection of microorganisms, and the collection number must be given. Alternatively, a strain number or name should be quoted; this should not be italicized. Names of ranks higher than genus (e.g., Eubacteriales, Lactobacillae), generic names used adjectivally (e.g., staphylococcal), and names of microorganisms used colloquially (e.g., most lactobacilli behave thus) should not be italicized. The first letter of the genus name should be capitalized. Elsewhere in the text, single-letter abbreviations may be given for the generic name after it is defined; if two genera with the same initial letter are studied, abbreviations such as *Strep.* and *Staph.* may be used.

The microorganisms and tissue culture strains referred to in a manuscript should be identified where possible by a type culture collection (e.g., the American Type Culture Collection) number.

Recommendations on nomenclature in bacterial genetics have been proposed by Demerec, Adelberg, Clark, and Hartman (1966, *Genetics* 54, 61–76). Authors should follow these guidelines whenever appropriate.

#### 3.4. Naming compounds

All chemical names are run together except for those of acids, esters, ethers, glycosides, ketones, and salts, which are printed as separate words. Hyphens are used to separate numbers, Greek letters, or some configurational and italic prefixes from words. Examples: *m*-dinitrobenzene,  $\beta,\beta$ -dimethyl-D-cysteine, 2-(*p*-isopropylphenyl)heptane, ethyl methyl ketone (butan-2-one). Refer to *Chemical Abstracts* for specific information.

#### 3.5. Prefixes

Italics are used for certain prefixes, e.g., *cis*, *trans*, *ortho*, *o*, *meta*, *m*, *para*, *p*, *dextro*, *d*, *levo*, *l*, *meso*, and also for *O*, *N*, etc., to indicate an element carrying a substituent, e.g., *N*<sup>4</sup>-acetylsulfanilamide. Italics are not used for *allo*, *bis*, *cyclo*, *epi*, *iso*, *n* (but *n*), *neo*, *nor* *s* (but *sec*), *t* (but *tert*), *tris*.

An alphabetical order should be followed for prefixes denoting substituents. Syllables indicating multiple substituents, e.g., *bis*, *di*, *tri*, do not count in deciding the order.

#### 3.6. Isotope experiments and isotopically labeled compounds

The symbol for the isotope introduced is placed in square brackets directly attached to the front of the name, as in [<sup>14</sup>C]urea. When more than one position in a

Table 1  
Abbreviations of units of measurement and of physical and chemical quantities<sup>a,b</sup>

| <i>Prefixes to the names of units</i>     |        |        |                                     |        |        | <i>Other units</i>                      |                                     |
|---|--------|--------|-------------------------------------|--------|--------|---|-------------------------------------|
| Multiplier                                | Prefix | Symbol | Multiplier                          | Prefix | Symbol |   |                                     |
| 10 <sup>-1</sup>                          | deci   | d      | 10                                  | deka   | da     | mole                                    | mol                                 |
| 10 <sup>-2</sup>                          | centi  | c      | 10 <sup>2</sup>                     | hecto  | h      | curie                                   | Ci                                  |
| 10 <sup>-3</sup>                          | milli  | m      | 10 <sup>3</sup>                     | kilo   | k      | becquerel <sup>c</sup>                  | Bq                                  |
| 10 <sup>-6</sup>                          | micro  | μ      | 10 <sup>6</sup>                     | mega   | M      | equivalent                              | eq                                  |
| 10 <sup>-9</sup>                          | nano   | n      | 10 <sup>9</sup>                     | giga   | G      | counts per minute                       | cpm                                 |
| 10 <sup>-12</sup>                         | pico   | p      | 10 <sup>12</sup>                    | tera   | T      | revolutions per minute                  | rpm                                 |
| 10 <sup>-15</sup>                         | femto  | f      | 10 <sup>15</sup>                    | peta   | P      | cycles per second (Hertz)               | Hz                                  |
| 10 <sup>-18</sup>                         | atto   | a      | 10 <sup>18</sup>                    | exa    | E      | degree Centigrade or Celsius            | °C                                  |
|   |        |        |                                     |        |        | degree absolute (Kelvin)                | K                                   |
|   |        |        |                                     |        |        | calorie                                 | cal                                 |
|   |        |        |                                     |        |        | kilocalorie                             | kcal                                |
|   |        |        |                                     |        |        | joule                                   | J                                   |
|   |        |        |                                     |        |        | gauss                                   | G                                   |
|   |        |        |                                     |        |        | ampere                                  | A                                   |
|   |        |        |                                     |        |        | volt                                    | V                                   |
|   |        |        |                                     |        |        | Svedberg (10 <sup>-13</sup> s)          | S                                   |
| <i>Units of concentration<sup>c</sup></i> |        |        |                                     |        |        | <i>Physical and chemical quantities</i> |                                     |
|   |        |        | Γ/2                                 |        |        | equilibrium constant                    | <i>K</i>                            |
|   |        |        | M <sup>d</sup>                      |        |        | Michaelis constant                      | <i>K<sub>m</sub></i>                |
|   |        |        | mM (rather than 10 <sup>-3</sup> M) |        |        | relative molecular mass                 | <i>M<sub>r</sub></i>                |
|   |        |        | μM (rather than 10 <sup>-6</sup> M) |        |        | (formerly molecular weight)             |                                     |
|   |        |        | nM (not mμM)                        |        |        | molar mass (g/mol)                      | <i>M<sub>m</sub></i>                |
|   |        |        | pM (not μμM)                        |        |        | retardation factor                      | <i>R<sub>r</sub></i>                |
|   |        |        | <i>X</i>                            |        |        | acceleration due to gravity             | <i>g</i>                            |
|   |        |        | <i>m</i>                            |        |        | specific rotation                       | [α] <sup>f</sup>                    |
|   |        |        |                                     |        |        | sedimentation coefficients              | <i>s</i>                            |
|   |        |        |                                     |        |        | sedimentation coefficient in            | <i>S<sub>20,w</sub><sup>0</sup></i> |
|   |        |        |                                     |        |        | water at 20 °C, extrapolated            |                                     |
|   |        |        |                                     |        |        | to zero concentration                   |                                     |
|   |        |        |                                     |        |        | diffusion coefficient                   | <i>D</i>                            |
|   |        |        |                                     |        |        | molecular mass (dalton)                 | Da                                  |
| <i>Units of length</i>                    |        |        |                                     |        |        | <i>Thermodynamic terms<sup>f</sup></i>  |                                     |
|   |        |        | m                                   |        |        | Gibbs energy change                     | Δ <i>G</i>                          |
|   |        |        | cm                                  |        |        | (formerly Δ <i>F</i> )                  |                                     |
|   |        |        | mm                                  |        |        | entropy change                          | Δ <i>S</i>                          |
|   |        |        | μm (not μ)                          |        |        | enthalpy change                         | Δ <i>H</i>                          |
|   |        |        | nm (not mμ)                         |        |        | chemical potential                      | μ                                   |
|   |        |        | μm                                  |        |        |   |                                     |
|   |        |        | Å                                   |        |        |   |                                     |
| <i>Units of light intensity</i>           |        |        |                                     |        |        | <i>Other words</i>                      |                                     |
|   |        |        | W                                   |        |        | logarithm (Briggsian)                   | log                                 |
|   |        |        |                                     |        |        | logarithm (natural)                     | ln                                  |
|   |        |        | W/m                                 |        |        | standard deviation of series            | SD                                  |
|   |        |        |                                     |        |        | standard error of mean                  | SE                                  |
| <i>Units of area and volume</i>           |        |        |                                     |        |        |   |                                     |
|   |        |        | m <sup>2</sup>                      |        |        |   |                                     |
|   |        |        | m <sup>3</sup>                      |        |        |   |                                     |
|   |        |        | ml                                  |        |        |   |                                     |
|   |        |        | μl (not λ)                          |        |        |   |                                     |
| <i>Units of mass</i>                      |        |        |                                     |        |        |   |                                     |
|   |        |        | g                                   |        |        |   |                                     |
|   |        |        | mg                                  |        |        |   |                                     |
|   |        |        | μg (not γ)                          |        |        |   |                                     |
| <i>Units of time</i>                      |        |        |                                     |        |        |   |                                     |
|   |        |        | s                                   |        |        |   |                                     |
|   |        |        | min                                 |        |        |   |                                     |
|   |        |        | h                                   |        |        |   |                                     |

<sup>a</sup> These abbreviations may be used without definition. They are not followed by periods. The same form is used in the plural (e.g., mol is the abbreviation for mole and moles).

<sup>b</sup> This journal recommends the use of the International System of Units (SI) (C.H. Page and P. Vigoureux, Eds., 1997, NBS Special Publication 330, US Government Printing Office; see also the IUPAC Manual of Symbols and Terminology for Physicochemical Quantities and Units, Pure Appl. Chem. 29, 8–44). However, it will continue to accept certain units as listed here (e.g., Ångstrom, calorie, minute) even though they are not part of the SI. Note that wavelengths should be expressed in nanometers or in Ångstrom units; millimicron is specifically unacceptable.

<sup>c</sup> Terms such as milligram percent (mg%) should not be used. Weight concentrations should be given as g/ml, g/100 ml, g/liter, etc.

<sup>d</sup> The letter M is not an abbreviation for mole; it is reserved for molar. Use mM for 10<sup>-3</sup> and μM for 10<sup>-6</sup> M. Avoid designating concentrations as μmol/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<sup>-4</sup> M and 10<sup>5</sup> M).

<sup>e</sup> Preferred to curie; equals one disintegration per second.

<sup>f</sup> For thermodynamic terms see the Recommendations for the Interunion Commission on Biothermodynamics (J. Biol. Chem. 251 (1976) 6879–6885).

Table 2  
Symbols for amino acids<sup>a</sup>

| Name  | Symbol            |
|---|-------------------|
| Alanine   | *Ala (A)          |
| Allohydroxylysine   | *aHyl             |
| Alloisoleucine  | Alle              |
| Amino acid residue  | AA                |
| 2-Aminoadipic acid  | Aad               |
| 3-Aminoadipic acid  | βAad              |
| 2-Aminobutyric acid   | Abu               |
| <i>c</i> -Aminohexanoic acid                                      | <i>c</i> Ahx      |
| 3-Aminopropionic acid   | βAla              |
| Arginine  | *Arg (R)          |
| Asparagine  | *Asn (N)          |
| Aspartic acid   | *Asp (D)          |
| Aspartic acid or asparagine                                       | *Asx (B)          |
| Carboxyglutamic acid  | Gla               |
| Cysteic acid  | Cya               |
| Cysteine (cf. half-cystine)                                       | *Cys (C)          |
| 2,4-Diaminobutyric acid   | A <sub>2</sub> bu |
| 2,2-Diaminopimelic acid   | A <sub>2</sub> pm |
| Glutamic acid   | *Glu (E)          |
| Glutamine   | *Gln (Q)          |
| Glutamic acid or glutamine  | *Glx (Z)          |
| Glycine   | *Gly (G)          |
| Half-cystine (cf. cysteine)                                       | *Cys              |
| Histidine   | *His (H)          |
| Homocysteine  | Hcy               |
| Homoserine  | Hse               |
| Homoserine lactone  | Hse>              |
| Hydroxylysine   | *Hyl              |
| Hydroxyproline  | *Hyp              |
| Isoleucine  | *Ile (I)          |
| Leucine   | *Leu (L)          |
| Lysine  | *Lys (K)          |
| Methionine  | *Met (M)          |
| Norleucine  | Nle               |
| Norvaline   | Nva               |
| Ornithine   | *Orn              |
| Phenylalanine   | *Phe (F)          |
| Proline   | *Pro (P)          |
| 5-Pyrrolidone-2-carboxylic acid (pyroglutamic acid; 5-oxoproline) | <Glu              |
| Sarcosine   | Sar               |
| Serine  | *Ser (S)          |
| Threonine   | *Thr (T)          |
| Tryptophan  | *Trp (W)          |
| Tyrosine  | *Tyr (Y)          |
| Valine  | *Val (V)          |

<sup>a</sup>The symbols preceded by an asterisk may be used without definition. The use of the one-letter abbreviations (in parentheses) should be restricted to comparisons of long sequences in tables, lists, or figures and for such special use as tagging three-dimensional models of proteins. They should not be used in papers where the single-letter system for nucleotide sequences is employed, as in repeating codons. Di( $\alpha$ -amino acids) are listed in Appendix B of Nomenclature of  $\alpha$ -Amino Acids Biochemistry, 1975, 14, 449–462).

substance is labeled by means of the same isotope and the positions are not indicated (as below), the number of labeled atoms is added as a right-hand subscript, as in [<sup>14</sup>C<sub>2</sub>]glycollic acid. The symbol U indicates uniform and G general labeling, e.g., [U-<sup>14</sup>C]glucose (where each

Table 3  
Symbols for substituents of amino acids and of reagents used for their modification<sup>a</sup>

| Name                                     | Symbol                                    |
|--|---|
| Acetyl-                                  | Ac-                                       |
| Benzhydryl- (diphenylmethyl)             | Bzh- or Ph <sub>2</sub> CH-               |
| Benzoyl-                                 | Bz- or PhCO-                              |
| Benzyl-                                  | Bzl- or PhCH <sub>2</sub> -               |
| Benzyloxycarbonyl-                       | Cbz- or Z-                                |
| Butyl-                                   | Bu-                                       |
| <i>tert</i> -Butyloxycarbonyl-           | Boc                                       |
| Carbamoyl-                               | Cbm- or NH <sub>2</sub> CO-               |
| Carboxymethyl-                           | Cm- or -CH <sub>2</sub> CO <sub>2</sub> H |
| 1-Carboxy-2-nitrophenyl-5-thio-          | Nbs-                                      |
| <i>p</i> -Carboxyphenylmercuri-          | -HgBzOH                                   |
| 3-Carboxypropionyl- (cf. succinyl-)      | Suc-                                      |
| <i>p</i> -Chloromercuribenzoate          | <i>p</i> Cl-HgBzO-                        |
| Cyclohexyl-                              | <i>c</i> Hx-                              |
| Cyclopentyl-                             | <i>c</i> Pe-                              |
| Dihydro-                                 | H <sub>2</sub> (not DH)                   |
| 5-Dimethylaminonaphthalene-1-sulfonyl-   | Dns- or dansyl-                           |
| Dinitrophenyl-                           | N <sub>2</sub> ph- or Dnp-                |
| Ethoxy-                                  | -OEt or EtO-                              |
| Ethyl-                                   | Et-                                       |
| Hydroxyethyl-                            | -(CH <sub>2</sub> ) <sub>2</sub> OH       |
| <i>p</i> -Iodophenylsulfonyl-            | Ips-                                      |
| Isopropylidene-                          | Me <sub>2</sub> C<                        |
| Maleoyl-                                 | Mal< or -Mal-                             |
| Maleyl-                                  | Mal-                                      |
| Methoxy-                                 | -OMe                                      |
| Methyl-                                  | Me-                                       |
| Pentyl-                                  | Pe-                                       |
| Phenyl-                                  | Ph-                                       |
| Phenylmethylsulfonyl-( $\alpha$ -tosyl)  | $\alpha$ Tos                              |
| Phenylthiocarbamoyl-                     | PhNCS- or Ptc-                            |
| Phosphoric residue                       | <i>P</i> or - <i>P</i>                    |
| Phthaloyl-                               | Pht< or -Pht-                             |
| Phthalyl-                                | Pht-                                      |
| Pipsyl- ( <i>p</i> -iodophenylsulfonyl-) | Ips-                                      |
| Propyl-                                  | Pr-                                       |
| Succinyl- (cf. 3-carboxypropionyl-)      | Suc< or -Suc-                             |
| Tetrahydro-                              | H <sub>4</sub> (not TH)                   |
| Tosyl- ( <i>p</i> -toluenesulfonyl-)     | Tos                                       |
| Trifluoroacetyl-                         | CF <sub>3</sub> CO- (not TFA)             |
| Trimethylsilyl-                          | Me <sub>3</sub> Si- (not TMS)             |
| Triphenylmethyl-                         | Ph <sub>3</sub> C- or Trt-                |

<sup>a</sup> These symbols should be defined.

molecule has <sup>14</sup>C at all six positions), [G-<sup>14</sup>C]glucose (where a molecule may have <sup>14</sup>C at any or all, but not necessarily all, of the six positions).

The isotopic prefix precedes that part of the name to which it refers, as in ethyl [<sup>14</sup>C]formate, phenyl[<sup>14</sup>C<sub>2</sub>]acetic acid, and 1-amino[<sup>14</sup>C]methylcyclopentanol.

When isotopes of more than one element are introduced, their symbols are arranged in alphabetical order, including <sup>2</sup>H and <sup>3</sup>H (for deuterium and tritium, respectively).

When not sufficiently distinguished by the foregoing means, the positions of isotopic labeling are indicated by Arabic numerals, Greek letters, or prefixes (as appropriate), placed within the square brackets and before the

Table 4  
Symbols for carbohydrates<sup>a</sup>

| Carbohydrate                  | Symbol            |
|-------------------------------|-------------------|
| Arabinose                     | Ara               |
| Fructose                      | *Fru              |
| Fucose                        | Fuc               |
| Galactose                     | *Gal              |
| Glucose                       | *Glc              |
| Mannose                       | *Man              |
| Muramic acid                  | Mur               |
| Neuraminic acid               | Neu               |
| Rhamnose                      | Rha               |
| Ribose                        | *Rib              |
| Xylose                        | Xyl               |
| Derivatives, e.g., of glucose |                   |
| <i>N</i> -Acetylglucosamine   | GlcNAc            |
| Glucosamine                   | GlcN              |
| 2-Deoxyglucose                | dGlc <sup>b</sup> |
| Glucuronic acid               | GlcU              |

<sup>a</sup>This table lists some used symbols for carbohydrates. Pyranose and furanose forms are designated where necessary by the suffixes *p* and *f*. The symbols preceded by an asterisk may be used without definition.

<sup>b</sup>The prefix “d” indicates a 2-deoxysugar. Isomers may be designated with a positional numeral, e.g., 3-deoxyglucose = 3-dGlc.

Table 5  
Symbols for bases<sup>a</sup>

| Base           | Symbol |
|----------------|--------|
| Adenine        | *Ade   |
| “a base”       | Base   |
| Cytosine       | *Cyt   |
| Guanine        | *Gua   |
| Hypoxanthine   | Hyp    |
| Orotate        | Oro    |
| “a purine”     | Pur    |
| “a pyrimidine” | Pyr    |
| Thiouracil     | Sur    |
| Thymine        | *Thy   |
| Uracil         | *Ura   |
| Xanthine       | *Xan   |

<sup>a</sup>The symbols preceded by an asterisk may be used without definition.

symbol of the element concerned, to which they are attached by a hyphen; examples are [1-<sup>2</sup>H]ethanol, [1-<sup>14</sup>C]aniline, L-[2-<sup>14</sup>C]leucine or L-[ $\alpha$ -<sup>14</sup>C]leucine, [*carboxy*-<sup>14</sup>C]leucine, [*Me*-<sup>14</sup>C]isoleucine, [2,3-<sup>14</sup>C]maleic anhydride, [6,7-<sup>14</sup>C]xanthopterin, [3,4-<sup>13</sup>C<sub>2</sub>,<sup>35</sup>S]methionine, [1-<sup>14</sup>C,2-<sup>13</sup>C]acetaldehyde, [3-<sup>14</sup>C,2,3-<sup>2</sup>H,<sup>15</sup>N]serine, [*methyl*-<sup>3</sup>H]thymidine, [<sup>4</sup>A-<sup>3</sup>H]NADPH, all-*trans*-[11-<sup>3</sup>H]retinyl acetate, and [5,6(N)-<sup>3</sup>H]prostaglandin.

The same rules apply when the labeled compound is designated by a standard abbreviation or symbol other than the atomic symbol, e.g., [ $\gamma$ -<sup>32</sup>P]ATP.

For simple molecules, however, it is often sufficient to indicate the labeling by writing the chemical formulas, e.g., <sup>14</sup>CO<sub>2</sub>, H<sub>2</sub><sup>18</sup>O, <sup>2</sup>H<sub>2</sub>O, and H<sub>2</sub><sup>35</sup>SO<sub>4</sub>, with the prefix superscripts attached to the proper atomic symbols in the formulas.

Table 6  
Symbols for nucleosides and nucleotides<sup>a</sup>

| Nucleoside                                      | Symbol             |                      |
|---|--------------------|----------------------|
|   | Three-letter       | One-letter           |
| Adenosine                                       | *Ado               | *A                   |
| Bromouridine                                    | BrUrd              | B                    |
| Cytidine  | *Cyd               | *C                   |
| Dihydrouridine                                  | H <sub>2</sub> Urd | D or hU              |
| Guanosine                                       | *Guo               | *G                   |
| Inosine   | *Ino               | *I                   |
| 6-Mercaptopurine ribonucleoside (6-thioinosine) | Sno                | M or sI              |
| “a nucleoside”                                  | Nuc                | N                    |
| Orotidine                                       | Ord                | O                    |
| Phosphoric residue                              | -P                 | p or - <sup>b</sup>  |
| Pseudouridine                                   | *ψrd               | *ψ or Q <sup>c</sup> |
| “a purine nucleoside”                           | Puo                | R                    |
| “a pyrimidine nucleoside”                       | Pyd                | Y                    |
| Ribosylthymine                                  | *Thd               | *T                   |
| Thiouridine                                     | SUrd               | S or sU              |
| Thymidine (2'-deoxyribosylthymine)              | *dThd              | *dT                  |
| Uridine   | Urd                | U                    |
| Xanthine  | *Xao               | *X                   |

<sup>a</sup>The symbols preceded by an asterisk may be used without definition. Two systems are recognized, one using three-letter symbols for the common nucleosides and a capital italic *P* for the phosphoric residue, the other using single capital letters for the common nucleosides and a lowercase *p* for the phosphoric residue. The three-letter symbols should be used whenever chemical changes involving nucleosides or nucleotides are being discussed. The one-letter symbols are intended for the nucleoside residues in sequences or partial sequences only; in these they should always be connected by hyphens (for internal phosphodiester 3'-5' linkages) and the terminal phosphoric residue should be indicated by *p*. Codons may be indicated in the text without hyphens or the terminal *p*'s. The 2'-deoxyribonucleosides are indicated by the prefix “d”.

<sup>b</sup>For internal phosphodiester bonds.

<sup>c</sup>For computer work.

Terms such as “<sup>131</sup>I-labeled albumin” should not be contracted to “[<sup>131</sup>I]albumin” (since native albumin does not contain iodine); however, <sup>131</sup>I-albumin and [<sup>131</sup>I]iodoalbumin are both acceptable.

The square brackets are not to be used when the isotopic symbol is attached to a word that is not a chemical name, abbreviation, or symbol (e.g., <sup>131</sup>I-labeled proteins or <sup>14</sup>C-labeled amino acids).

### 3.7. Spectrophotometric data

Authors reporting spectrophotometric data must indicate the relationships among the symbols used. Although a number of alternatives exist, the Editors recommend adherence to the symbols and terminology adopted by IUPAC, (Pure Appl. Chem. 21 (1970) 1). Beer's law may be stated as

$$A = -\log T = \epsilon lc,$$

Table 7  
Substituents on terminal sugar hydroxyl groups and phosphoric acid protecting groups<sup>a</sup>

| Name                                   | Symbol                  |
|--|-------------------------|
| Aminoacyl-                             | (AA)                    |
| Anisyl-                                | (MeOPh)                 |
| Benzhydryl-                            | (Ph <sub>2</sub> CH)    |
| Benzyl-                                | (Bzl)                   |
| Borate                                 | (>BOH)                  |
| Carbonyl                               | (>CO)                   |
| 5'-Cyanoethyl-; 3' (or 2')-cyanoethyl- | (CNEt)-; -(CNEt)        |
| Dimethoxytrityl-                       | [(MeO) <sub>2</sub> Tr] |
| 1-Ethoxyethyl-                         | (EtOEt)                 |
| Ethoxymethyl-                          | (EtOMe)                 |
| Ethyl-                                 | (Et)                    |
| Glycyl-                                | (Gly)                   |
| Leucyl-                                | (Leu)                   |
| Isopropylidene-                        | (>CMe <sub>2</sub> )    |
| Methyl-                                | (Me)                    |
| Monomethyltrityl-                      | (MeOTr)                 |
| Phenyl-                                | (Ph)                    |
| Tetrahydropyranyl-                     | (Thp)                   |
| Tosyl-                                 | (Tos)                   |
| Trifluoroacetyl-                       | F <sub>3</sub> CCO-     |
| Trityl-                                | (Tr)                    |

<sup>a</sup> These symbols, generally placed in parentheses, follow the appropriate nucleoside symbol or adjoin the appropriate symbol for the phosphoric acid residue.

Table 8  
Symbols for specific preparations of nucleic acids<sup>a</sup>

| Name   | Symbol   |
|--|--|
| Complementary DNA  | cDNA   |
| Complementary RNA  | cRNA   |
| Heterogeneous nuclear RNA                                  | hnRNA  |
| Messenger RNA  | mRNA   |
| Mitochondrial DNA  | mtDNA  |
| Mitochondrial RNA  | mtRNA  |
| Nuclear DNA  | nDNA   |
| Nuclear RNA  | nRNA   |
| Ribosomal RNA  | rRNA   |
| Transfer RNA   | tRNA   |
| Specific transfer RNA species                              |  |
| Alanine-accepting tRNA                                     | tRNA <sup>Ala</sup>  |
| Aminoacylated alanine-accepting tRNA                       | Ala-tRNA <sup>Ala</sup>  |
| Isoacceptor species of alanine-accepting tRNA              | tRNA <sub>1</sub> <sup>Ala</sup> , tRNA <sub>2</sub> <sup>Ala</sup> , etc. |
| Methionine-accepting tRNA                                  | tRNA <sup>Met</sup>  |
| Formylatable methionine-accepting tRNA                     | tRNA <sup>cMet</sup> or tRNA <sub>f</sub> <sup>Met</sup>                   |
| Formylaminoacylated formylatable methionine-accepting tRNA | fMet-tRNA <sup>fMet</sup> or fMet-tRNA <sub>f</sub> <sup>Met</sup>         |

<sup>a</sup> These symbols may be used without definition.

where  $A$  is the absorbance;  $T$ , the transmittance ( $= I/I_0$ );  $\epsilon$ , the molar absorption coefficient;  $c$ , the concentration of the absorbing substances in moles per liter; and  $l$ , the length of the optical path in centimeters. Under these conditions  $\epsilon$  has the dimensions liter mol<sup>-1</sup> cm<sup>-1</sup>, or more briefly M<sup>-1</sup> cm<sup>-1</sup> (not cm<sup>2</sup> mol<sup>-1</sup>).

Table 9  
Miscellaneous symbols<sup>a</sup>

| Name                              | Symbol                  |
|-----------------------------------|-------------------------|
| Cobalamin                         | Cbl                     |
| Cobamide                          | Cba                     |
| Cobinamide                        | Cbi                     |
| Corrin                            | Crn                     |
| Ferredoxin                        | Fd                      |
| Menaquinone                       | MQ                      |
| Platoquinone                      | PQ                      |
| Phosphoric residue                | <i>P</i> - or <i>-P</i> |
| Pteric acid (pteroyl-)            | Pte                     |
| Pteroylglutamic acid <sup>b</sup> | PteGlu                  |
| Pyridoxyl-                        | Pxy-                    |
| Pyridoxylidene =                  | Pxd =                   |
| Tocopherol                        | T                       |
| Tocopherolquinone                 | TQ                      |
| Ubiquinone                        | Q                       |

<sup>a</sup> These symbols should be defined.

<sup>b</sup> Folate and folyl- are not abbreviated.

If Beer's law is not followed by a particular substance in solution, this should be explicitly stated; in such cases the substance may be characterized by reporting the absorbance at a specified concentration. When the spectrophotometric measurements are made with the use of a radiant energy source that is not confined strictly (as in a line spectrum) to the wavelength or frequency specified, the exact value of  $\epsilon$  will be somewhat ambiguous; report the spectral characteristics of the source.

### 3.8. Equilibrium and velocity constants

Dissociation constants, association constants, and Michaelis constants should ordinarily be written in terms of concentration: The units should always be clearly indicated at the point where the equilibrium constant is defined and where its value is given.

Values of rate constants should be similarly specified, first-order velocity constants being generally given as s<sup>-1</sup> (other units of time may be used, but the time unit must be specified). Second-order rate constants are ordinarily given in M<sup>-1</sup> s<sup>-1</sup>.

### 3.9. Molecular weight and mass

Do not express molecular weight in daltons. The term molecular weight (relative molecular mass,  $M_r$ ) is defined as mass ratio, a pure number. The dalton is a unit of mass equal to one-twelfth the mass of an atom of carbon-12; hence, it is correct to say "the molecular weight (relative molecular mass) of  $X$  is 10<sup>6</sup>" or " $M_r$  is 10<sup>6</sup>" or "the molecular mass of  $X$  is 10<sup>6</sup> Da" or "the molecular mass is 10<sup>6</sup> g" or to use expressions such as "the 16,000-Da peptide." For entities that do not have a definable molecular weight it is satisfactory to say, for example, "the mass of a ribosome is 10<sup>7</sup> Da." It is incorrect to say "the molecular weight of  $X$  is 10<sup>6</sup> Da."

Table 10  
Abbreviations for semisystematic or trivial names<sup>a</sup>

| Name   | Abbreviation                     |
|--|----------------------------------|
| Adenosine 5'-mono-, 5'-di-, and 5'-triphosphates                               | *AMP, ADP, ATP <sup>b</sup>      |
| S-Adenosylmethionine   | AdoMet                           |
| O-(Carboxymethyl)-cellulose  | *CM-cellulose                    |
| Coenzyme A   | *CoA (or CoASH)                  |
| Corticotropin (adrenocorticotropin, adrenocorticotropic hormone)               | ACTH                             |
| Cyclic AMP (adenosine 3':5'-monophosphate), etc.                               | cAMP, cGMP, etc.                 |
| Cytidine 5'-mono-, 5'-di-, and 5'-triphosphates                                | *CMP, CDP, CTP <sup>b</sup>      |
| Deoxyribonucleic acid, or deoxyribonucleate                                    | *DNA                             |
| Dibutyl cyclic AMP   | Bt <sub>2</sub> cAMP             |
| O-(Diethylaminoethyl)-cellulose  | *DEAE-cellulose                  |
| 3,4-Dihydroxyphenylalanine   | *Dopa                            |
| Diisopropyl fluorophosphate  | DFP                              |
| Dimethyl sulfoxide   | Me <sub>2</sub> SO               |
| 2,4-Dinitrophenyl-   | DNP- or Dnp-                     |
| Ethylenediaminetetraacetate  | *EDTA                            |
| Ethylene glycol bis(β-aminoethyl ether) <i>N,N'</i> -tetraacetic acid          | *EGTA                            |
| Flavin-adenine dinucleotide and its fully reduced form                         | *FAD, FADH <sub>2</sub>          |
| 1-Fluoro-2,4-dinitrobenzene  | FDNB                             |
| Glutathione and its oxidized form  | *GSH, GSSG                       |
| Guanosine 5'-mono-, 5'-di-, and 5'-triphosphates                               | *GMP, GDP, GTP <sup>b</sup>      |
| Hemoglobin, carbon monoxide hemoglobin, oxyhemoglobin                          | *Hb, HbCO, HbO <sub>2</sub>      |
| 4-(2-Hydroxyethyl)-1-piperazineethanesulfonic acid                             | *Hepes                           |
| Inorganic orthophosphate   | *P <sub>i</sub>                  |
| Inorganic pyrophosphate  | *PP <sub>i</sub>                 |
| Inosine 5'-mono-, 5'-di-, and 5'-triphosphates                                 | *IMP, IDP, ITP <sup>b</sup>      |
| Methemoglobin, metmyoglobin  | MetHb, MetMb                     |
| Monobutyl cyclic AMP   | Bt-cAMP                          |
| Myoglobin, carbon monoxide myoglobin, oxymyoglobin                             | Mb, MbCO, MbO <sub>2</sub>       |
| Nicotinamide adenine dinucleotide and its oxidized and reduced forms           | *NAD, NAD <sup>+</sup> , NADH    |
| Nicotinamide adenine dinucleotide phosphate and its oxidized and reduced forms | *NADP, NADP <sup>+</sup> , NADPH |
| Nicotinamide mononucleotide  | *NMN                             |
| Riboflavin 5'-phosphate  | *FMN                             |
| Ribonucleic acid or ribonucleate   | *RNA                             |
| Ribosylthymine 5'-mono-, 5'-di-, and 5'-triphosphates                          | *TMP, TDP, TTP <sup>b</sup>      |
| Sodium dodecyl sulfate   | *SDS                             |
| Tetramethylsilyl   | *Me <sub>4</sub> Si              |
| Thymidine 5'-mono-, 5'-di-, and 5'-triphosphates                               | *dTMP, dTDP, dTTP <sup>b</sup>   |
| 1,1,1-Trichloro-2,2-bis( <i>p</i> -chlorophenyl)ethane                         | DDT                              |
| Triphosphopyridine nucleotide and its oxidized and reduced forms               | *TPN, TPN <sup>+</sup> , TPNH    |
| Tris(hydroxymethyl)aminomethane  | *Tris                            |
| Uridine 5'-mono-, 5'-di-, and 5'-triphosphates                                 | *UMP, UDP, UTP <sup>b</sup>      |
| Uridine diphosphogalactose   | *UDP-Gal                         |
| Uridine diphosphoglucose   | *UDP-Glc                         |

<sup>a</sup> The abbreviations preceded by an asterisk may be used without definition.

<sup>b</sup> The d prefix may be used to represent the corresponding deoxyribonucleoside phosphates, e.g., dADP. The various isomers of adenosine monophosphate may be written 2'-AMP, 3'-AMP, or 5'-AMP (in case of possible ambiguity). A similar procedure may be applied to other nucleoside or deoxyribonucleoside monophosphates.

### 3.10. Composition of solutions and buffers

The compositions of all solutions and buffers should be specified in sufficient detail to define the concentration of each species. For ordinary buffers, such as 0.1 M sodium acetate, pH 5.0, it will be assumed that the molarity refers to the total concentration of the species that buffers at the indicated pH and the concentration of the counterion is sufficient to neutralize the charge of the ionized buffer species. The compositions of mixtures should be indicated by the use of a colon or a slash (/). Examples are chloroform:ether (9:1); butanol/acetic

acid/water (75/20/5). Hyphens or dashes are not acceptable for this purpose. Do not use abbreviations for buffers, but specify these as Buffer A, B, etc., after defining them under Materials and Methods.

Give the complete unabbreviated name and the source (or a reference that gives the complete composition) for all culture media.

### 3.11. Kinetic constants

Velocity constants for the forward and the backward reactions in the *n*th step of an enzymatic reaction can be

represented (a) by  $k_{+n}$  and  $k_{-n}$ , respectively, or (b) by  $k_q$  and  $k_{q+1}$ , respectively, where  $q = 2n - 1$ . The Michaelis constant is defined as  $K_m = [S]$  when  $v = V/2$ , where  $v$  is the initial rate of appearance of product or disappearance of substrate at a given substrate concentration  $[S]$  and  $V$  (or  $V_{\max}$ ) is the initial rate when the enzyme is saturated with that substrate. When reactions with two substrates A and B are being considered,  $K_m^A$  or  $K_m(A) = [A]$  when  $v = V/2$  and  $[B]$  has been extrapolated to infinity; a value for  $[A]$  when  $v = V/2$  at a finite concentration (which must be specified) of B should be referred to as an apparent  $K_m$  for A.  $K_s$  (or  $K_d$ ) is the equilibrium constant of the dissociation of the substrate–enzyme complex.

### 3.12. Abbreviations and symbols

All nonstandard abbreviations used in the text should be defined in a single footnote, inserted immediately after the first such abbreviation. Abbreviations used only in a table or figure may be defined in the legend (rather than in the abbreviations footnote). Abbreviations listed in Tables 1, 8, and 11 of this Guide, and those so indicated in the other tables, may be used without definition (see Tables 2–7, 9, and 10).

**Abbreviations are hindrances to readers in fields other than that of the author.** Their use should be restricted to a minimum. On the other hand, it is sometimes convenient to use abbreviations or symbols for the names of chemical substances, particularly in equations, tables, and figures. The limited use of abbreviations and symbols of specified meaning is therefore accepted. However, clarity and lack of ambiguity are more important than brevity.

When other abbreviations for chemical compounds are needed, the maximum use should be made of standard chemical symbols (C, H, O, N, P, S, Na, Cl, etc.), of numerical multiples (subscripts 2 and 3, not di or D

or T, etc., as in  $\text{Me}_2\text{SO}$ ,  $\text{Me}_3\text{Si}$ -), and of trivial names and their symbols (e.g., folate,  $\text{P}_i$ , Me, Pr, Bu, Ph, Ac).

Symbols may be combined to represent more complex symbols, such as Tos-Arg-OMe, in which the basic structure (arginine) remains recognizable.

**Names of enzymes should not be abbreviated** except in terms of substrates for which accepted abbreviations exist (e.g., ATPase and RNase). Authors should use the recommended name given in *Enzyme Nomenclature: Recommendations of the Nomenclature Committee of the IUBMB*. The latest version can be found at [www.chem.qmw.ac.uk/iubmb/enzyme](http://www.chem.qmw.ac.uk/iubmb/enzyme).

Class names, such as fatty acids, proteins, etc., or short terms (poly, furan, folate, etc.) are not to be abbreviated. Abbreviations should usually not be used for terms such as “central nervous system,” “red blood cells,” or “extracellular fluid.”

For some of the most important biochemical reagents and factors, even shorter abbreviations are universally employed, e.g., ATP, NAD, and RNA. These abbreviations do not represent a chemical structure in the same way as symbols. The creation of such abbreviations should therefore be restricted to an absolute minimum.

Symbols or abbreviations other than those specified in the tables here should always be defined. Such ad hoc abbreviations and symbols should not conflict with known ones. None should be introduced except when repeated use is required. If, in exceptional circumstances, symbols or abbreviations are used in the abstract, they should be defined in the abstract as well as in the body of the paper.

There are three main series of symbols of monomeric units, those for amino acids, monosaccharides, and mononucleosides, of which the amino acid series is the oldest. The monomeric units are generally designated by three-letter symbols—a capital followed by two lowercase letters. The abbreviations should not be used for the free monomers in the text of papers.

A standard treatment has been devised for the three groups of macromolecules built up from these units. When the sequence of residues is known, the symbols are written in order and joined by short lines (dashes, hyphens). When the sequence is not known, the group of symbols, separated by commas, is enclosed in parentheses. Example: Ala–Gly–(Met,Pro)–Lys means that the sequence of methionine and proline is unknown.

For the amino acid residues in polypeptides, the residue with the free  $\alpha$ -amino group (if one is present) is understood to be at the left of the sequence as written. For the polysaccharides, the symbols for the sugars are joined by short dashes or arrows to indicate the links between units. The position and nature of the links are shown by numerals and the anomeric symbols  $\alpha$  and  $\beta$ , e.g.,

Table 11  
Miscellaneous<sup>a</sup>

| Name                                   | Abbreviation |
|--|--------------|
| Circular dichroism                     | CD           |
| Electron paramagnetic resonance        | EPR          |
| Electron spin resonance                | ESR          |
| Gas chromatography                     | GC           |
| Gas–liquid chromatography              | GLC          |
| High-performance liquid chromatography | HPLC         |
| Infrared                               | ir           |
| Mass spectrometry                      | MS           |
| Nuclear magnetic resonance             | NMR          |
| Optical rotary dispersion              | ORD          |
| Polyacrylamide gel electrophoresis     | PAGE         |
| Polymerase chain reaction              | PCR          |
| Thin-layer chromatography              | TLC          |
| Ultraviolet                            | uv           |

<sup>a</sup> These abbreviations may be used without definition.

Table 12  
Recommendations of the IUPAC–IUBMB Combined Commission on Biochemical Nomenclature<sup>a,b</sup>

| Group  | Title  | Citation   |
|--|--|--|
| Abbreviations and symbols                        | Abbreviations and symbols for chemical names of special interest in biological chemistry; revised tentative rules (1965)   | Arch. Biochem. Biophys. 136 (1970) 1–12  |
| Amino acids and peptides                         | Nomenclature and symbolism for amino acids and peptides; recommendations 1983  | Biochem. J. 219 (1984) 345–373   |
| Biothermodynamics                                | Corrections<br>Recommendations for the measurement and presentation of biochemical equilibrium data  | Eur. J. Biochem. 152 (1985) 1<br>J. Biol. Chem. 251 (1976) 6879–6885   |
| Carbohydrates                                    | Tentative rules for carbohydrate nomenclature; part I<br>Abbreviated terminology of oligosaccharide chains; recommendations 1980<br>Conformational nomenclature for five- and six-membered ring forms of monosaccharides and their derivatives; recommendations 1980<br>Nomenclature of branched-chain monosaccharides; recommendations 1980<br>Nomenclature of unsaturated monosaccharides; recommendations 1980<br>Polysaccharide nomenclature; recommendations 1980<br>Symbols for specifying the conformation of polysaccharide chains; recommendations 1981 | J. Biol. Chem. 247 (1972) 613–634<br>Arch. Biochem. Biophys. 220 (1983) 325–329<br>Arch. Biochem. Biophys. 207 (1981) 469–472<br>Eur. J. Biochem. 119 (1981) 5–8<br>Eur. J. Biochem. 119 (1981) 1–3<br>Arch. Biochem. Biophys. 220 (1983) 330–332<br>Eur. J. Biochem. 131 (1983) 5–7 |
| Carotenoids                                      | Tentative rules for the nomenclature of carotenoids<br>Amendments  | J. Biol. Chem. 247 (1972) 2633–2643<br>Eur. J. Biochem. 57 (1975) 317  |
| Corrinoids                                       | The nomenclature of corrinoids; recommendations 1973   | Arch. Biochem. Biophys. 161 (1974) iii–xi  |
| Cyclitols  | The nomenclature of cyclitols; recommendations 1973  | Eur. J. Biochem. 57 (1975) 1   |
| Enzymes  | Enzyme Nomenclature; recommendations 1992<br>Nomenclature of multiple forms of enzymes, recommendations 1976<br>Symbolism and terminology in enzyme kinetics; recommendations 1981<br>Units of enzyme activity; recommendations 1978<br>Correction   | Academic Press, San Diego, 1992<br>Arch. Biochem. Biophys. 185 (1978) 1–3<br>Arch. Biochem. Biophys. 224 (1983) 732–740<br>Eur. J. Biochem. 97 (1979) 319–320<br>Eur. J. Biochem. 104 (1980) 1   |
| Folic acid                                       | Nomenclature and symbols for folic acid and related compounds; recommendations 1986  | Eur. J. Biochem. 168 (1987) 251–253  |
| Glycoproteins, glycopeptides, and peptidoglycans | Nomenclature of glycoproteins, glycopeptides, and peptidoglycans; recommendations 1985<br>Correction   | Eur. J. Biochem. 159 (1986) 1–6<br>Eur. J. Biochem. 185 (1989) 485   |
| Immunoglobulins                                  | Nomenclature of human immunoglobulins  | Eur. J. Biochem. 45 (1974) 5–6   |
| <i>myo</i> -Inositol                             | Numbering of atoms in <i>myo</i> -inositol   | Biochem. J. 258 (1989) 1–2   |
| Isotopically modified compounds                  | Isotopically modified compounds; recommendations 1977  | Eur. J. Biochem. 86 (1978) 9   |
| Lignins and neolignans                           | Nomenclature of lignins and neolignans   | Pure Appl. Chem. 72 (2000) 1493–1523   |
| Lipids   | Nomenclature of lipids; recommendations 1976   | Eur. J. Biochem. 79 (1977) 11  |
| Natural products                                 | Natural products and related compounds; recommendations 1978   | Eur. J. Biochem. 86 (1978) 1   |
| Nucleotides and nucleic acids                    | Abbreviations and symbols for the description of conformations of polynucleotide chains; recommendations 1982<br>Abbreviations and symbols for nucleic acids, polynucleotides, and their constituents; recommendations 1970<br>Incompletely specified bases in nucleic acid sequences; recommendations 1984<br>Definition and nomenclature of nucleic acid structure   | Eur. J. Biochem. 131 (1983) 9–15<br>Arch. Biochem. Biophys. 145 (1971) 425–436<br>Biochem. J. 229 (1985) 281–286<br>EMBO J. 8 (1989) 1–4   |
| P450 gene superfamily                            | The P450 gene superfamily: recommended nomenclature<br>The P450 gene superfamily: update on new sequences, gene mapping, and recommended nomenclature  | DNA 6 (1987) 1–11  |
| Phosphorus                                       | Nomenclature of phosphorus-containing compounds of biochemical importance; recommendations 1976  | Proc. Natl. Acad. Sci. USA 74 (1977) 2222–2230   |
| Prenols  | Prenol nomenclature; recommendations 1986  | Eur. J. Biochem. 167 (1987) 181–184  |
| Proteins   | Nomenclature of electron-transfer proteins; recommendations 1989   | Bur. J. Biochem. 200 (1991) 599–611  |

Table 12 (continued)

| Group                 | Title   | Citation  |
|-----------------------|---|---|
| Quinones              | The nomenclature of quinones with isoprenoid side chains; recommendations 1973  | Arch. Biochem. Biophys. 165 (1974) 1–8  |
| Reference citations   | The citation of bibliographic references in biochemical journals  | Arch. Biochem. Biophys. 160 (1974) xiii–xv  |
| Retinoids             | Nomenclature of retinoids; recommendations 1981   | Arch. Biochem. Biophys. 224 (1983) 728–731  |
| Stereochemistry       | Stereochemistry; recommendations 1974   | Pure Appl. Chem. 45 (1976) 11   |
| Steroids              | Revised tentative rules for nomenclature of steroids <sup>c</sup><br>Amendments to steroid rules  | Arch. Biochem. Biophys. 136 (1970) 13–35<br>Arch. Biochem. Biophys. 147 (1971) 4–7                                |
| Système International | The nomenclature of steroids; recommendations 1989<br>The international system of units (SI), C.H. Page and P. Vigoureux, Eds., revised | Eur. J. Biochem. 186 (1989) 429–458<br>National Bureau of Standards Special Publication 330, Washington, DC, 1977 |
| Tetrapyrroles         | Nomenclature of tetrapyrroles; recommendations 1986   | Eur. J. Biochem. 178 (1988) 277–328   |
| Tocopherols           | Nomenclature of tocopherols and related compounds; recommendations 1981   | Arch. Biochem. Biophys. 218 (1982) 347–348  |
| Translation factors   | Prokaryotic and eukaryotic translation factors  | Biochimie 78 (1996) 1119–1122   |
| Trivial names         | Trivial names of miscellaneous compounds of importance in biochemistry  | Arch. Biochem. Biophys. 118 (1967) 505–507  |
| Vitamin B-6           | Nomenclature of vitamins B-6 and related compounds; recommendations 1973  | Arch. Biochem. Biophys. 162 (1974) 1–5  |
| Vitamin D             | Nomenclature of vitamin D; recommendations 1981   | Arch. Biochem. Biophys. 218 (1982) 342–346  |

<sup>a</sup> Although primary print versions are cited in the table, the latest information, including corrected versions of prior recommendations, are available on the Internet at [www.chem.qmw.ac.uk/iupac/](http://www.chem.qmw.ac.uk/iupac/). The listings are current to this year.

<sup>b</sup> A compilation of this material had been available at *The Collected Tentative Rules and Recommendations* from the American Society of Biological Chemists, but is now out of print. An updated version, *Biochemical Nomenclature and Related Documents* (1992), 2nd ed., is available from Portland Press, Inc., P.O. Box 2191, Chapel Hill, NC 27515–2191.

<sup>c</sup> The definitive rules for nomenclature of steroids may be found in *Pure Appl. Chem.* 31 (1972) 285–322.

Maltose  $\alpha$ 1–4Glc or Glcp  $\alpha$ 1  $\rightarrow$  4Glc

Lactose  $\beta$ 1–4Glc or Galp  $\beta$ 1  $\rightarrow$  4Glc

The arrows point away from the hemiacetal link. If the dash is used, it is assumed that the hemiacetal link is to the left of it. When it is necessary to indicate furanose or pyranose, the letter *f* or *p* after the saccharide symbol may be used, e.g., Rib*f* for ribofuranose. **D** or **L** may be added as needed, e.g., **D**-Glcp  $\alpha$ 1–4**D**-Glc.

Macromolecules composed of repeating sequences may be represented by the prefix “poly” or the subscript *n*, both indicating “polymer of.” The symbols for the monomeric units of the sequence are enclosed in parentheses. Thus, poly(Lys) or (Lys)<sub>*n*</sub> is polylysine, and poly(Ala-Lys) or (Ala-Lys)<sub>*n*</sub> is a linear polymer consisting of alanine and lysine in regular alternating

sequence and poly(Ala,Lys) is the irregular random copolymer of equal amounts of these amino acids. Between poly and the parenthesis there is no intervening space or hyphen. The *n* may be replaced by a definite number (e.g., 10), an average (e.g.,  $\overline{10}$ ), or a range (e.g., 8–12). “Oligo” may replace “poly” for short chains. The same rules apply to oligo- and polynucleotides.

### 3.13. Covalent structure of proteins

Recommendations for the Documentation of Results in the Determination of the Covalent Structure of Proteins will be found in *J. Biol. Chem.* 251 (1976) 11–12. Authors planning to submit manuscripts in this area are advised to consult this document before undertaking the task of writing.