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MOLECULAR BIOLOGY
CELL
BIOTECHNOLOGY

JB Review

Mutational Analysis for DnaA Protein

Tohru Mizushima

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Call for applications under new policy

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Submission of a paper implies that the work described has not been published previously, that it is not under consideration for publication elsewhere, and that if the paper is accepted for publication, the author(s) will transfer the copyright to the Japanese Biochemical Society.

Manuscripts should be written in succinct forms. No length-limit is set for a Regular paper, whereas a Rapid communication is not allowed to exceed 3.5 printed pages. Charges of ¥700 and ¥7,200 are made for every printed page of a Regular paper and a Rapid communication, respectively.

The manuscript should be typewritten in double-spacing and appropriately numbered. Submission of four copies of manuscript is requested. The manuscript should be sent to: The Japanese Biochemical Society, Ishikawa Building-3f, 25-16, Hongo 5-chome, Bunkyo-ku, Tokyo 113-0033, Japan.

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On submission of papers, authors are requested to select one of the following five fields and its topic, under which the submitted papers should be reviewed, and to indicate their selection on the title page of the manuscript. Authors may suggest a few names and addresses of potential reviewers, who are suitable for reviewing the submitted papers.

Fields and topics to be selected:

Fields	Topics
Biochemistry (I):	Biochemistry General
	Biomolecular Structures
	Glycobiology and Carbohydrate Biochemistry
	Lipid Biochemistry
	Biological Oxidation and Bioenergetics
	Reactive Oxygen and Nitrogen Species
	Biochemical Pharmacology
	Biochemistry in Diseases and Aging
	Cancer Biochemistry
	Analytical Biochemistry
	Nucleic Acids
Biochemistry (II):	Physiological Chemistry
	Protein and Peptide Chemistry
	Enzymology
	Biochemistry of Proteolysis
	Metabolism
	Biochemistry in Cell Membranes
	Neurochemistry
Molecular Biology:	Molecular Biology General
	Structure and Function of Genes and Other Genetic Materials
	Replication and Recombination
	Transcription
	Translation
	Regulation of Gene Expression
	DNA–Protein Interaction
	RNA Processing
	Recombinant DNA Technology
	Transgenic Animals and Plants
	Genome Analysis
	Genetic Diseases
	Molecular Genetics
	Molecular Evolution

Fields	Topics
Cell:	Cell General
	Differentiation, Development, and Aging
	Extracellular Matrices and Cell Adhesion Molecules
	Muscles, Cell Motility, and Cytoskeleton
	Stress Proteins and Molecular Chaperones
	Protein Targeting and Sorting
	Organelles and Biomembranes
	Neurobiology
	Receptors and Signal Transduction
	Cell Cycle Control
	Cell Death
	Tumor Cell Biology
	Molecular and Cellular Immunology
Biotechnology:	Biotechnology General
	Biomimetic Chemistry
	Biomaterials
	Bioactive Substances
	Gene and Protein Engineering
	RNA Technology
	Glycotechnology
	Immunological Engineering
	Cell and Tissue Engineering
	Transgenic Technology
	Drug Delivery Systems
	Biosensor and Bioelectronics
	New Devices in Biotechnology
	Environmental Technology

"Instructions to Authors" are printed in the January and July issues of this JOURNAL every year. Please conform to these instructions when submitting manuscripts. Reprint of "Instructions to Authors" is available.

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Author Index

INSTRUCTIONS TO AUTHORS

The Journal of Biochemistry
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The Journal of Biochemistry publishes the results of original research in the fields of Biochemistry, Molecular Biology, Cell, and Biotechnology written in English, in the forms of **Regular Papers** and **Rapid Communications. A Rapid Communication is not a Preliminary Note but is, although brief, a complete and final publication.** The materials described in Rapid Communications should not be included in a later paper. The Journal also publishes short reviews (JB Review) and invited papers which will be solicited by the Editorial Board. Submission of a paper implies that the work described has not been published previously, that it is not under consideration for publication elsewhere, and that **if the paper is accepted for publication, the author(s) will transfer the copyright to the Japanese Biochemical Society.**

I. GENERAL INFORMATION

Manuscripts should be submitted in **quadruplicate (one original and three clear copies)** to:

The Editorial Office
The Japanese Biochemical Society
Ishikawa Building-3f
25-16, Hongo 5-chome, Bunkyo-ku
Tokyo 113-0033, Japan
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On submission of a paper, **authors are requested to select one of the following five fields and its topic, under which the submitted paper should be reviewed, and to indicate their selection on the title page of the manuscript.**

Fields to be selected:

Biochemistry (I)
Biochemistry (II)
Molecular Biology
Cell
Biotechnology

Topics to be selected:

Biochemistry (I): Biochemistry General; Biomolecular Structures; Glycobiology and Carbohydrate Biochemistry; Lipid Biochemistry; Biological Oxidation and Bioenergetics; Reactive Oxygen and Nitrogen Species; Biochemical Pharmacology; Biochemistry in Diseases and Aging; Cancer Biochemistry; Analytical Biochemistry; Nucleic Acids

Biochemistry (II): Physiological Chemistry; Protein and Peptide Chemistry; Enzymology; Biochemistry of Proteolysis; Metabolism; Biochemistry in Cell Membranes; Neurochemistry

Molecular Biology: Molecular Biology General; Structure and Function of Genes and Other Genetic Materials; Replication and Recombination; Transcription; Translation; Regulation of Gene Expression; DNA-Protein Interaction; RNA Processing; Recombinant DNA Technology; Transgenic Animals and Plants; Genome Analysis; Genetic Diseases; Molecular Genetics; Molecular Evolution

Cell: Cell General; Differentiation, Development, and Aging; Extracellular Matrices and Cell Adhesion Molecules; Muscles, Cell Motility, and Cytoskeleton; Stress Proteins and Molecular Chaperones; Protein Targeting and Sorting; Organelles and Biomembranes; Neurobiology; Receptors and Signal Transduction; Cell Cycle Control; Cell Death; Tumor Cell Biology; Molecular and Cellular Immunology

Biotechnology: Biotechnology General; Biomimetic Chemistry; Biomaterials; Bioactive Substances; Gene and Protein Engineering; RNA Technology; Glycotechnology; Immunological Engineering; Cell and Tissue Engineering; Transgenic Technology; Drug Delivery Systems; Biosensor and Bioelectronics; New Devices in Biotechnology; Environmental Technology

No definite limit of length is set for a **Regular Paper**, but all manuscripts should be as concise as possible. A concise well-written paper will usually reduce the time required for review and tends to be published more rapidly. A **Rapid Communication** should not exceed an equivalent of 3.5 printed pages including the spaces required for figures, tables, and references. In estimating this limit, note that one single printed page is approximately 3.5 pages of a double-spaced type-written manuscript.

A manuscript describing primary structures of biological macromolecules (proteins and nucleic acids) without enough data for their deductions within the limited page space is not acceptable as a Rapid Communication. **In the case of a Rapid Communication, the author should submit two copies of a free style letter describing the urgency or necessity for the rapid publication.**

II. REVIEW PROCESS

Manuscript will be sent to at least two referees for evaluation. The JOURNAL always attempts to minimize the potential for conflict of interest in the review of manuscripts. Therefore, authors may request that a specific individual with a possible conflict of interest not be involved in reviewing the manuscript. Authors may suggest the names and addresses of a few potential reviewers. The Editors and Associate Editors will be guided but not necessarily bound by these suggestions.

Contributors will receive a letter from one of the Editors or Associate Editors stating whether their manuscript is acceptable. Revised manuscripts, and correspondence concerning manuscripts, should be sent directly to the relevant Editor at the address indicated on the letter. Revised papers will be considered as newly submitted papers if they are not resubmitted within 2 months for no justifiable reason. The manuscript may be sent to a member of the English revisors associated with the Society to correct English grammar and syntax depending on the Editor's judgement before the final acceptance. Handling of manuscripts is free of charge. Manuscripts, if accepted, will be published only after agreement by the author(s) to pay the costs of publication including page charges (see "notes to contributors" in recent issues). Authors should provide "materials for the preparation of indices" upon request from the Editor. Alteration in galley proofs, other than the correction of printer's errors, are not granted, except when the Editor admits inevitable addition of a brief note in proofs at the author's expense. Galley proofs corrected by authors should be returned to the printer by a designated date. Otherwise, the Editor reserves the right of proofreading. Illustrations, photographs, electron micrographs, color plates, and other special illustrations will be reproduced at the author's expense at cost prices. The list of these cost prices will be sent to the author after the final decision. Reprints can be purchased in lots of 50 copies at cost price and the order for reprints should be made on returning the proof.

When the manuscript is rejected, only the artwork (Tables and Figures) will be returned to the author. The copies will be discarded by the Editorial office.

The members of the Editorial Board use the following guidelines to assist them in making editorial decisions. To inform prospective authors of our criteria, the guidelines are listed below, but please note that these are only guidelines. ① Is the subject suitable for publication in the *Journal of Biochemistry*? ② Is it an original contribution? ③ Is it a complete and final paper? ④ Is it clearly presented? ⑤ Are the summary and title informative? Do they reflect the contents of the paper? ⑥ Are the appropriate key words given? ⑦ Does the introduction contain statements sufficient to explain the aim of the work? ⑧ Are the methods sound? ⑨ Are the results relevant and sufficient? ⑩ Are the illustrations and tables necessary and acceptable? ⑪ Are the interpretations and conclusions justified by the data? ⑫ Are the references adequate; are all of them necessary? Does the list of references contain all the information?

In general, the *Journal of Biochemistry* will not publish papers that are: ① Merely confirmatory or descriptive as to the presence of a

well-known process in tissues or organisms not previously studied. ② Not novel enough: purification of an enzyme or sequencing of a protein or nucleic acid which has already been reported for another species or organ, unless the manuscript includes novel findings or is of biological significance. ③ Too preliminary or incomplete: incomplete amino acid or nucleotide sequences, incomplete structures of natural compounds, incomplete NMR or other spectroscopic assignments, *etc.* ④ Deals only with the description of a new method or the preparation of a reagent such as a monoclonal antibody, unless it is novel or represents a substantial improvement. ⑤ Too specialized in areas outside the scope of the *Journal of Biochemistry*. ⑥ Just negative.

III. FORM AND STYLE OF MANUSCRIPT

Manuscripts should conform to the style and usage of the Journal as exemplified in current issues. They should be typed on A4 form (21 × 29.7 cm or 21.6 × 28 cm) paper with double-spacing throughout. Separate sheets should be used for the following: (1) **title page(s),** (2) **summary,** (3) **text,** (4) **footnote(s) to the text,** (5) **references,** (6) **table(s),** (7) **legend(s) to figure(s),** (8) **figures or other subsidiary matters.** The manuscripts should be arranged in the order indicated above and all sheets should be numbered in succession except the figure(s), the title page being page 1. Indicate the appropriate location in the text of the tables, figures, and other subsidiary materials by marginal notes. Latin words should be italicized (for example: *in vitro, i.e., etc., per se*). Footnote(s) to the title, author's name(s), and affiliation(s) should appear on the title page. Footnotes to the text should be typed on a separate sheet. All footnotes should be numbered in succession with superscript, arabic numerals, starting from the title page footnote(s). Footnotes to tables should be identified with superscript lower case (a, b, *etc.*), and placed at the bottom of the table.

IV. ORGANIZATION OF MANUSCRIPT

A desirable plan for the organization of a **Regular Paper** is as follows: **(a) SUMMARY, (b) INTRODUCTION** with no heading, **(c) EXPERIMENTAL PROCEDURES** or **MATERIALS AND METHODS, (d) RESULTS, (e) DISCUSSION, (f) REFERENCES.** In some cases, presentation will be clearer and more effective if the author combines some of these section. For a **Rapid Communication,** a brief summary is requested, but headings and subheadings should be omitted.

1. Title Page(s)

Provide a title page(s), containing the following items.

(1) The form of the paper (Regular Paper or Rapid Communication). The field and its topic under which the paper is to be reviewed.

(2) Title. The title should be informative and as short as is consistent with clarity. The title should not include chemical formulae or arbitrary abbreviations, but chemical symbols may be used to indicate the structures of isotopically labeled compounds. The numbering of parts in a series of papers is not permitted, but titles and subtitles may be used if necessary.

(3) By-line. List full names of all authors. A footnote reference(s) to an author(s), indicating a change of address, should be given on the title-page.

(4) From-line. List the institution(s) in which the work was carried out, and the Zip Code, if available.

(5) Running title. Provide a short running title of less than 60 strokes. It should be as informative as possible.

(6) The name, complete mailing address, telephone number, and (if accessible) Fax number and E mail address of the person to whom correspondence should be sent. To expedite the review, much of the journal's correspondence will be by Fax, unless the authors request use of regular mail when submitting the manuscript. The Japanese author(s) must also list in Japanese the name and address of the person who is in charge of proofreading.

(7) Abbreviations. Non-standard abbreviations (see Section IX-6, 7, and 8) should be defined, even if they are known to those familiar with the field. List all non-standard abbreviations used in the paper in alphabetical order in a footnote on the title page.

2. Summary

(1) Every paper should have summary. The summary should be concisely written in less than 200 words. Summaries of Rapid Communications should be limited to 100 words. The summary should briefly present the problem, suggest the scope of the work and the plan of experiments, mention significant data and state major findings and conclusions. Avoid statements such as "The significance of these results is discussed" that do not help the reader. The summary should be intelligible to the nonspecialist as well as the specialist in your field, and hence should avoid specialized terms and abbreviations.

(2) Key words. Provide five key words identifying the nature of the subject matter **alphabetically** in the last part of the summary.

3. Introduction

The text of a **Regular Paper** should begin with a short introduction with no heading. This should state the reasons for performing the work, with brief reference to previous work on the subject. Avoid giving an extensive review of the literature.

4. Methods, Results, and Discussion

The arrangement of the paper after the introduction is not fixed. The author may separate sections with italicized subheadings.

The **Experimental Procedures** or **Materials and Methods** should give sufficient details to enable the reader to repeat your work exactly, if necessary. **The necessity for conciseness should not lead to omission of important experimental details.** Refer to previously published procedures employed by citation of both the original description and pertinent published modifications, and do not include extensive description unless they present substantially new modifications. Combination of the Results and Discussion in a single section sometimes gives a clearer and more compact presentation.

5. References

References cited in the text should be numbered in parentheses with italicized Arabic numerals in order of appearance. References to "unpublished experiments" and "personal communications" should appear parenthetically in the text following the name(s) of the source of information [(Yamada, T., personal communication), (Suzuki, M. and Yoshida, M., unpublished observations) *etc.*]. Be sure to verify the wording of any personal communication with the person who supplied the information and get his approval for the use of his name in connection with the quoted information. All references should be listed in numerical order typed double-spaced on a separate sheet under the heading REFERENCES. Please note the following examples.

(1) For a journal article:

7. Sanger, F., Nicklen, S., and Coulson, A.R. (1977) DNA sequencing with chain-terminating inhibitors. *Proc. Natl. Acad. Sci. USA* **74**, 5463-5467

(2) For a chapter in an edited book:

12. Messing, J. (1983) New M13 vectors for cloning in *Methods in Enzymology* (Wu, R., Grossman, L., and Moldave, K., eds.) Vol. 101, pp. 20-51, Academic Press, New York

(3) For a book by one or more authors:

15. Sambrook, J., Fritsch, E.F., and Maniatis, T. (1989) *Molecular Cloning. A Laboratory Manual* pp. 1339-1341, Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY

Text citations to references written by more than two authors should be styled for example as, Smith *et al.* In the reference list, however, the names of all authors (with initials) must be given. 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:

29. Tanahashi, H. and Ito, T. (1994) Molecular characterization of a novel factor recognizing the interleukin-6 responsive element. *J. Biochem.* (in press)

The use of "in preparation" and "submitted for publication" is not allowed in the reference list.

Citation of the references written in a language which is usually unreadable for general readers and those published in a journal (or book) to which general reader could not easily access should be avoided.

6. Nucleotide Sequence

Upon acceptance of a paper containing new nucleotide sequence data, a DNA Data Bank of Japan (DDBJ) data submission form will accompany notification of acceptance of manuscript. The Editorial Board strongly urge the deposit of nucleotide sequence data in one of the data banks, DDBJ, GenBank™, or EMBL. Submission to one of these is sufficient because data are exchanged between these three

banks. If the data are already deposited, indicate the accession number in the title page footnote.

7. Electronic manuscripts

Electronic manuscripts reduce the possibility of introducing errors and resulted in rapid delivery of proofs. After acceptance, authors are encouraged to send the disk plus one printed manuscript to the Editorial Office of the Journal.

V. PREPARATION OF TABLES

1. Tables should be drawn on separate sheets and numbered consecutively in Roman numerals. For aid in designing tables in acceptable style, refer to current issues of the Journal.
2. Each table should have an explanatory title and sufficient experimental detail, usually in a paragraph immediately following the title, to be intelligible without reference to the text (unless the procedure is given in the Experimental Procedures section, or under another table or figure).
3. Indicate units of measure clearly.
4. Footnotes to tables should be kept to a minimum and should be indicated by superscript lower cases, at the bottom of the table.

VI. PREPARATION OF ILLUSTRATIONS

1. Each figure (Scheme, Diagram) should be given on a separate sheet numbered with an Arabic numeral (Fig. 1, Fig. 2, *etc.*). Figures will be reduced to fit into the type area of the printed page (17.5×23.5 cm).
2. **Identify all figures in the margin or on the back, with the author's name and figure number and indicate TOP.**
3. Each figure should be accompanied by a title and an explanatory legend (Legends to Figures). There should be sufficient experimental detail in the legend to make the figure intelligible without reference to the text (unless the same material has been given with a previous figure, or in the Experimental Procedures section).
4. Legends to Figures should be typed double-spaced, in numerical order, on a separate page.
5. **Photographs should be glossy and as high in contrast as possible. Quadruplicate copies for referees should be of the same quality as the original.**
6. Indicate the magnification of photomicrographs in the legend or include a bar indicating the scale in the figure.
7. Flow diagrams and amino acid or nucleotide sequences should always be presented as direct photographic reproduction.

VII. CHEMICAL AND MATHEMATICAL FORMULAE

1. Refer in the text to simple chemical compounds by their formulae when these can be printed in simple horizontal lines of type. Do not use structural formulae in the running text.
2. Ionic charge should be shown as a superscript following the chemical symbol, *e.g.* Fe^{3+}, SO_4^{2-}.
3. Prepare large structural formulae and long mathematical equations in a form suitable for direct photographic reproduction and include them as a Diagram at the end of the paper.
4. **Isotopically Labeled Compounds**—The symbol for an isotope is shown in square brackets directly before the name (word), as in [^{14}C]urea, [α-^{14}C]leucine, DL-[methyl-^{14}C]methionine. When more than one position in a substance is labeled with the same isotope and the positions are not indicated, the number of labeled atoms should be indicated as a right-hand subscript; as in [$^{14}C_2$]-glycolic acid. The symbol *U* indicates uniform, *e.g.* [*U*-^{14}C]-glucose (where the ^{14}C is uniformly distributed among all six positions). The isotopic prefix precedes that part of the name to which it refers, as in sodium [^{14}C]formate, thiamine [β-^{32}P]-diphosphate. Terms such as ^{131}I-labeled albumin should not be contracted to [^{131}I]albumin. When isotopes of more than one element are introduced, their symbols should be arranged in alphabetical order: *e.g.* L-[3-^{14}C, 2,3-^{2}H, ^{15}N]serine. The symbols ^{2}H and ^{3}H or D and T may be used for deuterium and tritium, respectively.

   For simple molecules, the labeling is indicated by writing the chemical formulae with the prefix superscripts attached to the correct atomic symbols in the formulae: *e.g.* $^{14}CO_2$, $H_2{}^{18}O$, $^{2}H_2O$. Square brackets should not be used for them, or when the isotopic symbol is attached to a word that is not a specific chemical name, abbreviation or symbol: *e.g.* ^{131}I-labeled, ^{14}C-sugar, ^{14}C-steroids, $^{32}PO_4^{3-}$, but [^{32}P]phosphate.
5. **Spectrophotometric Data**—Beer's law may be stated as
$$A = -\log T = \varepsilon lc$$
   Where A is the absorbance; T, the transmittance ($= I/I_0$); ε, 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 ε has the dimensions liter·mol^{-1}·cm^{-1} or more briefly M^{-1}·cm^{-1} (not cm^2·mol^{-1}). Do not use "O.D." and "E."

VIII. ETHICS

In scientific investigations involving human subjects, experiments should be performed in accordance with the ethical standards formulated in the Helsinki Declaration of 1964 (revised in 1989, *cf.* http://helix.nih.gov:8001/ohsr/helsinki.phtml). Similarly, animal experiments should follow the ethical standards formulated in the Helsinki Declaration, and measures taken to protect animals from pain or discomfort should be mentioned.

IX. TERMINOLOGY AND ABBREVIATIONS

1. Abbreviations with specific meanings may be used for convenience for complex chemical substances, particularly in equations, tables, or figures. Avoid using abbreviations in titles and summaries except the standard ones listed in Table II of Section IX-8.
2. Use abbreviations and symbols sparingly in the text. In chemical equations, which traditionally depend upon symbols, an abbreviation or symbol may be used for a term that appears in full in the neighboring text. Trivial names are usually sufficiently short not to require abbreviations.
3. An abbreviated name or symbol in a column heading in a table, figure, or photograph must either be taken from the "accepted" list given in Section IX-8 or formulated in accordance with the principles of Section IX-6.
4. For spelling of chemical names consult current issues of the Journal. For chemical terms follow essentially the usages and rules recommended by International Scientific Union, especially Nomenclature Committee of IUBMB (NC-IUBMB, IUBMB: International Union of Biochemistry and Molecular Biology) and IUPAC-IUBMB Joint Commission on Biochemical Nomenclature (JCBN, IUPAC: International Union of Pure and Applied Chemistry): see the recommendations in *Biochemical Nomenclature and Related Documents (1978)*, available from The Biochemical Society, 7 Warwick Court, London WC1R 5DP, U.K. and in *Biochemical Nomenclature and Related Documents. A Compendium*, 2nd edn (Liébecq, C., ed.), Portland Press Ltd, London (1992). (see *Eur. J. Biochem.* **213**, 1-3 (1993)).
   Refer also to http://www.chem.qmw.ac.uk/iupac/jcbn/
5. **Enzymes**—Where one or more enzymes figure prominently in a manuscript, authors should use the recommended (trivial) name or systematic name given by Nomenclature Committee of IUBMB and IUPAC-IUBMB Commission on Biochemical Nomenclature: see
   Enzyme Nomenclature, Recommendations (1992), Academic Press, Inc.,
   see also *Eur. J. Biochem.* **213**, 1-3 (1993).
   —Supplement *Eur. J. Biochem.* **223**, 1-5 (1994).
   —Supplement 2 *Eur. J. Biochem.* **232**, 1-6 (1995).
   —Supplement 3 *Eur. J. Biochem.* **237**, 1-5 (1996).
   —Supplement 4 *Eur. J. Biochem.* **250**, 1-6 (1997).
   When an enzyme is the main subject of a paper, its source, trivial name, systematic name (or the reaction that it catalyzes) and code number (preceded by "EC") should be included.
6. **Non-Standard Abbreviations**—Use of abbreviations other than the standard ones listed in IX-7 and IX-8 should be kept to a minimum. Such abbreviations should be introduced only when absolutely necessary, as in tables, figures, and other illustrations where space is particularly limited. Abbreviations are usually not needed in the text of a paper where repeated use of long names can be avoided by judicious use of pronouns, or by paraphrasing with words such as "the substrate," "the inhibitor," "the methyl derivative," *etc.* **All non-standard abbreviations used in the text should be defined in alphabetical order in a single footnote on the title page.**
7. **Abbreviations of Units of Measurement and Physical and**

Chemical Quantities—These abbreviations listed in Table I may be used without definition.

TABLE I

(1) Prefixes to the names of units					
tera	10^{12}	T	milli	10^{-3}	m
giga	10^{9}	G	micro	10^{-6}	μ
mega	10^{6}	M	nano	10^{-9}	n
kilo	10^{3}	k	pico	10^{-12}	p
deci	10^{-1}	deci (not d)	femto	10^{-15}	f
centi	10^{-2}	c[1]	atto	10^{-18}	a
(2) Units of Concentration[2]					
molar (moles/liter)			M		
millimolar (millimoles/liter)			mM (not 10^{-3} M)		
micromolar (micromoles/liter)			μM (or 10^{-6} M)		
nanomolar (nanomoles/liter)			nM (or $\times 10^{-9}$ M)		
picomolar (picomoles/liter)			pM (or $\times 10^{-12}$ M)		
(3) Units of Length					
meter			m		
centimeter			cm		
millimeter			mm		
micrometer (not micron)			μm (not μ)		
nanometer			nm (not mμ)		
Ångstrom (0.1 nm)			Å		
(4) Units of Area and Volume					
square centimeter			cm^2		
cubic centimeter			cm^3		
liter			l (in tables only)		
milliliter			ml		
microliter			μl (not λ)		
(5) Units of Mass					
gram			g (kg, mg, μg [not γ], ng, pg)		
dalton[3]			Da		
(6) Units of Time					
hour	h		year	yr	
minute	min		month	mo	
second	s		week	wk	
			day	d	
(7) Units of Radioactivity					
becquerel			Bq (=1 dps or 60 dpm)		
counts per minute			cpm		
curie(s)			Ci ($=3.7\times 10^{10}$ Bq)		
disintegrations per minute			dpm		
(8) Other Units					
mole			mol (mmol, μmol, nmol, pmol)		
degree Celsius			°C		
degree absolute (kelvin)			K		
joule			J		
kilojoule			kJ		
calorie			cal		
kilocalorie			kcal		
parts per billion			ppb		
parts per million			ppm		
cycles per second (hertz)			Hz (not cps)		
equivalent			eq		
ampere			A (mA)		
ohm			Ω		
volt			V		
gauss			G		
pascal			Pa		
revolutions per minute			rpm		
Svedberg unit of sedimentation coefficient (10^{-13} s)			S		
(9) Physical and Chemical Quantities					
absorbance			A		
equilibrium constant			K		
rate constant			k		
maximum velocity			V_{max}		
Michaelis constant			K_m		
equilibrium dissociation constant			K_d		
isoelectric point			pI		
molecular weight[3]			M_r		
retardation factor			R_f		
acceleration of gravity			g		
specific rotation			$[\alpha]_\lambda^t$		
partial specific volume			$\bar{v}$		
diffusion constant			D		
sedimentation coefficient			s		
density			ρ		
sedimentation coefficient in water at 20°C, extraporated to zero concentration			$s^0_{20,w}$		
Gibbs energy change			ΔG		
entropy change			ΔS		
enthalpy change			ΔH		
melting temperature			T_m		
(10) Other Terms					
logarithm			log		
logarithm (natural)			ln		
standard deviation of a series			SD		
standard error of mean of series			SE		

[1] to be avoided where possible (except for cm).
[2] Terms such as milligram percent (mg%) should not be used. Weight concentrations should be given as g/ml, g/100 ml, *etc.*
[3] Molecular weight is dimensionless. Only molecular mass is expressed by daltons.

8. **Accepted Abbreviations and Symbols**—Authors may use, without definition, the abbreviations given in Table II and the symbols and abbreviations for amino acid or nucleotide residues in polymers or sequences. Define other abbreviations in a single footnote on the title page.

TABLE II

(1) General	
Adenosine 3′:5′-cyclic monophosphate	cAMP
Adenosine 5′-mono-, di, and triphosphates[1]	AMP, ADP, and ATP
Adenosine triphosphatase	ATPase
Base pair(s)	bp
Bovine serum albumin	BSA
O-(Carboxymethyl)	CM-
Circular dichroism	CD
Coenzyme A and its acyl derivatives	CoA (or CoASH) and acyl-CoA
Complementary DNA	cDNA
Cyclic AMP	cAMP
Cyclic GMP	cGMP
Cytidine diphosphate choline, *etc.*	CDP-choline, *etc.*
Cytidine 5′-mono-, di-, and triphosphates	CMP, CDP, and CTP
Deoxyribonuclease	DNase
Deoxyribonucleic acid	DNA
O-(Diethylaminoethyl)	DEAE-
Dithiothreitol	DTT
Electron paramagnetic resonance	EPR
Electron spin resonance	ESR
Ethylenediaminetetraacetic acid	EDTA
[Ethylenebis(oxyethlenenitrilo)]-tetraacetic acid	EGTA
Flavin-adenine dinucleotide and its fully reduced form	FAD and $FADH_2$
Flavin mononucleotide and its fully reduced form	FMN and $FMNH_2$
Fourier transform	FT
Gas chromatography-mass spectrometry	GC-MS
Gas liquid chromatography	GLC
Glutathione and its oxidized form	GSH and GSSG
Guanosine 3′:5′-cyclic monophosphate	cGMP
Guanosine 5′-mono-, di-, and triphosphates	GMP, GDP, and GTP
Guanosine triphosphatase	GTPase
Hemoglobin	Hb
Heterogenous nuclear RNA	hnRNA

High performance (pressure) liquid chromatography	HPLC
4-(2-Hydroxyethyl)-1-piperazineethanesulfonic acid	HEPES
Immunoglobulin	Ig (IgG, IgM, *etc.*)
Infrared	IR
Inorganic orthophosphate	P_i
Inorganic pyrophosphate	PP_i
Inosine 5′-mono-, di-, and triphosphates	IMP, IDP, and ITP
Kilobases	kb
Kilobase pairs	kbp
Lethal dose, 50%	LD_{50}
Messenger RNA	mRNA
Nicotinamide adenine dinucleotide and its reduced form	NAD^+ and NADH[2]
Nicotinamide adenine dinucleotide phosphate and its reduced form	$NADP^+$ and NADPH[2]
Nuclear magnetic resonance	NMR
Nuclear RNA	nRNA
Optical rotatory dispersion	ORD
Phosphoric acid residue	P- or -P
Pseudouridine and pseudouridine mononucleotide	ψ and ψMP
Polyacrylamide gel electrophoresis	PAGE
Poly(adenylic acid), polyadenylate[3]	Poly(A)[3]
Polymerase chain reaction	PCR
Restriction fragment length polymorphism	RFLP
Ribonuclease	RNase
Ribonucleic acid	RNA
Ribosomal RNA	rRNA
Ribosylthymine 5′-mono-, di-, and triphosphates	TMP, TDP, and TTP
Sodium dodecyl sulfate	SDS
Thin layer chromatography	TLC
Thymidine (2′-deoxyribosylthymine) 5′-mono-, di-, and triphosphates	dTMP, dTDP, and dTTP[4]
Transfer RNA	tRNA
Tris(hydroxymethyl)aminomethane	Tris
Ultraviolet	UV
Uridine diphosphate glucose, *etc.*	UDP-glucose, *etc.*
Uridine 5′-mono-, di-, and triphosphates	UMP, UDP, and UTP

(2) Amino acids

Alanine	Ala	(A)
Arginine	Arg	(R)
Asparagine	Asn	(N)
Aspartic acid	Asp	(D)
Aspartic acid or asparagine	Asx	(B)
Cysteine	Cys	(C)
Glutamic acid	Glu	(E)
Glutamine	Gln	(Q)
Glutamic acid or glutamine	Glx	(Z)
Glycine	Gly	(G)
Histidine	His	(H)
Isoleucine	Ile	(I)
Leucine	Leu	(L)
Lysine	Lys	(K)
Methionine	Met	(M)
Phenylalanine	Phe	(F)
Proline	Pro	(P)
Serine	Ser	(S)
Threonine	Thr	(T)
Tryptophan	Trp	(W)
Tyrosine	Tyr	(Y)
Valine	Val	(V)

(3) Nucleic acids

Adenosine		A
Bromouridine	BrUrd or	B
Cytidine		C
Dihydrouridine		D or hU
Guanosine		G
Inosine		I
6-Mercaptopurine ribonucleoside (6-thioinosine)		M or sI
'a nucleoside'	Nuc or	N
Pseudouridine		ψ or Q^a
'a purine nucleoside'		R
'a pyrimidine nucleoside'		Y
Thiouridine		S or sU
Thymidine (2′-deoxyribosylthymine)		dT
Uridine		U
Xanthosine		X
Phosphoric residue	-*P* or	p

[1] 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.
[2] NAD(P)$^+$ and NAD(P)H indicate either NAD^+ or $NADP^+$ and either NADH or NADPH, respectively.
[3] Similarly abbreviate oligo- and polynucleotides composed of repeating sequences or of unknown sequence of given purine or pyrimidine bases, *e.g.* oligothymidylate, oligo(dT); alternating copolymer of A and U, poly(A-U); random copolymer of A and U, poly(A,U).
[4] The d prefix may be used to represent the corresponding deoxyribonucleoside phosphates, *e.g.* dADP.

9. **Names of Animals, Plants, and Microorganisms**—The scientific names are Latin binomials and should be given in full in the title and summary and on first mention in the text (*e.g. Escherichia coli*). Subsequently, the generic name may be contracted (usually to the first letter), *e.g., E. coli.* The strain of laboratory animals and if possible the source should be stated.
10. The cytochromes should be designated by a small italicized letter, *e.g.* cytochrome *a*, b_2, c_1, *etc.*

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