INSTRUCTIONS TO AUTHORS: 1996

POLICY AND ORGANIZATION OF THE JOURNAL

General policy

The *Biochemical Journal* publishes papers in English in all fields of biochemistry and cellular and molecular biology, provided that they make a sufficient contribution to biochemical knowledge. Papers may include new results obtained experimentally, descriptions of new experimental methods of biochemical importance, or new interpretations of existing results. Theoretical contributions will be considered equally with papers dealing with experimental work. All work presented should have as its aim the development of biochemical concepts rather than the mere recording of facts. Preliminary, confirmatory or inconclusive work will not be published. The *Biochemical Journal* will not publish material that has been wholly or largely published elsewhere, even as a preliminary communication or in unrefereed symposium proceedings; equally, fragmentation of research into 'least publishable units' is discouraged.

The Journal places emphasis on the provision of quantitative data, with appropriate statistical analysis wherever possible.

The interpretation of this policy is in the hands of the Editorial Board, who judge whether each paper submitted is acceptable in terms of science and presentation.

Editorial office

The editorial office is part of Portland Press Ltd, the publishing division of the Biochemical Society, and administers all aspects of the processing, subediting and printing of the *Biochemical Journal*. The Chairman of the Editorial Board, on behalf of the Editorial Board, takes responsibility for the journal's content. All correspondence concerning publication of the *Biochemical Journal* should be directed to the Managing Editor at the journal's London address given on p. 4.

The Editorial Board and the Editorial Advisory Panel

Members of the Editorial Board, which is international, are appointed by the Executive Committee of the Biochemical Society on the recommendation of the Editorial Board. The composition of the Board is such that there is a wide range of expert opinion covering most areas of biochemical research.

The Editors are supported by an international panel of some 400 Editorial Advisers. These are independent reviewers, who are expert each in their own specific field of biochemistry, and who review up to ten papers a year for the journal. The close association of the Advisers with the journal means that a high standard of reviewing can be maintained.

Editors normally serve for a period of 5 years, although this may be extended for a further 2 years in some cases. The composition of the Advisory Panel is reviewed each year. The names of the members of the Editorial Board are published in each issue of the journal; those of the members of the Advisory Panel appear in part 2 of each volume.

Authors may suggest potential reviewers for their paper in the letter of submission, but the journal will usually regard such suggestions as a guide only and is under no obligation to follow them. Authors may also specify the names of those they wish to be excluded from the review process for a particular paper; in such cases their wishes are usually respected, unless, of course, in the opinion of the journal such a request unreasonably excludes all the expertise available to it in that scientific area.

Handling of papers

Copies of submitted papers are sent simultaneously to a selected Adviser (or, occasionally, to another independent reviewer) and to a relevant Editor. The Adviser (or other reviewer) assesses the paper and sends a report directly to the Editor by a date stipulated by the editorial office. The Editor will, in the meantime, have reached an independent judgement and, on receipt of the report, compiles a combined editorial report based on both opinions. In some cases, Editors will seek further advice from other scientists, and the report then reflects the views of all consulted. If the Editor and Adviser disagree, even after direct discussion, a second Editor is asked for an opinion and, if need be, a further Adviser. This may also be done when review of a paper demands expertise in more than one field of biochemistry. All papers are therefore seen by at least two independent scientists, and sometimes by more. The time taken for review is monitored by the editorial office, so that the policy of the journal to give authors rapid decisions is sustained.

When a paper is judged to have scientific merit and thus to be basically acceptable, the editorial office sends an appropriate letter to the authors together with an editorial report containing comments for the authors' consideration. After revision by the author the paper is checked by an Editor before being finally prepared for press by the subeditors. After typesetting, proofs are supplied to authors (except for Research Communications and BJ Letters) for correction of printer's errors only. On publication, 50 free offprints are supplied per paper; more may be purchased using the form supplied with the proofs.

If a paper is to be declined, the reports and correspondence are seen by the Chairman or one of the Deputy Chairmen, who then writes an explanatory letter to the authors. Papers may be declined for several reasons. They may, in the opinion of the reviewers, be unsatisfactory scientifically in that the methodology is open to criticism or that the conclusions are not sufficiently supported by the evidence presented. They may contain material that is, in principle, of interest but which is not clearly expounded; many papers suffer from being overlong with the result that the salient points are not as clear to the reader(s) as to the author(s). They may be sound but only of peripheral biochemical interest and thus of more relevance to another discipline. Finally, and often most contentiously, they may represent an insufficient advance in knowledge. It cannot be overemphasized that, because of pressure for space in the journal, scientific soundness alone is not sufficient reason for publication of a paper: it must represent a definite and significant contribution to the field of study. Thus, in general, preliminary or confirmatory papers, or those reporting the existence of well-known biochemical processes in sources not previously studied, will not be accepted.

The Chairman's, or Deputy Chairman's, letter will set out the reasons why a paper has been declined and will indicate whether this decision is a final one or whether suitable revision might improve the paper sufficiently for it to be reconsidered. In this latter instance, encouragement for resubmission does not imply that a revised version will necessarily be accepted. In all cases the decision of the Chairman of the Editorial Board will be final.

If a paper that is returned to the authors for amendment, for

whatever reason, is not resubmitted within 3 months (1 month for Research Communications) it will be treated as a new paper and the date of receipt will be altered to the date of resubmission.

It is accepted that the reviewers may from time to time come to decisions that are not easily accepted by authors. This may be because of a conflict of opinion or, for example, and as frequently happens, because the authors' point is felt by the reviewers to be obscured by the presentation. The journal is always willing to hear from authors and to consider their views sympathetically. In rare cases, and if the reviewers and the Chairman agree, the usual anonymity of the reviewers may be set aside to allow discussion between all parties concerned.

SUBMISSION OF PAPERS

General requirements

The main way in which authors can contribute to shortening the time between receipt and publication of a paper is to follow the requirements and suggestions in these Instructions to Authors, and to write in a concise style, although sufficient information must always be included to permit repetition of the experimental work and to support the conclusions that are drawn. Papers containing prolix or repetitive text or unnecessary Figures or Tables will always be returned for revision, with consequent delay in publication. Fragmentation of research into the 'least publishable unit' should be avoided, and authors considering the submission of a series of papers on the same topic, which usually involves some degree of repetition, should consider whether appropriate combination of two or more papers could be achieved without loss of clarity of presentation.

The *Biochemical Journal* publishes papers in all fields of biochemistry and cellular and molecular biology; therefore it is important that papers on specialized subjects should be written in such a way that their approach and conclusions are intelligible to the informed, but non-specialist, reader of the journal.

Format of papers

Before preparing papers, authors should consult a current issue of the journal to make themselves familiar with the general format, such as the use of cross-headings, layout of Tables and citation of references. Typescripts must be in double-spaced typing of at least 12pt throughout (including the references and legends of Tables and Figures) on sheets of uniform size (preferably ISO A4) with wide margins. Pages should be numbered. Typescripts produced on low-quality dot-matrix printers may not be of an acceptable standard, particularly with respect to the superscripts and subscripts often found in scientific work. Please do not supply a diskette for Research Papers on first submission (see Use of authors' diskettes).

The **full title** should be concise but informative enough for use in coding for information storage and retrieval; it should not contain non-standard abbreviations. Papers should also be headed by the **authors' names** (with one forename in full for each author, other forenames being given as initials) and by the name and address (including postal code) of the **establishment(s)** where the work was done. If there is more than one establishment involved in the work, authors' names should be linked to the appropriate establishment by the use of symbols *, †, ‡, §, ‖ and ¶, in that order. A **short (page heading) title** of up to 75 characters (but not containing non-standard abbreviations) should also be suggested.

Separate papers in a series should not be numbered, but subtitles may be used.

The **synopsis** should be of less than 250 words (60 words for Research Communications) and normally only 3–4% of the length of the paper. It should be as informative as possible but should not contain inessential details or material not described in the body of the paper. References quoted in the synopsis should be given in full (surnames of all authors, year of publication, name of journal, volume number, inclusive pagination), and should not form part of the numbered reference system. No synopsis is required for BJ Letters.

The **main body** of the paper should be divided into (a) **introduction**; (b) **experimental**, including materials and methods; (c) **results**, with appropriate quantification and statistical treatment of data; (d) **discussion**; (e) **acknowledgements**, including details of financial support; (f) numbered **references**; (g) **Tables and Figures**. It is often an advantage to combine (c) and (d) with gains of conciseness and clarity. The discussion section should not recapitulate the results, but only discuss their implications.

Authors may find it helpful to know that a full page of text in the *Biochemical Journal* contains approximately 1200 words. When calculating the printed length of papers, allowance must be made for the space taken up by insertions such as Figures, Tables and Schemes, and this is best assessed by inspection of similar insertions in a recent copy of the journal. A quick method of estimating the printed text length of typescripts is to add the number of pages (including references, but not Figure or Table legends) to the number of Figures and Tables and divide the total by 4. This assumes double-spaced typing on A4 paper with normal margins.

Procedure for submission

Submission of a paper to the *Biochemical Journal* implies that it has been approved by all the named authors, that all persons entitled to authorship have been so named, that it reports unpublished work that is not under consideration for publication elsewhere, and that if the paper is accepted for publication the authors will transfer to the Biochemical Society the copyright of the paper, which will then not be published elsewhere in the same form, in any language, without the consent of the Society. Authors will be required to sign an undertaking to these effects.

The following types of paper are included in the journal.

1. Research Papers are the normal form of publication, and may be of any length that is justified by their content. Authors should, however, note that no paper, whatever its scientific merits, will be accepted if it exceeds the minimum length required for precision in describing the experiments and clarity in interpreting them. As a guide, most Research Papers are of between six and eight printed pages. A concise well-written paper tends to be published more quickly.

Three copies of the typescript should be submitted, together with a brief covering letter. The first page of the typescript should bear the name, address and telephone and fax numbers of the person to whom correspondence (including proofs) should be sent. An additional copy of the synopsis should be enclosed to facilitate selection of reviewers. The top copy, clearly marked as such and typed on one side of the paper only, should be accompanied by the original artwork (see p. 10 for advice on the preparation of Figures). Photocopies of line drawings are acceptable for the other copies, but glossy prints (**not** photocopies) of all the half-tone Figures must be provided. To allow the reviewers to assess possible overlap with previous work, all papers must be accompanied by duplicate copies of the author's relevant published work and of all related papers that are in press or under editorial consideration in this or other journals. Failure to do so may seriously delay evaluation of the paper.

Authors should state under which section in the contents list their paper should appear: *Proteins*; *Enzymes*; *Carbohydrates and lipids*; *Gene structure and expression*; *Regulation of metabolism*; *Membranes and bioenergetics*; *Receptors and signal transduction*; *Cell biology and development*.

2. Research Communications are short papers (maximum four printed pages) bringing particularly novel and significant findings to the attention of the research community. It is intended that a decision on acceptance or rejection will be made within 10 working days of receipt, and publication of accepted Communications will follow within 2 months. Research Communications receive full but accelerated reviewing and the criteria of 'novelty and significance' are strictly enforced. Communications are not a path to accelerated publication of sound but non-urgent material. **Papers reporting nucleotide sequences only are not acceptable as Research Communications.**

Four copies of the typescript should be submitted together with a covering letter containing a brief statement of why it is believed that the paper merits accelerated treatment.

Research Communications should be arranged in the usual style for a *Biochemical Journal* paper (synopsis, introduction, methods, results and discussion, with sufficient experimental detail to permit repetition of the work) and should not be longer than four printed pages of the journal [about 4000 words (24000 characters) of uninterrupted text, including references, but this number should be decreased to allow for the space taken up by Figures and Tables]. Papers submitted as Research Communications that clearly exceed this length will be treated as Research Papers and the authors informed. Research Communications may be submitted by fax unless they contain half-tone Figures (see Submission by fax below). Otherwise the submission procedures outlined above for Research Papers should be followed.

3. BJ Letters are brief items (two printed pages or less) of scientific correspondence intended to provide an opportunity to discuss or expand particular points made in published work, to comment on or criticize work previously published in the *Biochemical Journal*, to discuss features of novel nucleotide and/or amino acid sequence data of particular biological significance, or to present a new hypothesis. They should not contain extensive new data (which would best be placed in a regular paper) and are not a vehicle for publication of preliminary results. If a letter is polemical in nature, a reply will be solicited from other interested parties.

BJ Letters may be submitted by fax (see Submission by fax below); otherwise the procedure for the submission of Research Papers above should be followed with the exceptions that a synopsis is not required and a contents list section need not be proposed.

4. Reviews will usually be solicited, although unsolicited reviews will be considered for publication. Prospective authors should first consult the Reviews Editor, via the editorial office, and should enclose a short (one typed page) summary of the area they propose to cover.

Submission by fax

To accelerate handling of Research Communications and Letters only, particularly from outside the U.K., they may be submitted by fax; acknowledgement of receipt and the review decision will then be transmitted to authors by fax. The criteria for submission in this way are: (i) that the paper meets the length requirement for a Research Communication or Letter, (ii) that the whole submission (covering letter, double-spaced text, Tables and Figures and their legends, and any supporting material) should not exceed 20 pages of A4 paper, and (iii) that, because of the technical limitations of fax transmission and the requirement (see above) that original prints of half-tone illustrations should be provided for the reviewers, the paper does not contain such half-tones. Original artwork of papers submitted in this way should be retained by authors until they receive acknowledgement of receipt; it should then be sent to the editorial office by post or courier, quoting the manuscript reference number, together with a further copy of the typescript (required for the printer if the paper is accepted), and a diskette must also be included at this stage. If a fax-submitted paper is rejected, a copy of the decision letter and the artwork will be returned to the authors by post. Authors submitting by fax need transmit only one copy of their paper; they should also be sure to include a fax response number in their covering letter.

Submission checklist

- ☐ **Covering letter (including justification for Research Communications)**
- ☐ **Master copy of typescript, double spaced on one side of the paper, containing:**
  - complete text in appropriate style, pages numbered
  - names (including forenames) and addresses of authors
  - name, address, telephone and fax numbers of corresponding author
  - synopsis
  - short (page heading) title
  - abbreviations footnote
  - acknowledgements
  - checked references in the Numbering System
  - Tables, with titles and legends
  - Figure legends, with titles
  - original artwork (no histograms, see p. 11)
  - copies of artwork
- ☐ **Two (three for Research Communications) further complete copies of the typescript, with glossy prints of all half-tone figures. These copies may be double-sided.**
- ☐ **Diskette for Research Communications only**
- ☐ **Additional copy of the synopsis**
- ☐ **Proposed section for Table of Contents**
- ☐ **Duplicate copies of relevant published work and all related papers in press or under editorial consideration**
- ☐ **Evidence of approval of personal communications**
- ☐ **Evidence of submission of nucleic acid sequences to an appropriate data bank**

Use of authors' diskettes

Authors should submit diskettes of **revised** papers to the editorial office. If the revised paper is acceptable every effort will be made to use the diskette during typesetting, but this cannot be guaranteed. Authors must ensure that files have been updated to incorporate all revisions, and hence that the version on the diskette matches the revised hard copy. We use WordPerfect for Windows, but we are able to read most 5.25″ and 3.5″ diskettes whether they have been created on an IBM PC or Macintosh computer. Our conversion software can translate a wide variety of commercially available word-processing packages and saving files in ASCII or DOS format is not necessary. The diskette should be accompanied by a covering letter specifying manuscript number, operating system and software program.

Text

Files should be formatted double-spaced with no hyphenation

and automatic wordwrap (no hard returns within paragraphs). Please type your text consistently, e.g. take care to distinguish between '1' (one) and 'l' (lower case L), and '0' (zero) and 'O' (capital O), etc.

Tables

Tables should be typed as text. The use of graphics programs and 'table editors' should be avoided.

Figures

No artwork should be incorporated into the text files. Figures are normally handled conventionally, but artwork may be provided on disk either in TIFF or EPS format and saved as a separate file. We can also accept CorelDraw files. Hard copy of illustrations must also be supplied (see p. 10).

Mathematics

In-line equations should be typed as text. The use of graphics programs and 'equation editors' should be avoided. Displayed equations (unless prepared by the 'MathType Equation Editor') are re-keyed by our printer.

Addresses for correspondence

- All **submissions, correspondence about papers, proofs and requests for permission to reproduce material** should be addressed to:

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Biochemical Journal
59 Portland Place
London W1N 3AJ
U.K.
telephone (U.K.) 0171-637 5873
(from overseas) +44 171 637 5873
fax (U.K.) 0171-323 1136
(from overseas) +44 171 323 1136
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NOMENCLATURE, STYLE AND CONVENTIONS

Abbreviations and symbols

The abbreviations listed in Table 1 are 'accepted', may be used without definition, and may be used in the title or the page-heading title. Other abbreviations, the use of which should be kept to a minimum compatible with clarity and conciseness, should not be used in the title or page-heading title and should be defined together in a footnote on the title page. In devising such abbreviations and symbols, the recommendations of the Nomenclature Committee of IUBMB and the IUPAC–IUBMB Joint Commission on Biochemical Nomenclature should be followed as far as practicable. The sections following summarize a number of these recommendations; all of the symbols listed may be used without definition.

Amino acids

The full residue names or the three-letter symbols are preferred to the one-letter symbols in the text (e.g. a phenylalanine residue at position 231 should be symbolized Phe-231 or Phe^{231} rather than F231). Either system may be used in sequences.

Alanine	Ala	A
Arginine	Arg	R
Asparagine	Asn	N
Aspartic acid	Asp	D
Aspartic acid or asparagine (undefined)	Asx	B
Cysteine	Cys |	C
Cystine (half)	Cys or Cys |	—
Glutamine	Gln	Q
Glutamic acid	Glu	E
Glutamic acid or glutamine (undefined)	Glx	Z
Glycine	Gly	G
Histidine	His	H
Hydroxylysine	Hyl	—
Hydroxyproline	Hyp	—
Isoleucine	Ile	I
Leucine	Leu	L
Lysine	Lys	K
Methionine	Met	M
Ornithine	Orn	—
Phenylalanine	Phe	F
Proline	Pro	P
Serine	Ser	S
Threonine	Thr	T
Tryptophan	Trp	W
Tyrosine	Tyr	Y
Unknown or 'other'	Xaa	X
Valine	Val	V

In polymers or sequences the three-letter symbols should be joined by hyphens if the sequence is known, or by commas if it is not; e.g.:

Gly-Ile-Gly-Phe(Gly,Tyr,Val,Ser)Leu-Val-Ala

Table 1 Accepted abbreviations (may be used without definition in the title, page-heading title and text)

Abbreviation	Meaning
ADP (CDP, GDP, IDP, UDP, XDP, dTDP)	adenosine 5′-diphosphate (and similarly for cytidine, guanosine, inosine, uridine, xanthosine, thymidine)
AIDS	acquired immunodeficiency syndrome
AMP etc.	adenosine 5′-phosphate etc.
ATP etc.	adenosine 5′-triphosphate etc.
ATPase etc.	adenosine 5′-triphosphatase etc.
bp	base-pair(s)
BSA	bovine serum albumin
cAMP etc.	cyclic AMP (adenosine 3′:5′-cyclic monophosphate) etc.
CD	circular dichroism
CHAPS	3-[(3-cholamidopropyl)dimethylammonio]propane-1-sulphonic acid
CM-cellulose	carboxymethylcellulose
CoA and acyl-CoA	coenzyme A and its acyl derivatives
COSY	correlation spectroscopy
dansyl	5-dimethylaminonaphthalene-1-sulphonyl
DEAE-cellulose	diethylaminoethylcellulose
DMSO	dimethyl sulphoxide
DNA, cDNA	deoxyribonucleic acid, complementary DNA
DNase	deoxyribonuclease
EC_{50}	concentration giving half-maximal response
EDTA	ethylenediaminetetra-acetate
EGTA	[ethylenebis(oxonitrilo)]tetra-acetate
EPR, ESR	electron paramagnetic (or spin) resonance
ELISA	enzyme-linked immunosorbent assay
EXAFS	extended X-ray absorption fine structure
FAD	flavin–adenine dinucleotide
FMN	flavin mononucleotide
FPLC	fast protein liquid chromatography
GLC	gas–liquid chromatography
G-protein	guanine-nucleotide-binding regulatory protein
GSH, GSSG	reduced and oxidized glutathione
Hb	haemoglobin
HIV	human immunodeficiency virus
HLA	histocompatibility locus antigen
HPLC	high-performance liquid chromatography
IC_{50}	concentration giving half-maximal inhibition
IgG etc.	immunoglobulin G etc.
IR	infrared
kb	kilobases
MHC	major histocompatibility complex
MS	mass spectrometry
NAD^+, NADH	oxidized and reduced nicotinamide–adenine dinucleotide
$NADP^+$, NADPH	oxidized and reduced nicotinamide–adenine dinucleotide phosphate
NMN	nicotinamide mononucleotide
NMR	nuclear magnetic resonance
NOESY	nuclear Overhauser enhancement spectroscopy
nt	nucleotide(s)
ORD	optical rotatory dispersion
PAGE	polyacrylamide-gel electrophoresis
PBS	phosphate-buffered saline
PCR	polymerase chain reaction
P_i, PP_i	orthophosphate, pyrophosphate
PMSF	phenylmethanesulphonyl fluoride
RIA	radioimmunoassay
RNA, mRNA, nRNA, rRNA, tRNA	ribonucleic acid, messenger RNA, nuclear RNA, ribosomal RNA, transfer RNA
RNase	ribonuclease
SDS	sodium dodecyl sulphate
TLC	thin-layer chromatography
TOCSY	total correlation spectroscopy
UV	ultraviolet

represents an undecapeptide composed of four amino acids whose sequence has been established, four for which the sequence is unknown and then three in known sequence. The glycine on the left carries the free amino group and the alanine on the right the free carboxyl group. The prefix poly or the suffix subscript *n* may accompany these symbols to indicate polymers [see Biochem. J. (1972) **127**, 753–756].

Special considerations apply to the spacing and punctuation of the one-letter symbols [see Biochem. J. (1984) **219**, 366–368].

Nucleosides, nucleotides and polynucleotides

The symbols for ribonucleosides are as follows (the prefix r should be used if there is possible ambiguity):

A	Adenosine	C	Cytidine
G	Guanosine	T	Ribosylthymine
I	Inosine	U	Uridine
X	Xanthosine	Ψ	5-Ribosyluracil (pseudouridine)

The 2′-deoxyribonucleosides are designated by the same symbols preceded by d, e.g.:

dA	2′-Deoxyribosyladenine
dT	2′-Deoxyribosylthymine (thymidine)

The letter p (for terminal phosphate only) or a hyphen (for phosphodiester group only) to the left of a nucleoside symbol indicates a 5′-phosphate; to the right it indicates a 3′-phosphate, e.g.:

pA-G	5′-Phosphoadenylyl(3′-5′)guanosine *or* guanylyl(5′-3′)adenosine 5′-phosphate
A-Gp	Adenylyl(3′-5′)guanosine 3′-phosphate
d(A-T)	Deoxyadenylyl(3′-5′)thymidine
A-G-cyclic-p or A-G > p	Adenylyl(3′-5′)guanosine 2′,3′-phosphate

Other points of attachment may be indicated by numerals, e.g.:

A2′-5′G2′p	Adenylyl(2′-5′)guanosine 2′-phosphate
A-G-(mixed 2′,3′)-p	A mixture of A-Gp and A-G2′p

In sequences, oligonucleotides or polynucleotides the phosphate between nucleoside symbols is shown by a hyphen if the sequence is known, or by a comma if it is not, e.g.:

G-A-U(C_2,U)Gp

indicates a heptanucleotide composed of three nucleotides of known sequence but with a trinucleotide of unknown sequence before the final Gp. The hyphens may be omitted.

For sequences that are repetitive or obscure, shorter forms may be used [see Biochem. J. (1972) **127**, 753–756], e.g.:

poly(A)	a simple homopolymer of A
poly(A_3,C_2)	random co-polymer of A and C in 3:2 proportions
poly[d(A-T)] or poly(dA-dT)	alternating co-polymer of dA and dT
poly(A,G,C,U)	random co-polymer of A, G, C and U, proportions unspecified

The prefix co-poly or oligo may replace poly, if desired. An alternative form is, e.g., A_n for poly(A), where the subscript *n* may be replaced by numerals indicating actual size. Similarly, d(A-T)$_n$ etc. may be used for poly(dA-dT) etc. It should be noted that no space follows the prefix 'poly'.

Associated (e.g. hydrogen-bonded) chains, or bases within chains, are indicated by a centre dot (not a hyphen or a plus sign) separating the complete names or symbols; non-associated chains are separated by a plus sign, and unspecified or unknown association by a comma, e.g.:

poly(A)·poly(U)	associated poly(A) and poly(U)
poly(G)·2poly(C) or $G_n \cdot 2C_n$	triple-stranded complex of poly(G) and poly(C) in the proportions 1:2
poly(dA-dC)·poly-(dG-dT) or (dA-dC)$_n$·(dG-dT)$_n$	associated poly(dA-dC) and poly(dG-dT)
poly(A)+poly(U)	non-associated poly(A) and poly(U)
poly(A),poly(U)	poly(A) and poly(U), no definite information on association

The abbreviations kb (kilobases), nt (nucleotide) and bp (base-pair) may be used in discussions of nucleic acid sequences without definition.

The use of a single symbol to designate a variety of possible nucleotides at a single position has become widespread. The following set of symbols, applicable to both DNA and RNA, has been recommended. These symbols do not discriminate between DNA and RNA, and the symbol T is used at all positions where U might appear in the RNA. Sequences may be assumed to have a deoxyribose phosphate (DNA) backbone unless otherwise specified; in circumstances where confusion between DNA and RNA is possible the sequence may be prefixed with the lower-case letter d or r.

G	guanine	S	G or C
A	adenine	W	A or T
T	thymine	H	A or C or T
C	cytosine	B	G or T or C
R	G or A	V	G or C or A
Y	T or C	D	G or A or T
M	A or C	N	G or A or T or C
K	G or T		

Sugars

These symbols are for use only in representing polymers or sequences and in Tables and Figures:

Ara	Arabinose	Glc	Glucose
dRib	2-Deoxyribose	Man	Mannose
Fru	Fructose	Neu	Neuraminic acid
Fuc	Fucose	Rib	Ribose
Gal	Galactose	Xyl	Xylose

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.

The following suffixes may be used, also without definition, to indicate derivatives:

A	for uronic acid (e.g. GlcA for glucuronic acid, GalA for galacturonic acid)
N and NAc	for 2-amino-2-deoxysaccharides and their *N*-acetyl derivatives (e.g. GlcN for glucosamine and GalNAc for *N*-acetylgalactosamine)

NeuAc or AcNeu suffices for *N*-acetylneuraminate.

Two systems (the extended or the condensed) exist for the representation of oligosaccharide chains. Either may be used.

In the extended system the configurational symbol (D or L) is included before the symbol for the monosaccharide, and is separated therefrom by a hyphen. The anomeric symbol (α or β) is included before the configurational symbol and separated therefrom by a hyphen. Between the symbol (abbreviated name) of one monosaccharide group or residue and the next are placed two locants that indicate the respective positions involved in this glycosidic union. These locants are separated by an arrow (directed from the locant corresponding to the glycosyl carbon atom to the locant corresponding to the carbon atom carrying the hydroxy group involved) and are enclosed in parentheses. The position of a branch is indicated above or below the main chain, with the numerals and an arrow indicating the glycosidic linkage:

$$\alpha\text{-D-Glc}p\text{-}(1\rightarrow 4)\text{-}\alpha\text{-D-Glc}p\text{-}(1\rightarrow 4)\text{-D-Man}p$$
$$\begin{array}{c} 2 \\ \uparrow \\ 1 \end{array}$$
$$\beta\text{-D-Xyl}p$$

The hyphens, except that separating the configurational symbol and the symbol for the monosaccharide, may be omitted.

In the condensed system the common configuration and ring size are implied in the symbol. Thus, Glc means D-glucopyranose; Fru, D-fructofuranose; and Fuc, L-fucopyranose. Whenever the configuration or ring size is found to differ from the common one, or is to be emphasized, this may be indicated by using the appropriate symbols from the extended system. The anomeric descriptor indicates the configuration of the glycoside linkage, and is therefore placed before the locant if the direction of the bond is to the right, or after the locant if the direction of the bond is to the left. The two locants are separated by a hyphen. No hyphens are used between the symbol for the sugar and the parentheses indicating the glycosidic bond; such parentheses may be omitted in representing branched oligosaccharides, when parentheses are used to indicate the branches:

Glcα1-4(Xylβ1-2)Glcα1-4Man

The condensed form may be shortened further by (i) omitting locants of anomeric carbon atoms, (ii) omitting the parentheses around the specifications of linkage, and (iii) omitting hyphens if desired:

Glcα4(Xylβ2)Glcα4Man

(Poly)phosphoinositides and their hydrolysis products

The following, and their various combinations with appropriate locants, need not be defined:

Ptd	phosphatidyl
Ins	1D-*myo*-inositol
P	phosphate

Multiple locants should be placed in parentheses, e.g. Ptd-Ins(4,5)P_2 symbolizes phosphatidylinositol 4,5-bisphosphate and Ins(1,4,5)P_3 symbolizes *myo*-inositol 1,4,5-trisphosphate (but note Ins4*P* etc. for the monophosphate).

The alternative ('Chilton') forms (e.g. PIP_2 and IP_3) may be used if defined; one or the other form should be used consistently throughout a paper.

Animals

The full binominal Latin names should be included for all experimental animals other than common laboratory animals. The strain, and if possible the source, of laboratory animals should be stated. The source, and if possible the composition, of the diet of laboratory animals should be specified; this is particularly important in papers reporting the effects of dietary manipulation.

Biochemical nomenclature

As far as possible authors should follow the recommendations of the Nomenclature Committee of IUBMB and the IUPAC–IUBMB Joint Commission on Biochemical Nomenclature. These recommendations are listed, with references, in Table 2. The full text of the recommendations may also be found in the compendium Biochemical Nomenclature and Related Documents [2nd edn., 1992, ISBN 1 85578 005 4, Portland Press, London; for corrections see Eur. J. Biochem. (1993) **213**, 1–3]. Comments on the recommendations should be sent to the Secretary of the Nomenclature Committee of IUBMB.

Centrifugation

When conditions for centrifuging are critical, sufficient information should be given for the procedure to be repeated. The quantitative composition of the suspension medium should be stated. The centrifuge rotor should be unambiguously identified and the temperature of operation stated.

The time of operation of the rotor at sustained plateau speed (ignoring initial rotor acceleration and deceleration periods) should be stated. The centrifugal field should be stated in multiples of $\boldsymbol{g}$ ($9.81\ \mathrm{m\cdot s^{-2}}$), based on the average radius of rotation of the liquid. For example: 'The rotor was operated for 15 min at 2 °C and 10000 $\boldsymbol{g}$'.

Density-gradient centrifugation

The make of centrifuge and rotor used, the temperature of the run and the composition of the gradients should be stated. Results should preferably be plotted against distance from rotor centre rather than against fraction numbers; it is then unnecessary to indicate top and bottom of the gradient. If fraction numbers are used, the top and bottom of the gradient should be indicated.

Ultracentrifuge data

Sedimentation coefficient (not constant), s; sedimentation coefficient corrected at 20 °C in water, $s_{20,w}$; sedimentation coefficient at zero concentration, s^0, $s^0_{20,w}$; Svedberg unit (10^{-13} s), S; partial specific volume, $\bar{v}$; diffusion coefficient, D, D^0, $D_{20,W}$ etc. as for sedimentation coefficient. The temperature at which the sedimentation and diffusion measurements are made should be stated.

Chemical nomenclature

The IUPAC recommendations on chemical nomenclature should be followed; see IUPAC's Compendium of Chemical Terminology (1987, ISBN 0 632 01767 8, Blackwell Scientific Publications, Oxford) and source documents listed therein.

Formulae

Chemical symbols may be used for elements, groups and simple

Table 2 Recommendations of the nomenclature committees of IUBMB and of other international committees

General	1.	Abbreviations and symbols for chemical names of special interest in biological chemistry	Biochem. J. (1966) **101**, 1–7 (extended by many of the items below)
	2.	Recommendations for the presentation of thermodynamic and related data in biology	Eur. J. Biochem. (1985) **153**, 429–434
	3.	Nomenclature of phosphorus-containing compounds of biochemical importance	Biochem. J. (1978) **171**, 1–19
Amino acids, peptides and proteins	4.	Nomenclature and symbolism for amino acids and peptides	Biochem. J. (1984) **219**, 345–373 [for corrections see Eur. J. Biochem. (1993) **213**, 1–3]
	5.	Nomenclature of α-amino acids	Biochem. J. (1975) **149**, 1–16 (replaced by item 4, but Appendices A and B contain an extensive list of naturally occurring amino acids)
	6.	Abbreviations and symbols for the description of the conformation of polypeptide chains	Biochem. J. (1971) **121**, 577–585
	7.	Abbreviated nomenclature of synthetic polypeptides (polymerized amino acids)	Biochem. J. (1972) **127**, 753–756
	8.	Recommendations for the nomenclature of human immunoglobulins	Biochem. J. (1975) **145**, 21–23
	9.	The nomenclature of peptide hormones	Biochem. J. (1975) **151**, 1–4
	10.	Nomenclature of electron-transfer proteins	Eur. J. Biochem. (1991) **200**, 599–611 [for corrections see Eur. J. Biochem. (1993) **213**, 1–3]
Enzymes	11.	The nomenclature of multiple forms of enzymes	Biochem. J. (1978) **171**, 37–39
	12.	Units of enzyme activity	Eur. J. Biochem. (1979) **97**, 319–320 [for corrections see Eur. J. Biochem. (1980) **104**, 1]
	13.	Symbolism and terminology in enzyme kinetics	Biochem. J. (1983) **213**, 561–571 [for corrections see Eur. J. Biochem. (1993) **213**, 1–3]
	14.	Nomenclature for multienzymes	Eur. J. Biochem. (1989) **185**, 485–486
Nucleic acids	15.	Abbreviations and symbols for nucleic acids, polynucleotides and their constituents	Biochem. J. (1970) **120**, 449–454
	16.	Abbreviations and symbols for the description of conformations of polynucleotide chains	Eur. J. Biochem. (1983) **131**, 9–15
	17.	Nomenclature for incompletely specified bases in nucleic acid sequences	Biochem. J. (1985) **229**, 281–286
	18.	A nomenclature of junctions and branchpoints in nucleic acids	Eur. J. Biochem. (1995) **230**, 1–2
Lipids	19.	The nomenclature of lipids	Biochem. J. (1978) **171**, 21–35
	20.	The nomenclature of steroids	Eur. J. Biochem. (1989) **186**, 429–458 [for corrections see Eur. J. Biochem. (1993) **213**, 1–3]
	21.	Tentative rules for the nomenclature of carotenoids	Biochem. J. (1972) **127**, 741–752 [for amendments see Biochem. J. (1975) **151**, 5–7]
	22.	Nomenclature of quinones with isoprenoid side chains	Biochem. J. (1975) **147**, 15–21
	23.	Nomenclature of prenols	Eur. J. Biochem. (1987) **167**, 181–184
Carbohydrates	24.	Tentative rules for carbohydrate nomenclature, part 1	Biochem. J. (1971) **125**, 673–695
	25.	Nomenclature of cyclitols (see also item 32)	Biochem. J. (1976) **153**, 23–31
	26.	Nomenclature of unsaturated monosaccharides	Eur. J. Biochem. (1981) **119**, 1–3 [for corrections see Eur. J. Biochem. (1982) **125,** 1]
	27.	Conformation of 5- and 6-membered ring forms of sugars	Eur. J. Biochem. (1980) **111**, 295–298
	28.	Nomenclature of branched-chain monosaccharides	Eur. J. Biochem. (1981) **119**, 5–8 [for corrections see Eur. J. Biochem. (1982) **125**, 1]
	29.	Polysaccharide nomenclature	Eur. J. Biochem. (1982) **126**, 439–441
	30.	Abbreviated terminology of oligosaccharide chains	Eur. J. Biochem. (1982) **126**, 433–437
	31.	Symbols for specifying the conformation of polysaccharide chains	Eur. J. Biochem. (1983) **131**, 5–7
	32.	Nomenclature of glycoproteins, glycopeptides and peptidoglycans	Eur. J. Biochem. (1986) **159**, 1–6 [for correction see Eur. J. Biochem. (1989) **185**, 485]
	33.	Numbering of atoms in *myo*-inositol	Biochem. J. (1989) **258**, 1–2
Miscellaneous	34.	Trivial names of compounds of importance in biochemistry	Biochem. J. (1967) **102**, 15–16 (but see items 35–38 below)
	35.	Nomenclature of retinoids	Eur. J. Biochem. (1982) **129**, 1–5 (supersedes M-1 of item 34)
	36.	Nomenclature of vitamin D	Eur. J. Biochem. (1982) **124**, 223–227 (supersedes M-2 of item 34)
	37.	Nomenclature of tocopherols and related compounds	Eur. J. Biochem. (1982) **123**, 473–475 (supersedes M-3 of item 34)
	38.	Nomenclature for vitamins B-6 and related compounds	Biochem. J. (1974) **137**, 417–421 (replaces M-7 of item 34)
	39.	The nomenclature of corrinoids	Biochem. J. (1975) **147**, 1–10
	40.	Nomenclature of tetrapyrroles	Pure Appl. Chem. (1987) **59**, 779–832
	41.	Nomenclature and symbols for folic acid and related compounds	Eur. J. Biochem. (1987) **168**, 251–253
	42.	Nomenclature of initiation, elongation and termination factors for translation in eukaryotes	Eur. J. Biochem. (1989) **186**, 1–3

compounds, but authors are advised that the excessive use of chemical symbols may reduce the readability of a paper.

R, R′, R″ (or R^1, R^2, R^3, R^4 if more than three) should be used to denote variable substituents in formulae.

C_{20} acid is used to denote an acid containing 20 carbon atoms and C-3 or $C_{(3)}$ to denote the carbon atom numbered 3. $C_{18:0}$, $C_{18:1}$ etc. are used similarly to denote the number of double bonds in an unsaturated fatty acid.

Ions

These should be represented thus: Na^+, Zn^{2+}, Cl^-, PO_4^{3-}.

Naming compounds

All chemical names are run together except for those of acids, acetals, 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, e.g. *m*-dinitrobenzene, *β*,*β*-dimethyl-D-cysteine, 2-*p*-isopropylphenylheptane, ethyl methyl ketone (butan-2-one).

Optically active isomers

Names of chiral compounds whose absolute configuration is known may be differentiated by the prefixes *R*- and *S*- [see Pure Appl. Chem. (1976) **45**, 11–30]. When the compounds can be correlated sterically with glyceraldehyde, serine or other standard accepted for a specialized class of compound, small capital letters D-, L- and D,L- may be used for chiral compounds and their racemates. Where the direction of optical rotation is all that can be specified, (+)-, (−)- and (±)-, or *dextro*, *laevo* and 'optically inactive', are used.

Prefixes

Italics are used for certain prefixes, e.g. *cis*-, *trans*-, *o*-, *m*-, *p*-, *dextro*, *laevo*, *meso*, and also for *O*-, *N*- etc. to indicate an element carrying a substituent, e.g. N^4-acetylsulphanilamide. Italics are not used for allo, bis, cyclo, epi, iso, n, neo, nor, s, t, tris.

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

Locants (both numerical and alphabetical) should be separated by commas, e.g. *p*-nitroso-*N*,*N*-dimethylaniline.

Chromatography

The rate of movement of a substance relative to the solvent front in paper or thin-layer chromatography is best expressed as its R_F value, or, if relative to a reference compound, by its R_{compound} value. Solvents should be described in the form butan-l-ol/acetic acid/water (4:4:1, by vol.) or butan-l-ol/acetic acid (4:1, v/v).

Elution diagrams for chromatographic columns should be shown with the effluent volume increasing from left to right. Units of concentration and volume must be shown clearly. Column (i.e. bed) dimensions should always be quoted, and where possible column void volumes (V_0) should be given. Elution zone maxima may be characterized by elution volumes (V_e) or preferably by partition coefficients (α or K_D). The course of any eluent gradients used should be indicated clearly. Column calibration curves (e.g. plots of molecular mass against V_e or K_D) will not be published.

Computer programs

If the use of a computer program forms a significant and essential part of the work described in a paper, the program must be adequately documented, if not in the paper itself, then by reference to a previously published original source, or by deposition of the program listing with a suitable depository (it should be noted, however, that the Editorial Board cannot accept the responsibility of checking the accuracy of such deposited programs).

Deposition of data

Information (computer programs, evidence for amino acid sequences, spectra, etc.) supplementing papers in the *Biochemical Journal* may be deposited free of charge with the British Library Document Supply Centre (DSC), Boston Spa, Wetherby, West Yorkshire LS23 7BQ, U.K., where it will be stored in its original form. The supplementary material must in the first instance be sent to the journal with the parent paper, and **not** direct to the DSC. It may be subject to editing in the normal manner before being accepted for deposition and the authors will then be responsible for preparing camera-ready copy.

A memorandum on the preparation of material for data deposition is available from the *Biochemical Journal* editorial office on request.

Copies of supplementary publications may be obtained from the DSC. Requesters must quote the relevant supplementary publication number (e.g. SUP 12345) given in the paper in question. Registered DSC customers should use their normal request procedures. To others, supplementary publications will be available on a pro forma invoice basis. For details contact Customer Services (telephone 01937-546060/facsimile 01937-546333) at the address above.

Electrophoresis

Electrophoretic mobilities (*m*) and the composition of the electrophoretic medium, pH and temperature should be quoted. The operative voltage should be specified where possible.

The symbol pI should be used for isoelectric point.

English style

The *Biochemical Journal* uses as a standard for spelling the Concise Oxford Dictionary of Current English (Clarendon Press, Oxford). Papers must be concise and should conform to normal English usage.

Enzymes

Enzyme nomenclature

The recommendations of the latest edition of Enzyme Nomenclature [1992, ISBN 0 12 227 165 3, Academic Press, San Diego; for corrections and additions see Eur. J. Biochem. (1994) **223**, 1–5 and Eur. J. Biochem. (1995) **232**, 1–6] should be followed as far as possible. This includes the quoting of EC numbers.

Enzyme units

Units of the amount of enzyme should be defined in each paper, and this may be done in terms of the rate of reaction catalysed under conditions specified. The SI unit for the rate is 1 mol of substrate transformed/s (or, if necessary, 1 mol of measured

product formed/s), and this gives the unit of the amount of enzyme that has been given the name of katal (symbol: kat). Units of the amount of enzyme may, however, be expressed in terms of the amount that can catalyse other rates, e.g. 1 μmol of substrate transformed/min (the 'EC unit').

Kinetic constants

Velocity constants for the forward and the backward reactions in the nth step of an enzymic reaction should be represented by k_n and k_{-n} respectively. The Michaelis constant is defined as $K_m = [S]$ when $v = V/2$, where v is the velocity of appearance of product or disappearance of substrate at a given substrate concentration [S] and V (or V_{max}) is the velocity when the enzyme is saturated with the substrate. When reactions with two substrates A and B are being considered $K_m^A = [A]$ 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 apparent K_m for A. K_s is the equilibrium constant of the dissociation of the substrate–enzyme complex. Catalytic-centre activity (not 'turnover number') is defined as the number of molecules of substrate transformed/s per catalytic centre.

Ethics

Animal experimentation

Experiments with animals should be performed in accordance with the legal requirements of the relevant local or national authority. Procedures should be such that experimental animals do not suffer unnecessarily. The text of papers should include experimental details of the procedures and of anaesthetics used. The Editorial Board will not accept papers where the ethical aspects are, in the Board's opinion, open to doubt.

Information and advice about experiments involving animals are to be found in the Handbook for the Animal Licence Holder (1991), ISBN 0 900 490 276, obtainable from the Institute of Biology, 20 Queensberry Place, London SW7 2DZ, U.K., price £10.60, post free.

Human experimentation

A paper describing any experimental work with humans should include a statement that the research has been carried out in accordance with the Declaration of Helsinki of the World Medical Association, that the Ethical Committee of the Institution in which the work was performed has approved it, and that the subjects have given informed consent to the work.

Scientific publication

Authors may like to refer to the Ethical Guidelines to Publication of Chemical Research formulated by the American Chemical Society [see Biochemistry (1986) **25**, 9A–10A].

Experimental hazards

Authors should draw attention to any particular chemical or biological hazards that may be involved in carrying out the experiments described. It may be appropriate to describe relevant safety precautions taken for any hazard, or to include a statement that an accepted code of practice has been followed. In the latter case a reference to the relevant standards should be given.

Footnotes

These should be avoided, except in Tables and in footnotes to the title page concerning abbreviations, the address for offprint requests, an author's current address or a sequence database accession number (in that order). Reference is made by the symbols * † ‡ § ‖ ¶, in that order.

'Homology'

The term 'homologous' has a precise meaning in biology of 'having a common evolutionary origin', but it has often been used in work on protein and nucleic acid sequences to mean simply 'similar'. A group of experts has urged that the interests of clarity are best served by restricting use to the more precise definition [Reeck, G. R. et al. (1987) Cell **40**, 667; Lewin, R. (1987) Science **237**, 1570]. The *Biochemical Journal* agrees with these arguments and aims to preserve the distinction between 'homologous' and 'similar' in its pages.

Illustrations

Each illustration should be on a separate sheet and packed flat; each should bear the author's name, the title (abbreviated if necessary) of the paper and the Figure number on the back. Its approximate position should be indicated in the margin of the typescript. Illustrations constitute an expensive item of publication; their number should be kept to a minimum.

Titles and legends

Each illustration should be supplied with an informative title and an explanatory legend, starting on a new line and typed double-spaced. The title and legend should make the general meaning comprehensible without reference to the text. Conditions specific to a particular experiment should be stated. Reference to the text for general experimental details is permissible provided there is no ambiguity. All Figure legends should be grouped in a section at the end of the text.

Line diagrams

Artwork should be supplied in a form that can be reproduced directly by the printer. It is therefore essential for authors to adhere to the following instructions with regard to the preparation of line drawings for Figures; otherwise their illustrations will have to be returned to them for improvement, with consequent delay.

Figures will usually be reduced in size to occupy a single column (width 8.5 cm) or less unless a larger format is necessary for clarity. All lettering and symbols should be produced to be at least 1.5 mm, but not more than 3 mm, **after reduction**. All curves and lines should be drawn clearly, and of a line thickness that allows for the reduction in size on final printing. Axes should not extend appreciably beyond the curves, and it is often unnecessary for an axis scale to start at 0; only the part of the scale relevant to the curves should be given. Tints should not be used, as they do not reproduce clearly.

The preferred symbols for experimental points are ○, □, △, ●, ■, ▲. Symbols should not be generated by using tints. The same symbols must not be used on two curves where the points might be confused; subject to that limitation, however, the same symbols should, if possible, be used for the same entities throughout a paper. Individual curves may also be distinguished by distinctive line forms (e.g. —— and – – – –) or by single-letter labels or by brief explanatory labels (see below).

Authors are encouraged to use brief explanatory labels within a Figure if it is thereby more readily understood and if the labels can be inserted without requiring a larger Figure.

Histograms

Simple histograms recording only a few values will not be published. The information can be given more accurately, usefully and concisely as a table or as a sentence or two in the text. However, histograms will be acceptable when the visual complexity of the Figure overrides other considerations.

Sequence diagrams

Amino acid and nucleotide sequences are often printed in a form that requires careful vertical alignment. Authors should submit such sequence diagrams in high-quality camera-ready form, thereby avoiding the misalignments that can be introduced by typesetting and obviating the need for proof-reading of large arrays of complex information. Tints should not be used to highlight parts of sequences.

Half-tone illustrations

Half-tone illustrations will be reproduced on text paper. Glossy prints are required. Where the magnification is to be indicated (e.g. on electron micrographs), this should be done by adding a bar representing a stated length. The *Biochemical Journal* does not charge authors for half-tone reproduction.

Colour figures

These are accepted when, in the opinion of the Editorial Board, they are essential to illustrate a particular scientific point. Authors will normally be required to pay the cost of colour separation and printing (at 1996 prices, £550 for the first Figure and £300 for each subsequent Figure). If authors are unable to meet these costs, they should appeal in writing to the Chairman of the Editorial Board, who may in certain circumstances recommend that the charges to authors be reduced.

Isotopes

Units of measurement

Where possible radioactivity should be expressed in absolute terms; the SI unit for radioactivity is the becquerel (symbol Bq), defined as 1 disintegration/s, but the curie (symbol Ci; 1 Ci = 3.7×10^{10} Bq) may also be used. Alternatively, radioactivity may be expressed as disintegrations (or counts) per unit of time, e.g. disintegrations/s (d.p.s.) or counts/min (c.p.m.).

Isotopically labelled compounds

The symbol for the isotope introduced is placed in square brackets directly attached to the front of the name (word), as in [^{14}C]urea. When more than one position in a substance is labelled by means of the same isotope and the positions are not indicated (as below), the number of labelled positions is added as a right-hand subscript, as in [$^{14}C_2$]glycollic acid. The symbol 'U' indicates uniform and 'G' general labelling, e.g. [U-^{14}C]glucose (where the ^{14}C is uniformly distributed among all six positions) and [G-^{14}C]glucose (where the ^{14}C is distributed among all six positions, but not necessarily uniformly); in the latter case it is often sufficient to write simply '[^{14}C]glucose'.

The isotopic prefix precedes that part of the name to which it refers, as in sodium [^{14}C]formate, iodo[$^{14}C_2$]acetic acid, 1-amino[^{14}C]methylcyclopentanol ($H_2N-{}^{14}CH_2-C_5H_8-OH$), α-naphth[^{14}C]oic acid ($C_{10}H_7-{}^{14}CO_2H$), 2-acetamido-7-[^{131}I]-iodofluorene, fructose 1,6-[1-^{32}P]bisphosphate, D-[^{14}C]glucose, 2*H*-[2-^{2}H]pyran, *S*-[8-^{14}C]adenosyl[^{35}S]methionine. Terms such as '^{131}I-labelled albumin' should not be contracted to '[^{131}I]-albumin' [since native albumin does not contain iodine (but ^{131}I-albumin can be used)], and '^{14}C-labelled amino acids' should similarly not be written as '[^{14}C]amino acids' (since there is no carbon in the amino group).

When isotopes of more than one element are introduced, their symbols are arranged in alphabetical order, including ^{2}H and ^{3}H for deuterium and tritium respectively.

When not sufficiently distinguished by the foregoing means, the positions of isotopic labelling are indicated by Arabic numerals, Greek letters, or prefixes (as appropriate), placed within the square brackets and before the symbol of the element concerned, to which they are attached by a hyphen; examples are [1-^{2}H]ethanol ($CH_3-C^2H_2-OH$), [1-^{14}C]aniline, L-[2-^{14}C]-leucine (or L-[α-^{14}C]leucine), [*carboxyl*-^{14}C]leucine, [*Me*-^{14}C]-isoleucine, [2,3-^{14}C]maleic anhydride, [6,7-^{14}C]xanthopterin, [3,4-^{13}C,^{35}S]methionine, [2-^{13}C,1-^{14}C]acetaldehyde, [3-^{14}C,2,3-^{2}H,^{15}N]serine.

The same rules apply when the labelled compound is designated by a standard abbreviation or symbol, other than the atomic symbol, e.g. [γ-^{32}P]ATP.

For simple molecules, however, it is often sufficient to indicate the labelling by writing the chemical formulae, e.g. $^{14}CO_2$, $H_2{}^{18}O$, $^{2}H_2O$ (not D_2O), $H_2{}^{35}SO_4$, with the prefix superscripts attached to the proper atomic symbols in the formulae. The square brackets are not to be used in these circumstances, nor when the isotopic symbol is attached to a word that is not a chemical name, abbreviation or symbol (e.g. '^{131}I-labelled').

Isotopically substituted compounds

The attention of authors is drawn to the distinction between 'isotopically labelled' and 'isotopically substituted' compounds [see Eur. J. Biochem. (1978) **86**, 9–25].

Micro-organisms

In the title, in the synopsis and at the first mention in the text, micro-organisms must be given their full binominal Latin name, which will be printed in italics (e.g. *Escherichia coli*). Each organism should preferably have been obtained from or deposited with a recognized collection of micro-organisms, and the collection number must be given. Alternatively, a strain number or name should be quoted; this should not be underlined. Names of ranks higher than genus (e.g. Eubacteriales, Lactobacilleae), generic names used adjectivally (e.g. 'staphylococcal') and names of micro-organisms used colloquially (e.g. as in 'most lactobacilli behave thus') are not italicized. The first (i.e. generic) name should be spelt with a capital letter. Elsewhere in the text, single-letter abbreviations may be given for the generic name; if two genera with the same initial letter are studied, abbreviations such as *Strep.* and *Staph.* should be used.

Great care is needed in verifying the identities of micro-organisms, and authors should bear in mind that the value of their work may be limited if material is wrongly named. Many major culture collections of micro-organisms are able to verify identifications. Authors are urged to deposit new organisms in pertinent culture collections so that they may be readily available to other workers.

Recommendations on nomenclature in bacterial genetics have been proposed by M. Demerec, E. A. Adelberg, A. J. Clark and P. E. Hartman [(1966) Genetics **54**, 61–76]. Authors should follow these guidelines wherever appropriate. Genetic designations for various micro-organisms are listed in Genetic Maps (edited by S. J. O'Brien), Cold Spring Harbor Laboratory, Cold Spring Harbor, NY, U.S.A.

Molecular mass and the dalton

There are two preferred ways of specifying the mass of a biochemical entity. 'Relative molecular mass' (M_r; not 'molecular weight') is the ratio of the mass of a molecule to $\frac{1}{12}$ of the mass of the nuclide ^{12}C; it is thus dimensionless. 'Molecular mass' is the mass of one molecule of a substance expressed in daltons (symbol Da) or atomic mass units; the dalton is defined as $\frac{1}{12}$ of the mass of one atom of ^{12}C.

Thus a protein may be said to have a relative molecular mass of 50000 ($M_r = 50000$) or a molecular mass of 50000 Da (more conveniently, 50 kDa), and may be referred to as the 50000-M_r protein or the 50 kDa protein. It is not correct to express M_r in daltons or to use K to represent M_r 1000 or 1 kDa. Either 'M_r' or 'molecular mass (kDa)' should be used consistently throughout a single paper.

Nucleotide sequences

Authors should note that nucleotide sequences should be fully determined in both senses of the DNA. An explicit statement to this effect and a supporting diagram summarizing the sequence data would normally be sufficient evidence.

Papers reporting nucleotide sequences only are not acceptable as Research Communications.

Authors of papers containing primary nucleotide sequence data are required to have deposited their data with the European Molecular Biology Laboratory Nucleotide Sequence Database (EMBL) or with an associated data library before their paper can be published. The database accession number provided by EMBL will be included in the published paper. Data can be deposited and an accession number obtained before submission of the paper; alternatively, on acceptance of a paper containing such data and where no accession number is provided, the editorial office will send the authors a data submission form. The authors should return the completed form, together with the sequence data in computer-readable format or as computer printout, direct to EMBL who will allot an accession number that can be written into the proofs of the paper.

A memorandum on data submission, and data submission forms, are available from the editorial office.

Physical quantities and units

The recommended SI symbols should be used for all physical quantities and units (see Quantities, Units and Symbols in Physical Chemistry, 1988, ISBN 0 632 02591 3, Blackwell Scientific Publications, Oxford). A list of the most commonly

Table 3 Physical quantities and their units

Physical quantity	Name of unit	Symbol for unit	Definition of unit
Activity (of radioactive source)	becquerel	Bq	s^{-1}
Amount of substance	mole*	mol	
Dose absorbed (of radiation)	gray	Gy	$J \cdot kg^{-1}$
Electric capacitance	farad	F	$A \cdot s \cdot V^{-1}$
Electric charge	coulomb	C	$s \cdot A$
Electric conductance	siemens	S	$A \cdot V^{-1}$
Electric current	ampere*	A	
Electric potential difference	volt	V	$J \cdot A^{-1} \cdot s^{-1}$
Electric resistance	ohm	Ω	$V \cdot A^{-1}$
Energy	joule	J	$m^2 \cdot kg \cdot s^{-2}$
Force	newton	N	$J \cdot m^{-1}$
Frequency	hertz	Hz	s^{-1}
Illuminance	lux	lx	$m^{-2} \cdot cd \cdot sr$
Length	metre*	m	
	ångström†	Å	10^{-10} m
Luminous flux	lumen	lm	$cd \cdot sr$
Luminous intensity	candela*	cd	
Magnetic flux	weber	Wb	$V \cdot s$
Magnetic flux density	tesla	T	$V \cdot s \cdot m^{-2}$
Mass	kilogram*	kg	
Plane angle	radian	rad	
Power	watt	W	$J \cdot s^{-1}$
Pressure	pascal	Pa	$N \cdot m^{-2}$
	bar†	bar	10^5 Pa
Solid angle	steradian	sr	
Temperature (Celsius)	degree Celsius	°C	°C = K‡
Temperature (thermodynamic)	kelvin*	K	
Time	second*	s	
Volume	litre (cubic decimetre)	l (dm^3)	10^{-3} m^3

* SI base unit

† These units do not belong to the International System of units, but may be used if defined.

‡ The Celsius temperature, t, is defined by $t = T - T_0$, where T is thermodynamic temperature and $T_0 = 273.15$ K.

used quantities and units appears in Table 3. Where a quantity is given in terms of non-SI units, the SI equivalent should generally also be stated, e.g. either '42 kJ/mol' or '42 kJ/mol (10 kcal/mol)', but not '10 kcal/mol' alone. However, distance measurements at the molecular scale may be given in terms of the ångström (Å) only.

Plants

The full binominal Latin names should be included for all plant species. Where appropriate, the variety and the source should be specified.

Powers in Tables and Figures

Care is needed where powers are used in Table headings and in Figures in order to avoid numbers with too many digits. 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; the unit may be changed by the use of prefixes, e.g. m, μ, n or p. For example: (i) an entry '2' under heading $10^3\,k$ means that the value of k is 0.002; an entry '2' under heading 10^{-3} k means that the value of k is 2000; (ii) a concentration 0.00015 M may be expressed as 0.15 under heading 'concn. (mM)' or as 150 under heading 'concn. (μM)' or as 15 under heading '$10^5 \times$ concn. (M)' but not as 15 under heading 'concn. ($M \times 10^{-5}$)'; (iii) complex quantities are treated similarly; a value for 1/[S] of 200 M^{-1} would appear as '2' under the heading 10^{-2}/[S] (M^{-1}) or as '0.2' under the heading 1/[S] (mM^{-1}). Square brackets may conventionally be used to indicate concentration.

Prefixes for multiples and submultiples of units

These should be as follows:

Multiple	Prefix	Symbol	Multiple	Prefix	Symbol
10^{12}	tera	T	10^{-2}	centi	c*
10^9	giga	G	10^{-3}	milli	m
10^6	mega	M	10^{-6}	micro	μ
10^3	kilo	k	10^{-9}	nano	n
10^2	hecto	h*	10^{-12}	pico	p
10	deka	da*	10^{-15}	femto	f
10^{-1}	deci	d*	10^{-18}	atto	a

* To be avoided where possible (except for cm).

Quantification of data

The *Biochemical Journal* places emphasis on provision of quantitative data. Experiments which involve comparison of data from gels, blots, autoradiograms or similar techniques should, wherever possible, be quantified in order to permit pooling and statistical analysis of data from independent experiments, although it may in addition be useful to illustrate representative experiments in pictorial form.

References

The Numbering System must be used. References should be cited in the text by sequential numbers in square brackets, e.g. '[1]', '[2–6]', '[4,5,7–10]', etc. At the end of the paper references should be listed in numerical order, in the style shown in the following examples, preceded by the number. Thus:

1 Shepherd, P. R., Navé, B. T. and Siddle, K. (1995) Biochem. J. **305**, 25–28
2 Poulin, R., Pelletier, G. and Pegg, A. E. (1995) Biochem. J. **311**, 723–727

Names and initials of all authors, and first and last page numbers, should be provided for all references. Titles of journals should be abbreviated in accordance with the Chemical Abstracts Service Source Index (1907–1994 Cumulative) (1995) and subsequent Quarterly Supplements (American Chemical Society).

References to books and monographs should be in accordance with the following examples:

3 Cornish-Bowden, A. (1995) Fundamentals of Enzyme Kinetics, Portland Press Ltd., London
4 Esterbauer, H. (1995) in Oxidative Stress, Lipoproteins and Cardiovascular Dysfunction (Rice-Evans, C. and Bruckdorfer, K. R., eds.), pp. 55–79, Portland Press Ltd., London

References to a paper 'in the press' are permissible provided that it has been accepted for publication (the name of the journal and documentary evidence of acceptance must be provided):

5 Smith, A. (1996) Biochem. J., in the press

References to 'personal communication' and 'unpublished work' are permitted in the text only, not in the list of references; for the former citation, documentary evidence from the person quoted showing agreement with the quotation must be provided. A reference to 'unpublished work' must be supported by the names and initials of all involved. The use of 'in preparation', 'private communication' and 'submitted for publication' is not allowed.

References are often the cause of many proof corrections. Please check the list carefully before submission.

Solutions

Description

Solutions should be described in terms of molarity (M); 'normality' (N) is not acceptable. Fractional concentrations should be expressed in the decimal system, e.g. 0.25 M HCl (not M/4 HCl). The term % must be defined as w/w, w/v or v/v, e.g. 5% (w/v) means 5 g/100 ml. For aqueous solutions of concentration less than 1%, w/v need not be inserted if it is clear that the concentration is stated in terms of weight of solute.

Incubation media such as Krebs–Ringer solution, Eagle's medium, Waymouth's medium etc. should be defined by reference.

The symbol for ionic strength (mol/l) is I.

Buffers

These must be specified so that readers can reproduce the conditions used by authors. It is often useful to give the complete composition of each solution, e.g. '0.09 M sodium acetate/0.01 M acetic acid, pH 5.6' (which means that a single solution has these concentrations of these substances) at the first mention or in the Experimental section. A short designation, e.g. '0.1 M sodium acetate buffer, pH 5.6', may be used elsewhere throughout the paper.

Table 4 lists accepted abbreviations for buffers; these need not be defined.

Spectra and spectroscopic data

Full spectra should be published when important or novel features are demonstrated; however, other spectra or spectral information may be deposited with the British Library Document Supply Centre (see the Deposition of Data section on p. 9).

Table 4 Abbreviations for common buffers

Abbreviation	Chemical name
Aces	2-[(2-Amino-2-oxoethyl)amino]ethanesulphonic acid
Ada	[(Carbamoylmethyl)amino]diacetic acid
Bes	2-[Bis-(2-hydroxyethyl)amino]ethanesulphonic acid
Bicine	*N,N*-Bis-(2-hydroxyethyl)glycine
Bistris	2-[Bis-(2-hydroxyethyl)amino]-2-(hydroxymethyl)propane-1,3-diol
Hepes	4-(2-Hydroxyethyl)-1-piperazine-ethanesulphonic acid
Hepps	4-(2-Hydroxyethyl)-1-piperazinepropanesulphonic acid
Mes	4-Morpholine-ethanesulphonic acid
Mops	4-Morpholinepropanesulphonic acid
Pipes	1,4-Piperazinediethanesulphonic acid
Taps	3-{[2-Hydroxy-1,1-bis(hydroxymethyl)ethyl]amino}propane-1-sulphonic acid
Tes	2-{[2-Hydroxy-1,1-bis(hydroxymethyl)ethyl]amino}ethanesulphonic acid
Tricine	*N*-[2-Hydroxy-1,1-bis(hydroxymethyl)ethyl]glycine
Tris	2-Amino-2-hydroxymethylpropane-1,3-diol

The spectra for UV and visible absorption, fluorescence, circular dichroism and optical rotation should have a wavelength scale (e.g. nm or μm) whether or not a wavenumber scale (e.g. cm^{-1}) is given. Where possible, molar terms should be used in absorption, circular dichroism and optical rotation.

Circular dichroism (CD)

This is reported as the molar circular-dichroism absorption coefficient $\Delta\epsilon = \epsilon_L - \epsilon_R$ [or the molar ellipticity, $[\theta]_M$ (see below)]. For biopolymers, molar concentrations in terms of the mean residue M_r are generally used. Units of $\Delta\epsilon$ are the same as for ϵ, i.e. litre$\cdot$mol$^{-1}\cdot$cm^{-1} or M$^{-1}\cdot$cm^{-1}.

Specific ellipticity $[\theta]$, molar ellipticity $[\theta]_M$ and mean residue ellipticity $[\theta]_{m.r.w.}$ are directly analogous to the terms used in optical rotation. The units of $[\theta]$ are as for $[m]$. Note that $[\theta]_M = 3300 \times \Delta\epsilon$.

Electron spin (paramagnetic) resonance (ESR/EPR)

Derivative spectra are given, unless otherwise stated; a scale of the magnetic-field strength (in mT) and/or g values should be given. Peaks are described as, e.g., 'the $g = 2$ peak'.

Fluorescence spectroscopy

In reporting fluorescence excitation and emission spectra it should be stated whether intensities, F, are relative, normalized or corrected (and the nature of the correction).

Fluorescence-polarization data and spectra are reported as polarization ratio, P, or preferably anisotropy ratio, A; both are dimensionless.

Infrared spectroscopy (IR)

Spectra are reported as percentage transmittance, T, as a function of wavelength (given in μm) or frequency (given in cm^{-1}). When assigning bands the units need be given for the first value only and the description should be in the style, e.g. '(broad NH band)'.

Mass spectrometry (MS)

Spectra may be described as, e.g. 'm/z 300 [M^+ (the molecular ion)], 282 (M^+–H_2O) etc.'. If parenthetic values are quoted for percentage peak heights, it should be stated what these are relative to.

Mössbauer spectroscopy

The absorption (in %, arbitrary units or crude channel counts) is plotted against the Doppler velocity, v (in mm/s). The chemical shift, δ, in units of mm/s should be quoted relative to a specified standard (e.g. metallic iron at 290 K). The temperature should always be given and the applied magnetic field, if any, should be precisely described.

Nuclear magnetic resonance (NMR)

NMR chemical-shift data, δ, are expressed as parts per million (p.p.m.) and the reference compound must be quoted. The recommended convention is that downfield shifts are positively signed. Coupling constants are expressed in Hz.

For reporting structural NMR data the style suggested is: 'δ (δ_H, δ_C etc) (solvent) chemical-shift value [integration, peak type, coupling constant (in Hz), designation (relevant proton in *italics*)]'. E.g. 'δ_H [(^{2}H)chloroform] 0.92 [6 H, d, J 6 Hz, CH(CH_3)], 2.16 (2 H, t, J 7 Hz, CH_2CH_2CO)'. Singlet, doublet etc. are abbreviated to s, d, etc. without definition, but other descriptions, e.g. broad and overlapping, should be in full.

Optical rotation

This is reported as the specific rotation, $[\alpha]^t_\lambda$, which is numerically equal to the rotation in degrees of a 1 g/ml solution with a pathlength of 1 dm (10 cm) at wavelength λ and temperature t. The concentration (g/100 ml) and solvent are quoted, e.g. '$[\alpha]^{20}_{420} - 27.5°$ (c 2 in methanol)'.

The corresponding molar expressions for the molar rotation, $[M] = [\alpha] \times M_r$ and $[m] = [\alpha] \times M_r/100$, should be defined.

For biopolymers, the mean residue M_r is used, and $[m]_{m.r.w.}$ is the mean residue rotation. Where a refractive-index correction is applied, $[m']$, the reduced mean residue rotation, is reported. Dimensions of $[m]$ and $[m']$ are degrees$\cdot$cm$^2\cdot$dmol^{-1}.

Optical rotatory dispersion is reported as the variation of $[\alpha]$ or $[m]$ with wavelength (or frequency).

Visible and ultraviolet-absorption spectroscopy

The general name for the quantity $\log(I_0/I)$ is attenuance, and this reduces to absorbance when there is negligible scattering or reflection. The more general term attenuance should be used when scattering is considerable, e.g. when the quantity is measured to estimate the cell density of a culture. Otherwise the term absorbance should be used; neither should be called extinction or optical density. Symbols used are: A, absorbance; D, attenuance; a, specific absorption coefficient (litre$\cdot$g$^{-1}\cdot$cm^{-1}) (alternatively used $A^{1\%}_{1\,cm}$); ϵ, molar absorption coefficient (numerically equal to the absorbance of a 1 mol/litre solution in a 1 cm light-path) (use units of litre$\cdot$mol$^{-1}\cdot$cm^{-1} or M$^{-1}\cdot$cm^{-1} and not cm$^2\cdot$mol^{-1}). Wavelengths are given in (nm) as subscripts without units, e.g. $A^{1\%}_{1\,cm,\,420}$. No equals sign need be given between ϵ or A and its value.

Statistical treatment of results

Data from a sufficient number of independent experiments should be reported to permit evaluation of the reproducibility and significance of the results. When the object is to determine the

value of a quantity or the statistical characteristics of a population, sufficient information is usually conveyed by the following: (i) the number of independent experiments (replicate measurements in an individual animal or preparation and results from pooled tissues etc. represent only one independent estimate); (ii) the mean value; (iii) the standard deviation (S.D.), the coefficient of variation or the standard error of the estimate of mean value (S.E.M.), as may be appropriate. It should be made clear whether the S.D. or the S.E.M. is used. A convenient form for inclusion in a Table is, for example, 263 ± 2.5 (10), where the number in parentheses represents the number of values used in calculating the mean. Where statistical analysis is performed on replicate values within a single experiment, evidence should also be provided for reproducibility of findings between independent experiments (it would normally be expected that an experiment has been performed at least three times). In analysing the statistical significance of differences between data sets, it should be made clear which statistical tests have been applied and the choice of statistical test should be appropriate to the analysis.

Tables

Each Table should be supplied with an informative heading and an explanatory legend, starting on a new line and typed double-spaced. The heading and legend should make the general meaning comprehensible without reference to the text. Footnotes should be as few as possible, only being used where it is necessary to draw attention to a feature of a particular row, column or value. Conditions specific to the particular experiment should be stated. Reference to the text for general experimental methods is permissible provided that there is no ambiguity. The units in which the results are expressed, e.g. g/100 ml, should be given at the top of each column, and not repeated on each line of the table.

Tables should be typed on separate sheets and their approximate position in the text indicated. Words or numerals should be repeated on successive lines; 'ditto' or ',,' are not to be used.

Trademarks

Registered trademarks should be identified by the symbol ® where they appear in the text.

Unique biological materials

It is expected that authors will make samples of unique biological materials (including cell lines, DNA clones and antibodies) available to academic workers who request them. Authors are urged to deposit cell lines of more than local interest with appropriate collections at national centres (e.g. in Europe at the European Collection of Cell Cultures, Centre for Applied Microbiology and Research, Porton Down, Salisbury, Wilts. SP4 0J6, U.K. and in the U.S.A. at the American Type Culture Collection, 12301 Parklawn Drive, Rockville, MD 20852, U.S.A.).

X-ray crystallography

Authors of papers describing structure determination by X-ray crystallography are encouraged to deposit, either with the British Library (see p. 9) or, preferably, with the Protein Data Bank (Brookhaven National Laboratory, Upton, NY 11973, U.S.A.), all of the structural data required to validate the proposed structure and its discussion. It should be stated in a footnote to the paper that the necessary data have been deposited. Under certain circumstances the Protein Data Bank may be asked not to release the data until after a date (no more than 4 years after acceptance of the paper) specified by the authors.