**Abbreviations**

The following abbreviations may be used anywhere in the manuscript without further definition. All other abbreviations, including any used in the manuscript title, should be spelled out upon first appearance in the abstract or main text.

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| **Abbreviations** | |
| ABC | ATP-binding cassette, e.g., ABC transporter |
| Ac | acetyl |
| AIDS | acquired immunodeficiency syndrome |
| ALS | amyotrophic lateral sclerosis |
| AMP, ADP, ATP | adenosine 5'-mono, di-, and triphosphates |
| ATPase | adenosine triphosphatase |
| β-gal | β-galactosidase |
| BSA | bovine serum albumin |
| cAMP | cyclic AMP (adenosine 3':5'-monophosphate) |
| CD | circular dichroism |
| cGMP | cyclic guanosine monophosphate |
| CHAPS | 3-(3-cholamidopropyl) diethyl-ammonio-1-propanesulfonate |
| ChIP | chromatin immunoprecipitation |
| CMP, CDP, CTP | cytidine 5'-mono-, di-, and triphosphates |
| CoA | coenzyme A |
| COSY | correlated spectroscopy |
| CRISPR | clustered regularly interspaced short palindromic repeats |
| cryo-EM | cryo-electron microscopy |
| C-terminal | carboxy-terminal |
| d as in dADP, dTMP, etc. | deoxy |
| DEAD | acronym for Asp-Glu-Ala-Asp, e.g., DEAD-box helicase |
| DMSO | dimethyl sulfoxide |
| DNA | deoxyribonucleic acid |
| DNase | deoxyribonuclease |
| dsDNA | double-stranded DNA |
| dsRNA | double-stranded RNA |
| DTT | dithiothreitol |
| EC50 | half-maximal effective concentration |
| ED50 | half-maximal effective dose |
| EDTA | ethylenediaminetetraacetate |
| EGTA | [ethylenebis(oxyethylenenitrilo)]tetraacetic acid |
| ELISA | enzyme-linked immunosorbent assay |
| EM | electron microscopy |
| EPR | electron paramagnetic resonance |
| FACS | fluorescence-activated cell sorter/sorting |
| FAD, FADH2 | flavin-adenine dinucleotide and its fully reduced form |
| FITC | fluorescein isothiocyanate |
| fMet | formylmethionine |
| FMN | riboflavin 5'-phosphate |
| FPLC | fast protein liquid chromatography |
| FRET | Förster/fluorescence resonance energy transfer |
| FTIR | Fourier transform infrared |
| GABA | γ-aminobutyric acid |
| GalNAc | *N*-acetylgalactosamine |
| GC, GLC | gas chromatography, gas/liquid chromatography |
| GFP | green fluorescent protein |
| GlcNAc | *N*-acetylglucosamine |
| GMP, GDP, GTP | guanosine 5'-mono-, di-, and triphosphates |
| G protein | guanine nucleotide–binding regulatory protein |
| GSH/GSSG | glutathione and its disulfide form |
| Hepes or HEPES | 4-(2-hydroxyethyl)-1-piperazineethanesulfonic acid |
| HIV | human immunodeficiency virus |
| HPLC | high-performance/pressure liquid chromatography |
| IC50 | concentration giving half-maximal inhibition |
| ID50 | half-maximal infective dose |
| IDP, IMP, ITP | inosine 5'-mono-, di-, and triphosphates |
| IgG, etc. | immunoglobulin G, etc. |
| IR | infrared |
| kDa or Da | kilodalton, dalton |
| *K*M | Michaelis-Menten constant |
| LC/MS, LC-MS | liquid chromatography/mass spectrometry |
| LD50 | half-maximal lethal dose |
| mAb | monoclonal antibody |
| MALDI | matrix-assisted laser desorption/ionization |
| MDM2 | mouse double minute 2 homolog |
| Mes or MES | 2-(*N*-morpholino)ethanesulfonic acid |
| Mops or MOPS | 3-(*N*-morpholino)propanesulfonic acid |
| MRI | magnetic resonance imaging |
| mRNA | messenger RNA |
| MS | mass spectrometry/spectroscopy |
| mTOR | mechanistic/mammalian target of rapamycin |
| Na,K-ATPase | sodium-potassium pump |
| NAD, NAD+, NADH | nicotinamide-adenine dinucleotide and its oxidized and reduced forms |
| NADP, NADP+, NADPH | nicotinamide-adenine dinucleotide phosphate and its oxidized and reduced forms |
| NF-κB | nuclear factor κ-light-chain-enhancer of activated B cells |
| NMR | nuclear magnetic resonance |
| NOE | nuclear Overhauser effect/enhancement |
| NOESY | nuclear Overhauser effect/enhancement spectroscopy |
| N-terminal | amino-terminal |
| NMP, NTP, NDP | nucleoside 5'-mono-, di-, and triphosphates |
| *O*-GlcNAcylation | *O*-linked attachment of *N*-acetylglucosamine to proteins |
| ORF | open reading frame |
| PAGE | polyacrylamide gel electrophoresis |
| PBS | phosphate-buffered saline |
| PCR | polymerase chain reaction |
| PDZ | contraction of post-synaptic density protein 95, Drosophila disc large tumor suppressor, and zonula occludens-1, e.g., PDZ domain |
| PEG | polyethylene glycol |
| PET | positron-emission tomography |
| Pi | inorganic phosphate |
| Pipes or PIPES | piperazine-*N*-*N*'-bis(2-ethanesulfonic acid) |
| pKa | the logarithm of the acid dissociation constant |
| Poly(dG)Poly(dC), etc. | single-stranded DNA composed of polydeoxyguanylate, polydeoxycytidylate, etc. |
| Poly[d(A-T)], etc. | double-stranded DNA composed of polydeoxyadenylate and polydeoxythymidylate, etc. |
| PPi | inorganic pyrophosphate |
| RNA | ribonucleic acid |
| RNAi | RNA interference |
| RNA-Seq | RNA sequencing |
| RNase | ribonuclease |
| rRNA | ribosomal RNA |
| RT-PCR | reverse-transcription polymerase chain reaction |
| SAH/AdoHcy | S-adenosylhomocysteine |
| SAM/AdoMet | S-adenosylmethionine |
| SDS | sodium dodecyl sulfate |
| siRNA | small interfering RNA |
| SNP | single-nucleotide polymorphism |
| TCA | trichloroacetic acid |
| TFA | trifluoroacetic acid |
| THF | tetrahydrofuran |
| TLC | thin-layer chromatography |
| TMP, TDP, TTP | ribosylthymine 5'-mono, di-, and triphosphates |
| TMS | trimethylsilyl |
| TOF | time-of-flight |
| Tris | tris(hydroxymethyl)aminomethane |
| tRNA | transfer RNA |
| *t*1/2 | half-life |
| UDP-galactose | uridine 5'-diphosphate-galactose |
| UDP-glucose | uridine 5'-diphosphate-glucose |
| UMP, UDP, UTP | uridine 5'-mono, di-, and triphosphates |
| UTR | untranslated region |
| UV | ultraviolet |
| *V*max | maximum velocity |
| WT | wildtype |

# Units

These abbreviations may be used without definition. They are not followed by periods. The same form is used in the plural.

JBC recommends the use of [The International System of Units (SI)](https://www.nist.gov/sites/default/files/documents/2016/12/07/sp330.pdf) (Taylor, B.N. and Thompson, A., Editors, NIST Special Publication 330; see also the IUPAC Manual of Symbols and Terminology for Physicochemical Quantities and Units (1979) Pergamon Press and the Recommendations of the Interunion Commission on Biothermodynamics ([(1976) J. Biol. Chem. 251, 6879-6886](https://www.jbc.org/content/251/22/6879)).). However, it will continue to accept certain units as listed here (e.g. Ångstrom, calorie, minute) even though they are not part of the SI. Note that wavelength should be expressed in nanometers or Ångstroms.

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| **Prefixes** | | | | | |
| **Multiplier** | **Prefix** | **Symbol** | **Multiplier** | **Prefix** | **Symbol** |
| 10-1 | deci | d | 10 | deca | da |
| 10-2 | centi | c | 102 | hecto | h |
| 10-3 | milli | m | 103 | kilo | k |
| 10-6 | micro | µ | 106 | mega | M |
| 10-9 | nano | n | 109 | giga | G |
| 10-12 | pico | p | 1012 | tera | T |
| 10-15 | femto | f | 1015 | peta | P |
| 10-18 | atto | a | 1018 | exa | E |

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| **Units** | |
| mole | mol |
| molar (moles/liter) | M |
| meter | m |
| Ångstrom (0.1 nm) | Å |
| base pair | bp |
| square centimeter | cm2 |
| cubic centimeter | cm3 |
| volume per volume | v/v |
| weight per volume | w/v |
| disintegration per minute | dpm |
| becquerel[a](https://www.jbc.org/site/misc/itoa.TI.xhtml#a) | Bq |
| curie | Ci |
| dalton | Da |
| gram[b](https://www.jbc.org/site/misc/itoa.TI.xhtml#b) | g |
| mass-to-charge ratio | m/z |
| isoelectric point | pI |
| equivalent | eq |
| second | s |
| minute | min |
| hour | h |
| counts per minute | cpm |
| revolutions per minute | rpm |
| cycles per second (hertz) | Hz |
| colony-forming units | cfu |
| plaque-forming units | pfu |
| degree centigrade or Celsius | °C |
| degree absolute (kelvin) | K |
| calorie | cal |
| kilocalorie | kcal |
| joule | J |
| gauss | G |
| ampere | A |
| volt | V |
| Svedberg (10-13 s) | S |

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| **Physical and chemical quantities** | |
| absorbance | A |
| equilibrium constant | K |
| relative molecular mass[c](https://www.jbc.org/site/misc/itoa.TI.xhtml#c) | Mr |
| retardation factor | Rf |
| acceleration of gravity | g |
| specific rotation | [α]t |
| sedimentation coefficient | s |
| sedimentation coefficient in water at 20 °C | s20,°w |
| extrapolated to zero concentration diffusion coefficient | D |
| the logarithm of the reciprocal of the hydrogen ion activity in a solution | pH |

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| **Thermodynamic terms** | |
| Gibbs energy change | ΔG |
| entropy change | ΔS |
| enthalpy change | ΔH |

## Footnotes

a 1 becquerel = 1 disintegration per second or 60 dpm. 1 Ci = 3.7 x 1010 Bq. Note becquerel is the preferred term in [The International System of Units (SI)](https://www.nist.gov/sites/default/files/documents/2016/12/07/sp330.pdf).

b Weight concentrations should be given as g/ml, g/100 ml, etc.

c Molecular mass is expressed in daltons (Da); one dalton is 1/12 of the mass of carbon-12. Relative molecular mass (Mr) is the ratio of the mass of a molecule to 1/12 of the mass of carbon-12 and is dimensionless. Hence, it is not correct to express Mr in daltons.