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For enzymes, use the recommended (trivial) name assigned by the Nomenclature Committee of the International Union of Biochemistry as described in *Enzyme Nomenclature* (Academic Press, Inc., 1979). If a nonrecommended name is used, place the proper (trivial) name in parentheses at first use in the abstract and text. Use the EC number when one has been assigned, and express enzyme activity either in katalis (preferred) or in the older system of micromoles per minute.

**Nomenclature of Microorganisms**

Binary names, consisting of a generic name and a specific epithet (e.g., *Escherichia coli*), must be used for all microorganisms. Names of higher categories may be used alone, specific and subspecific epithets may not. A specific epithet must be preceded by a generic name the first time it is used in a paper. Thereafter, the generic name should be abbreviated to the initial capital letter (e.g., *E. coli*), provided there can be no confusion with other genera used in the paper. Names of all taxa (phyla for fungi, divisions), classes, orders, families, genera, species, subspecies) are printed in italics; strain designations and numbers are not.

The spelling of bacterial names should follow the Approved Lists of Bacterial Names (American Society for Microbiology, 1980), the subsequent validation lists and relevant articles published in the *International Journal of Systematic Bacteriology* since 1980, or Berger's Manual of Systematic Bacteriology (N. R. Krieg and J. G. Holt, ed., The Williams & Wilkins Co., 1984). If there is reason to use a name that does not have standing in nomenclature, the name should be enclosed in quotation marks and an appropriate statement concerning the nomenclatural status of the name should be made in the text (for an example, see Int. J. Syst. Bacteriol. 30:547–556, 1980).

It is recommended that a strain be deposited in a recognized culture collection when that strain is necessary for the description of a new taxon (see *Bacteriological Code, 1975 Revision*, American Society for Microbiology, 1975).

Since the classification of fungi is not complete, it is the responsibility of the author to determine the currently accepted binomial for a given yeast or mold. Some sources for the spelling of these names include *The Yeasts: a Taxonomic Study* (3rd ed., N. J. W. Kreger-van Rij, ed., Elsevier Science Publishers B.V., 1984) and *Ainsworth and Bisby's Dictionary of the Fungi, Including the Lichens*, 6th ed. (Commonwealth Mycological Institute, Kew, Surrey, England, 1971).

Names used for viruses should be those approved by the International Committee on Taxonomy of Viruses (ICTV) and published in the 4th Report of the ICTV, Classification and Nomenclature of Viruses (Intervirology 17:23–199, 1982). If desired, synonyms may be added parenthetically when the name is first mentioned. Approved generic (or group) and family names may also be used.

Microorganisms, viruses, and plasmids should be given designations consisting of letters and serial numbers. It is generally advisable to include a worker's initials or a descriptive symbol of locale, laboratory, etc., in the designation. Each new strain, mutant, isolate, or derivative should be given a new (serial) designation. This designation should be distinct from those of the genotype and phenotype, and genotypic and phenotypic symbols should not be included.

**Genetic Nomenclature**

**Bacteria.** The genetic properties of bacteria are described in terms of phenotypes and genotypes. The phenotypic designation describes the observable properties of an organism. The genotype refers to the genetic constitution of an organism, usually in reference to some standard wild type. Use the recommendations of Demerec et al. (*Genetics* 54:61–76, 1966) as a guide in employing these terms.

(i) Phenotypic designations must be employed when

<p>| TABLE 1. Distribution of protein and ATPase in fractions of dialyzed membranes* |
|---------------------------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Membranes from:</th>
<th>Fraction</th>
<th>ATPase (U/mg of protein)</th>
<th>Total U</th>
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<tr>
<td>Control</td>
<td>Depleted membrane</td>
<td>0.036</td>
<td>2.3</td>
</tr>
<tr>
<td></td>
<td>Concentrated supernatant</td>
<td>0.134</td>
<td>4.82</td>
</tr>
<tr>
<td>E1-treated cells</td>
<td>Depleted membrane</td>
<td>0.034</td>
<td>1.98</td>
</tr>
<tr>
<td></td>
<td>Concentrated supernatant</td>
<td>0.11</td>
<td>4.6</td>
</tr>
</tbody>
</table>

* Specific activities of ATPase of nondepleted membranes from control and treated bacteria were 0.21 and 0.20, respectively.
mutant loci have not been identified or mapped. Phenotypic designations generally consist of three-letter symbols; these are not italicized, and the first letter of the symbol is capitalized. It is preferable to use roman or arabic numerals (instead of letters) to identify a series of related phenotypes. Thus, a series of bacteriocin-tolerant mutants might be designated TolI, TolII, TolIII, etc., or a series of nucleic acid polymerase mutants might be designated Pol1, Pol2, Pol3, etc. Wild-type characteristics can be designated with a superscript plus (ToI⁺ or Pol⁺) and, when necessary for clarity, negative superscripts (ToI⁻ or Pol⁻) can be used to designate mutant characteristics. Lowercase superscript letters may be used to further delineate phenotypes (e.g., Str⁺ for streptomycin sensitivity). Phenotypic designations should be defined.

(ii) Genotypic designations are similarly indicated by three-letter locus symbols. In contrast to phenotypic designations, these are lowercase italic (e.g., ara his rps). If several loci govern related functions, these are distinguished by italicized capital letters following the locus symbol (e.g., araA araB araC). Promoter, terminator, and operator sites should be indicated as described by Bachmann and Low (Microbiol. Rev. 44:1–56, 1980), e.g., lacZp, lacA1, and lacZo.

(iii) Wild-type alleles are indicated with a superscript plus (ara⁺ his⁺). When the genotype of an organism is being specified (e.g., in a strain table), a superscript minus is not used to indicate a mutant locus. Elsewhere, a superscript minus may be used to distinguish between the symbol of a mutant allele and that of a genetic locus. However, this distinction is best made in the context, and thus one refers to an ara⁻ mutant rather than an ara⁻ strain.

(iv) Mutation sites are designated by placing serial isolation numbers (allele numbers) after the locus symbol (e.g., araA1 araA2). If it is not known in which of several related loci the mutation has occurred, a hyphen is used instead of the capital letter (e.g., ara-23). It is essential in papers reporting the isolation of new mutants that allele numbers be given to the mutations. For Escherichia coli, there is a registry of such numbers: E. coli Genetic Stock Center, Department of Human Genetics, Yale University School of Medicine, P. O. Box 3333, New Haven, CT 06510. For Salmonella, the registry is: Salmonella Genetic Stock Center, Department of Biology, University of Calgary, Calgary, Alberta, T2N 1N4 Canada. For Bacillus, the registry is: Bacillus Genetic Stock Center, Ohio State University, Columbus. A registry of allele numbers and insertion elements (omega [Ω] numbers) for chromosomal mutations and chromosomal insertions of transposons and other insertion elements has been established in conjunction with the ISP collection of Staphylococcus aureus at Iowa State University. Blocks of allele numbers and Ω numbers are assigned to laboratories on request. Requests for blocks of numbers and additional information can be obtained from Peter A. Pattee, Department of Microbiology, Iowa State University, Ames, IA 50011. A registry of plasmid designations is maintained by the Plasmid Reference Center, Department of Medical Microbiology, Stanford University, Stanford, CA 94305.

(v) The use of superscripts with genotypes (other than + to indicate wild-type alleles) should be avoided. Designations indicating amber mutations, temperature-sensitive mutations, indications of phenotype, etc., should follow the allele number [e.g., araA230(Am) hisD21(Ts)] and should be defined at the first occurrence. If superscripts must be used, they must be approved by the editor and they must be defined at the first occurrence.

(vi) Deletions are indicated by the symbol Δ placed before the deleted gene or region, e.g., ΔtrpA432, Δ[arO-aceE]419, or khs(dhuA hisJ hisQ)1256. Similarly, other symbols can be used (with appropriate definition).

Thus, a fusion of the ara and lac operons can be shown as Φ[ara-lac]95. Similarly, Φ[araB⁺-lacZ⁺]96 indicates that the fusion results in a truncated araB gene fused to an intact lacZ, and Φ[malE-lacZ]97(Hyb) shows that a hybrid protein is synthesized. An inversion is shown as inv(RQ-rrnE11). An insertion of an E. coli his gene into plasmid pSC101 at zero kilobases (0 kb) is shown as pSC101 Ω[0kb::K-12hisB]]. An alternative designation of an insertion can be used in simple cases, e.g., galT236::tn5. The number 236 refers to the locus of the insertion, and if the strain carries an additional gal mutation, it is listed separately. Additional examples, which utilize a slightly different format, can be found in the papers by Campbell et al. and Novick et al. cited below. It is important in reporting the construction of strains in which a mobile element was inserted and subsequently deleted that this latter fact be noted in the strain table. This can be done by listing the genotype of the strain used as an intermediate, in a table footnote, or by a direct or parenthetical remark in the genotype, e.g., (F⁻), ΔMu cts, mal::ΔMu cts::lac. In setting parenthetical remarks within the genotype or dividing the genotype into constituent elements, parentheses and square brackets are used without special meaning; square brackets are used outside parentheses. To indicate the presence of an episome, parentheses (or brackets) are used (λ, F⁺).

For yeasts, Chlamydomonas, and several fungal species, symbols such as those given in the Handbook of Microbiology (A. I. Laskin and H. A. Lechevalier, ed., CRC Press, Inc., 1974) should be employed.

"Mutant" vs. "mutation." Keep in mind the distinction between a mutation (an alteration of the primary sequence of the genetic material) and a mutant (a strain carrying one or more mutations). One may speak about the mapping of a mutation, but one cannot map a mutant. Likewise, a mutant has no genetic locus, only a phenotype.

Strain designations. Do not use a genotype as a name (e.g., "subsequent use of leuC6 for transduction"). If a strain designation has not been chosen, select an appropriate word combination (e.g., "another strain containing the leuC6 mutation").

Viruses. The genetic nomenclature for viruses differs from that for microorganisms. In most instances, viruses have no phenotype, since they have no metabolism outside host cells. Therefore, distinctions between phenotype and genotype cannot be made. Superscripts are employed to indicate hybrid genomes. Genetic symbols may be one, two, or three letters. For example, a mutant strain of λ might be designated as λ Aam11 int2 red14 cI857; this strain carries mutations in genes cI, int, and red and an amber-suppressible (am) mutation in gene A. A strain designated λ att34 imm21 would represent a hybrid of phage λ which carries the immunity region (imm) of phage 21 and the attachment (att) region of phage 434. Host DNA insertions into viruses should be delineated by square brackets, and the genetic symbols and designations for such inserted DNA should conform to those employed for the host genome. Genetic symbols for phage λ can be found in Szybalski and Szybalski (Gene 7:217–270, 1979) and in Echols and Murialdo (Microbiol. Rev. 42:577–591, 1978).

Transposable elements, plasmids, and restriction enzymes. Nomenclature of transposable elements (insertion sequences, transposons, phage Mu, etc.) should follow the recommendations of Campbell et al. (Gene 5:197–206, 1979), with the modifications given in section vi. The system of designating transposon insertions at sites where there are no known loci, e.g., zef-123:Tn5, has been described by Chumley et al. (Genetics 91:639–655, 1979). The nomenclature recommendations of Novick et al. (Bacteriol. Rev. 40:168–189, 1976) for plasmids and plasmid-specific activities, of Low (Bacteriol. Rev. 36:587–607, 1972) for F-prime factors, and of Roberts (Nucleic Acids Res. 9:175–196, 1981) for restriction enzymes and DNA fragments derived from treatment with these enzymes should be used. Recombinant DNA molecules constructed in vitro follow the nomenclature for insertions in general. DNA inserted into recombinant DNA molecules should be described by using the gene symbols and conventions for the organism from which the DNA was obtained. The Plasmid Reference Center, Stanford University School of Medicine, assigns Tn and IS numbers to avoid conflicting and repetitive use.

ABBREVIATIONS AND CONVENTIONS

Verb Tense

Use the past tense to narrate particular events in the past, including the procedures, observations, and data of the study you are reporting. Use the present tense for general statements, including your own general conclusions, the conclusions of previous researchers, and generally accepted facts. In addition, the present tense should be used for discourse having an immediate effect on the reader ("the data indicate"; "Fig. 1 shows").

Abbreviations

General. It is strongly recommended that all abbreviations except those listed below be introduced in the first paragraph in Materials and Methods. Alternatively, define each abbreviation and introduce it in parentheses the first time it is used; e.g., "cultures were grown in Eagle minimal essential medium (MEM)." Generally, eliminate abbreviations that are not used at least five times in the text (including tables and figure legends). Abbreviations should be used primarily as an aid to the reader rather than as a convenience to the author, and therefore their use should be limited. Abbreviations other than those recommended by the IUPAC-IUB (Biochemical Nomenclature and Related Documents, 1978) should be used only when a case can be made for necessity, such as in tables and figures.

It is often possible to use pronouns or to paraphrase a long word after its first use (e.g., "the drug," "the substrate"). Standard chemical symbols and trivial names or their symbols (folute, Ala, Leu, etc.) may be used for terms that appear in full in the neighboring text.

Not requiring introduction. In addition to abbreviations for standard units of measurement and chemical symbols of the elements, the following should be used without definition in the title, abstract, text, figure legends, and tables: DNA (deoxyribonucleic acid); cDNA (complementary DNA); RNA (ribonucleic acid); cRNA (complementary RNA); RNase (ribonuclease); DNase (deoxyribonuclease); rRNA (ribosomal RNA); mRNA (messenger RNA); tRNA (transfer RNA); AMP, ADP, ATP, dAMP, GTP, etc. (for the respective 5' phosphates of adenosine or other nucleosides) (add 2', 3', or 5' when needed for contrast); ATPase, dGTPase, etc. (adenosine triphosphatase, deoxyguanosine triphosphatase, etc.); NAD (nicotinamide adenine dinucleotide); NAD+ (nicotinamide adenine dinucleotide, oxidized); NADH
In the chemical formula (e.g., $^{14}$CO$_2$, $^3$H$_2$, $^{18}$SO$_4$), brackets are not employed when the isotopic symbol is attached to a word that is not a specific chemical name (e.g., $^{13}$I-labeled protein, $^{14}$C-amino acids, $^3$H-ligands, etc.). For specific chemicals, the symbol for the isotope introduced is placed in brackets directly preceding the part of the name that describes the labeled entity. Note that configuration symbols and modifiers precede the isotopic symbol. The following examples illustrate correct usage:

- $[^{14}]$urea
- UDP-$[^{14}]$glucose
- E. coli $[^{15}]$DNA
- fructose 1,6-$[^{2}]$P
- ATP
- AEM follows the same conventions for isotopic labeling as the Journal of Biological Chemistry, and more detailed information can be found in the instructions to authors of that journal (first issue of each year).
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