



教育部高等教育司推荐
国外优秀生命科学教学用书

Essentials of Genetics

遗传学基础

影印版

Fourth Edition

• William S. Klug

• Michael R. Cummings



高等教育出版社

Higher Education Press



Pearson Education

出版集团



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Fourth Edition

影印版

William S. Klug
The College of New Jersey

Michael R. Cummings
University of Illinois at Chicago

江苏工业学院图书馆
藏书章



高等教育出版社
Higher Education Press



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出版集团

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Essentials of Genetics, 4th ed.

By William S. Klug and Michael R. Cummings

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William S. Klug, Michael R. Cummings

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出版前言

随着克隆羊的问世和人类基因组计划的完成,生命科学成为 21 世纪名副其实的领头学科,生物高新技术产业逐步成为高科技产业的核心。生物技术和生物产业的发展对世界科技、经济、政治和社会发展等方面产生着深刻的影响,这也是我国赶超世界发达国家生产力水平最有前途和希望的领域。生命科学与技术全方位的发展呼唤高等教育培养更多高水平的复合型科技人才。

为此,教育部在《关于加强高等学校本科教学工作 提高教学质量的若干意见》[教高(2001)4 号文件]中提出,高等学校要大力提倡编写、引进和使用先进教材,其中信息科学、生命科学等发展迅速、国际通用性强、可比性强的学科和专业可以直接引进先进的、能反映学科发展前沿的原版教材。教育部高等教育司还于 2001 年 11 月向全国主要大学和出版社下发了“关于开展‘国外生命科学类优秀教学用书’推荐工作的通知”,有力推动了生命科学类教材的引进工作。

高等教育出版社对国外生命科学教材进行了充分的调研,并委托教育部高等学校生物科学与工程教学指导委员会的专家教授开展了“引进国外优秀生命科学教材及其教学辅助材料专项研究”,并就国内外同类教材进行了比较,提出了具体的引进教材书目。经过版权谈判,目前我社已经购买了 Pearson Education, McGraw-Hill, John Wiley & Sons, Blackwell Science, Thomson Learning, Cambridge University Press, Lippincott Williams & Wilkins 等出版的 13 种教材的影印权,学科领域涉及生物化学、细胞生物学、遗传学、微生物学、生态学、免疫学、神经科学、发育生物学、解剖学与生理学、分子生物学、普通生物学等。这些教材具有以下特点:(1)所选教材基本是近 2 年出版的,及时反映了学科发展的最新进展,在国际上使用广泛,具有权威性和时代感;(2)内容简明,篇幅适中,结构合理,兼具一定的深度和广度,适用范围广;(3)插图精美、丰富,既有很强的艺术性,又不失严谨的科学性,图文并茂,与正文相辅相成;(4)语言简练、流畅,十分适合非英语国家的学生阅读。其中 9 种已入选教育部高等教育司推荐“国外优秀生命科学教学用书”。

考虑到中国国情,为了让学生买得起,同时又能让学生看到原版书彩色精美的插图,我们在引进学生用原版教材时,一方面采用黑白影印,最大限度地降低定价,另一方面随书附赠含有原书彩色插图的光盘,以充分体现原教材的风格、特色,为读者提供方便。

引进国外优秀生命科学教学用书是我社一项长期的重点工作,因此,我们衷心希望广大专家教授和同学提出宝贵的意见和建议,如有更好的教材值得引进,请与高等教育出版社生命科学分社联系,联系电话:010-68344002, E-mail 地址: lifesciences-hep@x263.net。

高等教育出版社

2002 年 11 月

国外优秀生命科学教学用书
(影印教材)

<i>Biochemistry</i> (2nd ed.)	生物化学
<i>Cell and Molecular Biology</i> (3rd ed.)	分子细胞生物学
<i>Essentials of Genetics</i> (4th ed.)	遗传学基础
<i>Microbiology</i> (5th ed.)	微生物学
<i>Ecology: concepts and applications</i> (2nd ed.)	生态学
<i>Roitt's Essential Immunology</i> (10th ed.)	Roitt 免疫学基础
<i>Neuroscience: Exploring the Brain</i> (2nd ed.)	神经科学
<i>Essential Developmental Biology</i>	发育生物学基础
<i>Understanding Human Anatomy and Physiology</i> (4th ed.)	人体解剖生理学
<i>Gene Cloning and DNA Analysis</i> (4th ed.)	基因克隆和 DNA 分析
<i>Principles of Gene Manipulation</i> (6th ed.)	基因操作原理
<i>An Introduction to Genetic Engineering</i> (2nd ed.)	遗传工程导论
<i>Essential Biology</i>	生物学导论

Dedication

The appearance of this edition marks the tenth version of the textbooks *Essentials of Genetics* and *Concepts of Genetics*. The continued success of these books is due in no small part to the creative thinking and many diverse efforts of our various editors over the past 20 years.

They have provided leadership, good judgment, lots of patience, and many pleasant interactions. Collectively, they had to find us, guide us, and occasionally steer us through difficult times. Even after several of them have, for one reason or another, become separated from the project, they have remained supportive and continued as our colleagues and friends. It is to this group of highly talented individuals that we dedicate this book.

In particular, we thank Bob Lakemacher, Bob Rogers, Sheri Snavely, and Gary Carlson for their guidance and encouragement during the development and production of these texts.

We are indeed fortunate to have encountered each of you when we did, and we are grateful for the role that you have played during the evolution of these textbooks.

Steve Klug and Mike Cummings

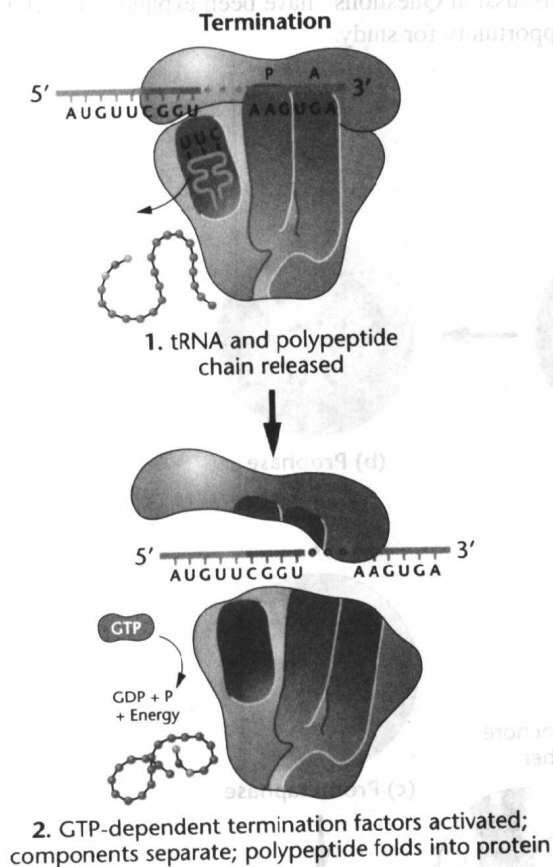
About the Authors

William S. Klug is currently Professor of Biology at The College of New Jersey (formerly Trenton State College) in Ewing, New Jersey. He served as Chairman of the Biology Department for 17 years, a position to which he was first elected in 1974. He received his B.A. degree in Biology from Wabash College in Crawfordsville, Indiana and his Ph.D. from Northwestern University in Evanston, Illinois. Prior to coming to Trenton State College, he returned to Wabash College as an Assistant Professor, where he first taught genetics as well as general biology and electron microscopy. His research interests have involved ultrastructural and molecular genetic studies of oogenesis in *Drosophila*. He has taught the genetics course as well as the senior capstone seminar course in human and molecular genetics to undergraduate Biology majors for each of the last 32 years.

Michael R. Cummings is currently Associate Professor in the Department of Biological Sciences and in the Department of Molecular Genetics at the University of Illinois at Chicago. He has also served on the faculty at Northwestern University and Florida State University. He received his B.A. from St. Mary's College in Winona, Minnesota, and his M.S. and Ph.D. from Northwestern University in Evanston, Illinois. He has also written textbooks in human genetics and general biology for non-majors. His research interests center on the molecular organization and physical mapping of human acrocentric chromosomes. At the undergraduate level, he teaches courses in Mendelian genetics, human genetics, and general biology for non-majors. He has received numerous teaching awards given by the university and by student organizations.

Preface

Essentials of Genetics is written for courses requiring a text that is shorter and more basic than its more comprehensive companion, *Concepts of Genetics*. While coverage is thorough, current, and of high quality, *Essentials* is written to be more accessible to biology majors early in their undergraduate careers, as well as by a mixture of students majoring in agriculture, forestry, wildlife management, chemistry, psychology, and so on. Because the text is shorter than many other books, *Essentials of Genetics* will be more manageable in one-quarter and one-semester courses.



Goals

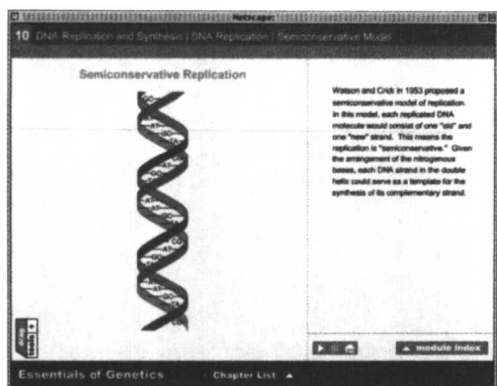
Although *Essentials of Genetics* is almost 300 pages shorter than its companion volume, our goals are the same for both books. Specifically, we seek to

- Emphasize concepts rather than excessive detail
- Write clearly and directly to students in order to provide understandable explanations of complex, analytical topics
- Establish a careful organization within and between chapters
- Maintain constant emphasis on scientific analysis as the means to illustrate how we know what we know
- Propagate the rich history of genetics that so beautifully illustrates how information is acquired and extended within the discipline as it develops and grows
- Create inviting, engaging, and pedagogically useful full-color figures enhanced by equally helpful photographs to support concept development

These goals serve as the cornerstones of *Essentials of Genetics*. This pedagogic foundation allows the book to accommodate courses with many different approaches and lecture formats. Chapters are written to be as independent of one another as possible, allowing instructors to utilize them in various sequences. We believe that the varied approaches embodied in these goals work together to provide students with optimal support for their study of genetics.

Features of the Fourth Edition

- Online Media Tutorials—Students are guided in their understanding of important concepts by working through what are simply the best animations, tutorial exercises, and self-assessment tools available.
- Length—Once again we have managed to streamline the text. This new *Essentials* is 508 pages, 7 pages shorter than the previous edition.
- Revised Organization—We provide an improved chapter sequence designed to flow smoothly from start to finish, including an early (the first chapter) introduction to DNA as well as a cohesive sequence of chapters centering on the genetic role of DNA, its structure, replication, expression, and regulation.
- New Chapters—Sex Determination and Sex Chromosomes combines new information with parts of chapters from the previous edition; Genomics and Proteomics is a totally new chapter that gives students concepts and tools necessary to understand the information explosion occurring in these fields. The chapter entitled Conservation Genetics represents the first coverage of this emerging discipline in any genetics textbook.

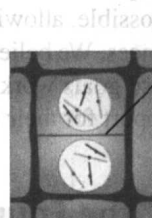


- **Redesign of the Art Program**—The pedagogic value, to say nothing of the beautiful execution, of the new art program will be readily apparent to users of the previous edition.
- **Section Numbers**—All sections are numbered making it easier to assign topics and for students to find topics within chapters
- **New Photographs**—An even greater number of photographs illustrate and enhance this edition.
- **Emerging Topics in Genetics**—Coverage of cutting edge topics includes comparative genomics, which analyzes the recently sequenced genomes of a number of organisms, in-

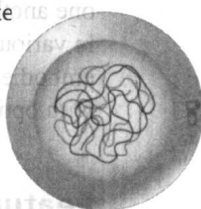
cluding our own species (Chapter 18); proteomics, which attempts to define the potential role of the genes discovered during the Human Genome Project (Chapter 18); and conservation genetics, which assesses and attempts to maintain genetic diversity in the many endangered species on our planet (Chapter 24).

- **Modernization of Topics**—In addition to the areas considered in the section above on emerging topics, modernization is particularly evident in the discussions of recombinant DNA technology (Chapter 16), the organization of repetitive DNA sequences in the human genome (Chapter 17), the role of genetics in the origin of cancer (Chapter 21), and the analysis of HIV infection and resistance in population genetic studies (Chapter 22).
- **New “Genetics, Technology, and Society” Essays**—New topics include “Genetically Modified Foods,” “DNA at the Millennium,” “Completion of the Human Genome Project: The Hype and the Hope,” and “Endangered Species: The Florida Panther.”
- **Emphasis on Problem Solving**—“Insights and Solutions” sections at the ends of chapters guide students in how to think analytically about problems. “Problems and Discussion Questions” have been expanded to offer more opportunity for study.

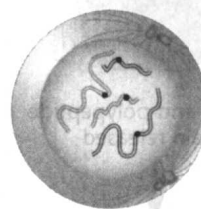
MITOSIS



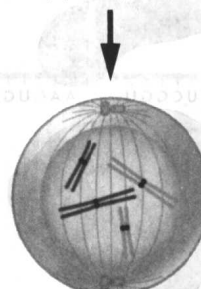
(g) Plant cell telophase



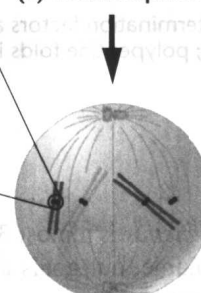
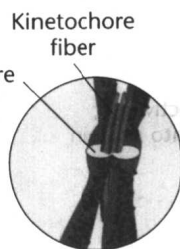
(a) Interphase



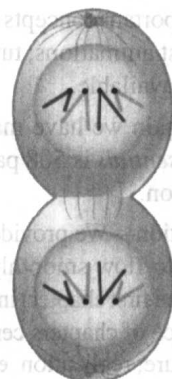
(b) Prophase



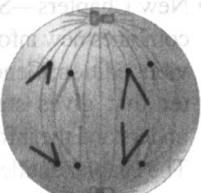
(c) Prometaphase



(d) Metaphase



(e) Anaphase



(f) Telophase

Emphasis on Concepts

As in its companion volume, *Essentials of Genetics* continues to emphasize the conceptual framework of genetics. Our experience with this approach shows that students more easily comprehend and take with them to succeeding courses the most important ideas in genetics as well as an analytic view of biological problems. To aid students in identifying conceptual aspects of a major topic, each chapter begins with a section called "Chapter Concepts," which in a few sentences captures the essence of the most important ideas about to be presented. Then, each chapter ends with a "Chapter Summary," which enumerates the five to ten key points that have been covered. These two features help to ensure that students focus on concepts and are not distracted by the many, albeit important, details of genetics. Specific examples and carefully designed figures support this approach throughout the book.

Insights and Solutions

Genetics, more than any other discipline within biology, requires problem solving and analytical thinking. At the end of each chapter we include what has become an extremely popular and successful section called "Insights and Solutions."

In this section we stress:

- Problem solving
- Quantitative analysis
- Analytical thinking
- Experimental rationale

Problems or questions are posed and detailed solutions or answers are provided. This feature primes students for moving on to the "Problems and Discussion Questions" section that concludes each chapter.

Problems and Discussion Questions

In order to optimize the opportunities for student growth in the important areas of problem solving and analytical thinking, each chapter concludes with an extensive collection of problems and discussion questions. These represent various levels of difficulty, with the most challenging problems located at the end of each section. Brief answers to half the problems are in Appendix A. The Student Handbook is available to students for faculty who wish to expose their students to detailed answers to all problems and questions.

Acknowledgments

All comprehensive texts are dependent on the valuable input provided by many reviewers and colleagues. While we take full responsibility for any errors in this book, we gratefully acknowledge the help provided by those individuals who reviewed or otherwise contributed to the content and pedagogy of this and previous editions.

In particular, we thank Sarah Ward at Colorado State University for creating Chapter 24—Conservation Genetics and Jon Herron at the University of Washington for his input into Chapter 22—Population Genetics and Chapter 23—Genetics and Evolution. As in past editions, Charlotte Spencer at the Cross Cancer Institute in Alberta wrote or revised most of the Genetics, Technology, and Society essays. Others essays were previously contributed by Mark Shotwell at Slippery Rock University.

Robert W. Adkinson, Louisiana State University
 Janice Bossart, The College of New Jersey
 Paul Bottino, University of Maryland
 Jim Bricker, The College of New Jersey
 Hugh Britten, University of South Dakota
 Aaron Cassill, University of Texas, San Antonio
 Jimmy D. Clark, University of Kentucky
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 Malcolm Schug, University of North Carolina, Greensboro
 Ralph Seelke, University of Wisconsin, Superior
 Gurel S. Sidhu, California State University
 Gerald Schlink, Missouri Southern State College
 Randy Scholl, Ohio State University
 Mark Sturtevant, Northern Arizona University
 Christine Tachibana, University of Washington
 R. C. Woodruff, Bowling Green State University
 Marie Wooten, Auburn University

For the Student

Online Media Tutorials (New)

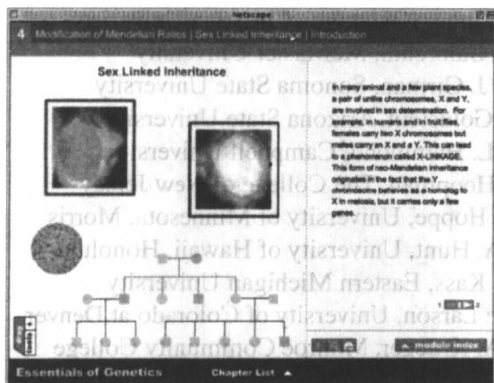
The most sophisticated learning and tutorial package available for students of genetics, this online tutorial support system addresses students' most difficult concepts as identified through a survey of instructors. Concepts and processes begin with an overview that usually includes animations, proceeds to one or a series of interactive exercises, followed by self

quizzes. Each chapter contains a glossary, help function, search function, web links to fascinating and useful web sites, plus additional problem-solving questions. Students who experience difficulty with exercises or quizzes will be directed to specific sections of the text for review. An online demonstration of these amazing tutorials can be found at http://csep10.phys.utk.edu/genetics_demo

Look for this icon to identify media tutorials in the book (placed vertically on the edge of the page):

The following topics are addressed in the interactive media tutorials:

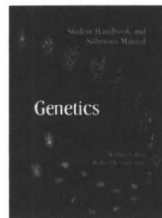
- Mitosis
- Meiosis
- Segregation
- Monohybrid Cross



- Independent Assortment
- Meiosis and Mendel
- Extensions of Mendelian Inheritance: codominance, incomplete dominance, multiple alleles, gene interaction
- Probability: simple probability, sum rule, product rule, binomial probability
- Sex-Linked Inheritance: X-linked, Y-linked
- Linkage and Recombination: linkage versus independent assortment
- Linked Genes: mapping linked genes, construction of linkage maps
- Mapping a Three-Point Cross: includes calculation of recombination frequency, interference
- Virtual Crossover Laboratory
- Chromosome Aberrations: overview, inversions, translocations, deletions, duplications
- Phage Genetics: life cycle (lytic, lysogenic) phage cross, phage complementation
- Bacterial Genetics: transformation, conjugation
- DNA Structure: helix, components (sugar, base, phosphate), nucleotides
- DNA Replication: components, bidirectional replication, fork formation

- DNA Recombination (steps, structures)
- Transcription: components, initiation, elongation, termination, genetic code, Prokaryotes versus eukaryotes
- Translation: initiation, elongation, termination, prokaryotes versus eukaryotes, summary: DNA to RNA to protein
- Regulation of Gene Expression: prokaryotes (lac operon)
- Regulation of Gene Expression: eukaryotes: transcriptional regulation, alternative splicing, translational, posttranslational control
- Mutation: gene/protein colinearity, effect on protein structure (hemoglobin)
- Mutation at the DNA Level: nucleotide substitution, frameshift mutations
- DNA Repair
- Recombinant DNA Technology: restriction enzymes, cloning in plasmid vector, selection
- PCR: mechanism, uses
- Restriction Fragment Length Polymorphisms: codominant trait, transmission, linkage to disease loci
- DNA Fingerprinting
- Chromatin, Chromosome Structure: nucleosomes, fibers, scaffolding, isochores
- Population Genetics: allele frequencies, Hardy-Weinberg, selection
- Analysis of Human Pedigrees: autosomal dominant, recessive, X-linked dominant, recessive, mitochondrial
- Nondisjunction: normal, meiosis I, meiosis II gamete formation, fertilization outcomes
- Chemical Mutagenesis, Ames Test
- Restriction Mapping

Student Handbook and Solutions Manual



Harry Nickla, Creighton University
(0-13-093338-4)

Completely reviewed and checked for accuracy, this valuable handbook provides a detailed step-by-step solution or extended discussion for every problem in the text in a chapter-by-chapter format. The handbook also contains extra study problems and a thorough review of concepts and vocabulary.

New York Times Themes of the Times: Genetics and Molecular Biology

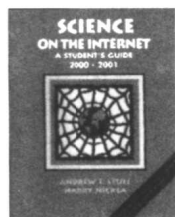


Coordinated by Harry Nickla, Creighton University
(0-13-060462-3)

This exciting newspaper-format supplement brings together recent genetics and molecular biology articles from the pages of the highly respected New York Times. This free supplement, available

through your local representative, encourages students to make the connections between genetic concepts and the latest research and breakthroughs in the field. This resource is updated regularly.

Science on the Internet: A Student's Guide

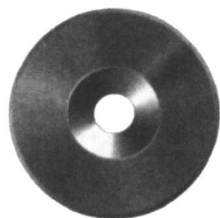


Andrew Stull and Harry Nickla
(0-13-028253-7)

The perfect guide to help your students take advantage of explosion of our *Essentials of Genetics* home page on the World Wide Web. This resource gives clear steps to access our regularly updated genetics resource area as well as an overview of general navigation and research strategies.

For the Instructor

Instructor's CD-ROM (0-13-065850-2)

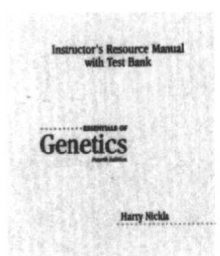


For *Essentials* adopters, this CD-ROM is partitioned into sections that contain

- Content from the website
- All figures from the text
- PowerPoint (TM) format for figures
- The complete Instructor's Manual

Instructors will be able to coordinate lectures presentations with text content knowing students will be studying using the same animations, based upon the text. No more searching for the Instructor's Manual—It's on the CD-ROM.

Instructor's Resource Manual with Testbank



This manual and test bank contains over 800 questions and problems an instructor can use to prepare exams. The manual also provides optional course sequences, a guide to audiovisual supplements, and a section on searching the web. The testbank portion of the manual is also available in electronic format for both Windows and

Macintosh users. Prentice Hall Custom Test allows instructors to create and tailor exams to their own needs. With the Online Testing option, exams can also be administered online and data can then be automatically transferred for evaluation. A comprehensive desk reference guide is included, along with online assistance.

Transparencies

200 figures from the text are included in the transparency package: 150 four-color transparencies from the text plus 50 transparency masters. The font size of the labels has been increased for easy viewing from the back of the classroom.

WebCT Course for Essentials of Genetics, 4th edition



The Prentice Hall WebCT course content for *Essentials* helps you meet the challenge of creating robust, interactive and educationally rich online courses. Our WebCT course material provides you with high quality, class-tested material pre-programmed and fully functional in the WebCT environment. Whether used as an online supplement to either a campus-based or distance learning course, our pre-assembled course content gives you a tremendous head start in developing your own online courses.

Blackboard Course for Essentials of Genetics, 4th edition



The *Essentials* Blackboard course contains web-based content and resources such as online study guides, assessment databanks, and lecture resource material. The abundant online content from *Essentials*, combined with Blackboard's popular tools and easy-to-use interface, result in a robust web-based course that is easy to implement, manage, and use—taking your courses to new heights in student interaction and learning. The Blackboard course management solution enable you to quickly add an online component to your campus-based course to provide you with a sophisticated technology base for total customization, scalability, and integration into your distance learning course.

CourseCompass Course for Essentials of Genetics, 4th edition



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