

Preface

The field of genetics continues its remarkable advance into the 21st century with major scientific and technological breakthroughs. To reflect these developments, new terms have been added to this 8th edition of *A Dictionary of Genetics*, existing entries have been modified, and supplementary information has been updated. The revision of the *Dictionary* has been extensive, involving over 1300 new or modified entries. Of these, 540 are either new definitions or completely rewritten previous ones, substantially detailed and with illuminating examples. More than 480 additional definitions have been updated with smaller-scale changes. Furthermore, the six appendices have been brought completely up to date with thousands of modifications. The following are some examples:

- Some of the major advances in the past decade concern the study of whole genomes. Entire genomes can now be sequenced with unprecedented speed and reliability, and it is possible to identify genomic features as well as differences and similarities between genomes in the minutest detail. Among the current definitions pertaining to this area are *genome*, *genome sequence*, *genomics*, *functional genomics*, *comparative genomics*, and *structural genomics*. The overwhelming amounts of data produced by genome sequencing projects are often displayed in genome maps. Definitions in this edition will help the reader distinguish between the various types of maps (e.g., a *contig map*, a *restriction map*, a *gene map*, or a *sequence map*), how these maps are derived, how they are used in genetic and biomedical research, and how one can access them online. Other related terms, such as *genetic marker*, *map unit*, and *map distance* have also been updated.
- Another area of focus in this 8th edition is genomic variation among individuals of a population, a subject of extensive research in recent years. There are numerous new or revised definitions related to this, including *copy number variation*, *genetic polymorphism*, and *DNA polymorphism* and its various forms (e.g., *variable-number tandem repeats*, *restriction fragment length polymorphism*, and *single nucleotide polymorphism*). There are also entries for the *International HapMap Project* (established to identify DNA sequence variation in different human populations), *haplotype*, and *haplotype map* (*HapMap*). Supplementary information in the definitions greatly broadens the scope of the information, revealing for example, how DNA polymorphisms are now used as

powerful new tools in genetic mapping and in evolutionary, population, and medical research.

- Users of this edition will also find new definitions related to noncoding RNAs, now known to be pervasive in many organisms and to play an integral role in a number of cellular processes. The last edition of the *Dictionary* defined many classes of such RNAs. New to this edition include definitions for *noncoding RNAs*, *large intergenic noncoding RNAs*, *Piwi-associated RNAs*, *functional RNA*, *regulator RNA*, *structural RNA*, *transcripts of unknown function*, *noncoding DNA*, and *noncoding gene*. Greater recognition of the noncoding regions of the genome also necessitated revision of the term *junk DNA*.
- Among the major breakthroughs of recent years has been our ability to “reprogram” differentiated cells so that they behave like embryonic stem cells. Related to this are new definitions for *induced pluripotent stem cells*, *nuclear reprogramming*, *somatic cell nuclear transfer*, *cell plasticity*, and *cell fate*. Detailed descriptions in the definitions provide insights into the significance of advancements in this area of research.
- Evolutionary and population genetics continue to feature prominently in this edition, and current definitions of terms such as *hybrid sterility*, *population bottleneck*, *speciation gene*, and *selective sweep* are included.
- Also added to this edition are current definitions for many genetic disorders (e.g., *dyskeratosis congenita*, *Charcot-Marie-Tooth disease*, and *Rett syndrome*), organisms and viruses of genetic interest (e.g., *Acanthamoeba*, *Taeniopygia guttata*, and *lentivirus*), laboratory techniques (e.g., *chromosome painting*, *reproductive cloning*, and *somatic cell hybridization*), and many new illustrations and tables.
- Finally, there have been innumerable changes in the six appendices, which comprise nearly 20% of the *Dictionary* and provide a wealth of useful supplementary resource material. Since the publication of the 7th edition, eight of the Nobel Prizes awarded in Medicine or Chemistry were directly related to the field of genetics. These and the landmark publications upon which these awards were based have been added to Appendix C. Appendix F, which shows genome sizes and gene numbers in selected viruses, organelles, and organisms has been revised, and the remaining appendices contain completely updated lists of periodicals and internet sites of genetic importance.

Whenever possible, the definitions are cross-referenced to one or more of the appendices (see below) as well as to one another, thereby providing supplementary information which complements that in a given definition and broadens the reader's perspective on a particular term or concept.

The Appendices

Appendix A, Classification, provides an evolutionary classification of the five kingdoms of living organisms. This list contains more than 400 words in parentheses, many of which are common names for easy identification (e.g., cellular slime mold, marine worms, and ginkgoes). The italicized words in parentheses are genera, including those of species notable for their economic importance (e.g., *Bos*, *Gossypium*, and *Oryza*), for causing human diseases (e.g., *Plasmodium*, *Staphylococcus*, and *Trypanosoma*), or for being useful laboratory organisms (e.g., *Arabidopsis*, *Neurospora*, and *Drosophila*).

Appendix B, Domesticated Species, lists the common and scientific names of approximately 200 domesticated animal and plant species not found elsewhere in the Dictionary.

Appendix C, Chronology, provides the historical framework within which genetics has flourished, spanning the period from 1590 to the present. Entries in this appendix include:

- Major discoveries or achievements that have advanced the field of genetics (e.g., 1856–66, Mendel's discovery of the existence of hereditary factors; 1989, the identification of the cystic fibrosis gene; 2006, the creation of induced pluripotent stem cells).
- Technological advances and techniques that have revolutionized genetic research (e.g., 1975, the development of Southern blotting; 1986, the production of the first automated DNA sequencer; 1994, the expression of green fluorescent protein in living cells).
- Sequencing and analysis of genomes of genetic, medical, or evolutionary importance (e.g., 1995, the first free-living organism, *Haemophilus influenzae*; 2003, *Homo sapiens*; 2010, *Neanderthal*).
- Breakthroughs in evolutionary genetics (e.g., 1868, Huxley's description of *Archaeopteryx*; 1977 the discovery of the Archaea; 2004, the proposal that viruses evolved from a common ancestor prior to the formation of the three domains of life), and publication of books with profound effects on evolutionary thought (e.g., 1959, C. Darwin's *On the Origin of Species*; 1963, E. Mayr's *Animal Species and Evolution*; 1981, L. Margulis' *Symbiosis in Cell Evolution*).
- Nobel Prizes for discoveries that have contributed to the progress of genetics (e.g., 1965, to F. Jacob, J. Monod, and A. Lwoff for their contributions to microbial genetics; 1983, to Barbara McClintock for her discovery of mobile genetic elements in maize; 2009, to Elizabeth H. Blackburn, Carol W. Greider, and J. W. Szostak for their work on telomeres and telomerase).

The Chronology in Appendix C is followed by an alphabetical List of Scientists who are cited in this appendix, together with the dates of these citations. This appendix also includes a Bibliography of more than 170 titles.

Appendix D, Periodicals, lists the titles and addresses of over 500 periodicals related to genetics, cell biology, and evolutionary studies, from *Acta Virologica* to *Zygote*.

Appendix E, Internet Sites, contains approximately 150 prominent web-site addresses to facilitate access to the wealth of information in the public domain. These include addresses for the following:

- Master websites (e.g., J. Craig Venter Institute, National Center for Biotechnology Information (NCBI), and Virtual Library on Genetics).
- Individual databases (e.g., Mendelian Inheritance in Man: OMIM, Protein Data Bank (PDB), and Single Nucleotide Polymorphisms (SNPs)).
- Species websites (e.g., *Arabidopsis thaliana*, *Caenorhabditis elegans*, and *Danio rerio*).

Appendix F, Genome Sizes and Gene Numbers, tabulates the genome sizes and gene numbers in selected viruses, organelles, and organisms representing all five kingdoms.

The Arrangement of Entries

As in the previous edition, the arrangement of entries in the current edition follows the following rules:

- Each definition is placed in alphabetical order using the bold face title letter by letter, while ignoring spaces between words. Thus, *Homo sapiens* is placed between *homopolymer tails* and *homosequential species*.
- In the case of identical alphabetical listings, lowercase letters precede uppercase letters. Thus, the *p* entry is found before the *P* entry.
- In entries beginning with a Greek letter, the letter is spelled out. Therefore, β *galactosidase* appears as *beta galactosidase*.
- When a number is found at the beginning of an entry, the number is ignored in the alphabetical placement. Therefore, *M5 technique* is treated as *M technique*. However, numbers are used to determine the order in the series. For example, *P1 phage* appears before *P22 phage*.
- For two- or three-word terms, the definition sometimes appears under the second or third word, rather than the first. For example, definitions for *embryonic stem cells* and *germ line transformation* occur under *stem cells* and *transformation*, respectively.