

***PRINCIPLES
OF
GENETICS***

SECOND EDITION

Irwin H. Herskowitz

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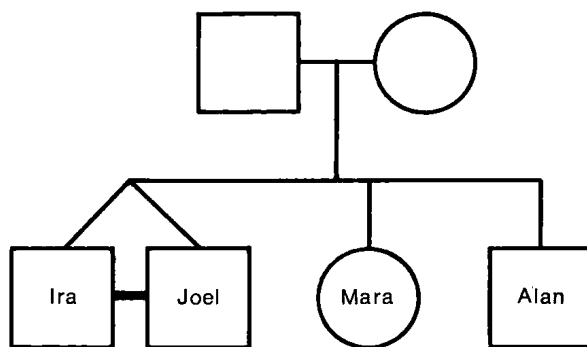
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To Our F₁



Preface

The First Edition

Most first courses in college biology provide a reasonably good introduction to genetics. Accordingly, students starting their first course in college genetics not only have some background in the origins and early advances in genetics, but also have some knowledge of the recent progress made through biochemical and microbial studies. Because of this prior exposure, the students also come to the course with enthusiasm and interest. It is feasible, therefore, to approach the subject in a highly structured manner.

This book aims to elucidate the principles of genetics, many of which were recently discovered in molecular and microbial studies. Since principles are dealt with rather than history, no distinction is made between "classical" and "modern" genetics, and the presentation aims to be logical rather than chronological. The few names in the text—Watson, Crick, Mendel, Hardy, and Weinberg—are there simply because they are uniquely important, widely known, and commonly used.

After a brief introduction, each chapter contains a series of numbered conclusions or postulates, each of which is then proved, supported, or discussed. Each chapter ends with a summary, references, and questions and problems. The literature cited includes general references to the subject matter of the entire chapter followed by references to specific numbered sections. The references that were selected provide an entry into the current literature, give a more general presentation of the subject matter, or represent key papers in the discovery of major principles. Photographs of certain geneticists are included for the sake of personalizing the largely impersonal presentation.

The essential subject matter in each chapter can be covered, on the average, in one lecture period. Accordingly, the main contents of the text can be covered in the usual three-credit single-semester college course for undergraduates. A considerable amount of optional material, which contains no terms, facts, diagrams, or concepts needed to understand the remainder of the text, is included also. This optional information is restricted to (1) footnotes to the main text, (2) supplementary sections placed after the references of various chapters, and (3) a biometrical appendix. The amount of optional material used will depend upon the time available and the preparation and interests of the students and teachers.

The Second Edition

Although this edition retains the format of the first edition, several important changes have been made. Significant developments in genetics during the last four years have been incorporated. The text has been rewritten almost completely to increase the clarity of the presentation; some nonessential material, particularly in

chemistry, has been eliminated, and some less essential information has been shifted from the main portion of the text to the optional supplementary sections. I have added many illustrations, a new chapter on the applications and implications of genetics, a glossary, and the answers to most questions and problems. These answers are based upon those kindly provided by Dr. James L. Farmer. There are now 30 chapters ; the main points of each can be covered in one or two lecture periods.

I wish to thank my students and several reviewers and colleagues, including Dr. C. Ceccarini and Dr. Ira Herskowitz, for their helpful comments about several chapters, and Ms. Janet Guthrie for her help with the style. Special thanks are due Dr. James L. Farmer, who critically reviewed the entire manuscript and made innumerable helpful suggestions. Any errors that remain are, of course, solely my responsibility. Finally, I again wish to thank my wife, Reida Postrel Herskowitz, for preparing the typescript.

I. H. H.

Symbols and Abbreviations

ADP	adenosine 5'-diphosphate	His	histidine
Ala	alanine	I	inosine
Alanine tRNA or tRNA^{Ala}, etc.	the "uncharged" transfer RNA molecule that normally accepts alanine, etc.	Ile	isoleucine
Alanyl-tRNA^{Ala} or Ala-tRNA^{Ala}	the same, "charged," with alanyl residue covalently linked.	Leu	leucine
Aminoacyl-tRNA	"charged" tRNA (tRNA carrying aminoacyl residues)	Lys	lysine
AMP	adenosine 5'-phosphate	Met	methionine
Arg	arginine	mRNA	messenger RNA
Asp	aspartic acid	NAD	nicotinamide-adenine dinucleotide (diphosphopyridine nucleotide)
Asn	asparagine	P	phosphate
ATP	adenosine 5'-triphosphate	P_i	inorganic orthophosphate
CDP	cytidine 5'-diphosphate	Phe	Phenylalanine
CMP	cytidine 5'-phosphate	poly N	polymer of ribonucleotides containing N
CTP	cytidine 5'-triphosphate	poly dN	polymer of deoxyribonucleotides containing dN
Cys	cysteine	poly (N-N')	copolymer of ribonucleotides with N-N'-N-N'- in regular, alternating, <i>known</i> sequence
d	deoxy	poly (dN-dN')	copolymer of deoxyribonucleotides with dN-dN'- dN-dN'- in regular, alternating, <i>known</i> sequence
DNA	deoxyribonucleic acid	poly (N, N')	copolymer of ribonucleotides with N and N' in <i>random</i> sequence
DNase	deoxyribonuclease	poly (A) · poly (B) or poly (A) · (B)	two chains, generally or completely associated
DPN	diphosphopyridine nucleotide	PP_i	inorganic pyrophosphate
fMet	formylmethionine	Pro	proline
Gal	galactose	RNA	ribonucleic acid
GDP	guanosine 5'-diphosphate	RNase	ribonuclease
Glu	glutamic acid		
Gln	glutamine		
Gly	glycine		
GMP	guanosine 5'-phosphate		
GTP	guanosine 5'-triphosphate		
Hb	hemoglobin		

¹ Taken from "Abbreviations and Symbols for Chemical Names of Special Interest in Biological Chemistry" of the IUPAC-IUB Combined Commission on Biochemical Nomenclature, published in the Journal of Biological Chemistry, 241: 527 (1966), Biochimica et Biophysica Acta, 108: 1 (1965), and in Biochemistry, 5: 1445 (1966).

rRNA	ribosomal RNA	Trp	tryptophan
Ser	serine	Tyr	tyrosine
Thr	threonine	UDP	uridine 5'-diphosphate
tRNA	"uncharged" transfer RNA (RNA that accepts and transfers amino acids; amino acid-accepting RNA); see also entries following Ala	UMP	uridine 5'-phosphate
		UTP	uridine 5'-triphosphate
		Val	valine

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