

Preface

Genomics Comes of Age

The transformation of genetics into genomics is finally happening.

Human Genetics: Concepts and Applications has evolved along with the field it covers. In the decade since the first edition was published, genetics has grown from a focus on the rarest of the rare to a field so familiar that the world watched Saddam Hussein have his DNA sampled shortly after his capture. In the first edition, the human genome project was little more than a footnote and table.

By the fourth edition, genomics had earned its own chapter. By the fifth edition, genomic explanations began to permeate the other chapters, as recognition of many genes increasingly explained the actions of single genes. In this new sixth edition, that trend continues, with genomic information seamlessly integrated with the basic concepts it explains:

- genetic testing of college roommates that has gone from fiction to fact over the editions (chapter 1, "Overview of Genetics")
- scrutinizing the genomes of healthy 100+-year-olds (chapter 3, "Development")
- how the chimp and human genomes differ (chapter 16, "Human Origins and Evolution")
- immunity from the point of view of the pathogen, courtesy of sequenced genomes (chapter 17, "Immunity")
- a new form of leukemia revealed through gene expression DNA microarray analysis (chapter 18, "Cancer")
- accounting for redundant gene function in planning gene therapies (chapter 20, "Gene Therapy and Genetic Counseling").

Audiences Enjoy a Unique Writing Style

From the beginning, the clarity, flavor, and immediacy of *Human Genetics: Concepts and Applications* has been uniquely interesting and accessible to non-scientist readers. Into the book flows my 25 years of experience as a journalist, 20 years as a genetic counselor, and my PhD background in genetics. As a frequent contributor to the magazine *The Scientist* for 15 years, I have had access to scientific meetings and researchers that are simply not available to the average professor-turned-textbook author. I speak regularly to the people in the labs and clinics, to patients, to family members and doctors, and combine their words with my own into articles. From my network of sources, I learn of new research results before they are published, thus avoiding the built-in obsolescence that is the bane of textbooks. *Human Genetics: Concepts and Applications* is and always has been ahead of its time—and that's vital for a scientific field that is racing ahead as fast as genetics/genomics.

My approach is straightforward: present the essential concepts in clear language, then demonstrate them with the very best, sometimes quirky, examples. Tables, illustrations, and pedagogical aids reinforce the main points. Consider chapter 15, "Changing Allele Frequencies," which covers the five ways that genes defy Hardy-Weinberg equilibrium. The cast of characters providing examples includes Genghis Khan, Bulgarian gypsies, a young physician helping Amish children, and the blind Pingelapese of Micronesia. The five mechanisms that form the chapter's core are all wrapped up in figure 15.10, which also summarizes Hardy-Weinberg equilibrium from the previous chapter. A student who masters this illustration will be well prepared for an exam—and more importantly, will understand the intimate relationship between genetics and evolution.

Instructional Art Program Provides Dynamic Examples

The art program is not only spectacular in appearance, but remarkably easy to follow. Often all a reader needs to do is follow the arrows. In this manner, figures 2.19 and 2.20 reduce two complex cellular processes—cell death and signal transduction—to their essentials, fostering instant understanding. Other illustrations provide a size perspective. Figure 9.12, for example, shows how DNA is condensed, and also how it winds into a chromosome, which fits into a nucleus inside a cell. Two photographs bring the illustration to life. Similarly, figure 4.10 depicts Mendel's second law at the level of genes, chromosomes, and peas, all at once—a perspective essential for understanding how gametes connect generations. Figure 14.7 is perhaps the best example of putting molecular information into a familiar context: A man lying in an alley has his DNA analyzed to establish the identities of victim and attacker.

Extraordinary Learning Aids Assist Students

Pedagogical aids ensure that students can identify the basic concepts presented and exemplified within each chapter. Chapters open with an **annotated outline** previewing the chapter contents. At the end of each major section, **key concepts** are summarized to reinforce important core material. **Chapter summaries** review the contents of the chapter, calling attention to important new vocabulary.

Each chapter ends with a great variety of **review questions** to measure content knowledge and **applied questions** to provide practice using that knowledge. Both sets of questions are written to engage students in understanding the mechanisms of

genetics and enable them to master content from a basic to a more advanced level. **Answers** to all questions are provided at the end of the book.

At the end of each chapter, a list of **suggested readings** provides further information and includes the sources used to write the chapter. Instructors can use these references to expand upon specific points, and students can use them to research papers and projects.

New Learning Aids

"Solving a Problem" sections present a step-by-step sample computation that leads to a genetic analysis and conclusion. This approach applies to the obvious—Mendel's laws, X-linked inheritance, and the Hardy-Weinberg equation—but also the not-so-obvious—such as comparing the "indels" (insertions and deletions) that distinguish the human from the chimp genome.

Case studies found after each chapter apply and sometimes extend concepts. These case studies supplement those in the *Case Workbook in Human Genetics* by Ricki Lewis. Relevant cases from the workbook are also listed for each chapter. New case studies include:

- a form of long-QT syndrome that causes excited children to collapse and die (chapter 5, "Extensions and Exceptions to Mendel's Laws")
- the Jukes family and inherited criminality (chapter 16, "Human Origins and Evolution")
- a woman who's ex-partner refuses to let her implant their frozen embryos (chapter 21, "Reproductive Technologies")
- a researcher who patented the use of what others once termed "junk" DNA to diagnose disease and is now charging licensing fees (chapter 22, "The Age of Genomics").

Web activities have been added for each chapter to encourage students to dig deeper. They provide an opportunity to find the newest genetic information and to use some of the latest tools and databases in genetic analysis. An appendix lists the reference

information for diseases mentioned in the text to the web resource **Online Mendelian Inheritance in Man**.

What's New in This Edition?

Like a genome, a textbook evolves. This sixth edition has undergone a few insertions, deletions, and rearrangements.

Emphasis on control of gene expression

- Chapter 10 has undergone binary fission: It now focuses on "Gene Action."
- Chapter 11 presents "Control of Gene Expression." This new chapter explores gene expression through time and tissue; chromatin remodeling via the histone code and RNA interference; and the enigma of a genome that devotes only 1.5 percent of its information to encoding proteins, and the fact that those proteins greatly outnumber the genes that specify them.
- The theme of gene expression continues in a practical sense in chapter 18, "The Genetics of Cancer." Figure 18.2 presents data that have saved lives—DNA microarrays that revealed why some people with a rare form of leukemia do not survive given standard treatments for the more common form; they have a different illness, apparent only at the level of gene expression.

Unparalleled coverage of stem cell biology

- To accompany chapter 2's ("Cells") clear descriptions, four illustrations progress from basic to applied views of stem cells. Unlike most textbook depictions, figures 2.22 and 2.23 show stem cells giving rise to other stem cells, as well as daughter cells that go on to yield differentiated cells. Figure 2.24 takes the reader through the steps of somatic cell nuclear transfer, and figure 2.25 looks at stem cells from adults to heal a young man's heart.
- The stem cell theme continues in figure 11.4, which depicts how differential gene expression guides development of the pancreas into a uniquely dual structure—from a single type of progenitor cell.

Classical genetic observations viewed from a genomic perspective

- Redundancy in gene function sheds new light on chapter 5's "Extensions and Exceptions to Mendel's Laws," a group of important topics ignored in some other books.
- In chapter 7, "Multifactorial Traits," eye color is no longer considered a simple blue or brown, but includes the specks and flecks, shading and intensity that arise from the landscape at the back of the eye, providing great variability. Figure 7.13 summarizes the gene-controlled hormonal interactions that regulate body weight, also a phenotype not as simple as we once thought.

Updated examples

- Chapter 15, "Changing Allele Frequencies," discusses the emerging infectious diseases SARS and West Nile virus illness. Discussion of the possible effect of long-ago cannibalism on resistance to prion diseases fleshes out the coverage of balancing selection.
- New topics in Chapter 16, "Human Origins and Evolution," include targeted comparative sequencing to track shared ancestries; the 160,000-year-old *H. sapiens idaltu*, who looked amazingly like us; and a consideration of the many clues pointing to a duplication of the entire human genome.
- Chapter 22, "The Age of Genomics," has translocated material to earlier chapters, and has deleted descriptions of techniques no longer used, yet it preserves the telling of the historic race to sequence the human genome. New topics include "\$1000 genome" sequencing technologies; the National Human Genome Research Institute's three-tiered architectural metaphor for the future of genomics; studies that focus on the healthy, rather than people with rare disorders; and a better understanding of the roots of disease. New genetic knowledge is not only providing information for the development of new diagnostic tests and treatments, but is easing identification of non-genetic factors that compromise health.

New "Stories" Integrated into the Narrative

- **Callipyge sheep**, whose giant rears illustrate genomic imprinting (chapter 6, "Matters of Sex")
- **Christina Vena**, a college student with lipodystrophy, cured with leptin shots (chapter 7, "Multifactorial Traits")
- **Let sleeping dogs lie**: how dogs with narcolepsy led to discovery of the gene in humans (chapter 8, "The Genetics of Behavior")
- **Rosalind Franklin's famed "photo 51"** (chapter 9, "DNA Structure and Replication")
- **The "blue people of Troublesome Creek"** (chapter 12, "Gene Mutation").

New Boxes

- The cast of real characters who have shared their experiences in past editions in "In Their Own Words" boxes update their stories, and are joined by some new voices.
- In "The Y Wars" (chapter 6), researcher Jennifer Marshall-Graves laments "The Rise and Fall of the Human Y Chromosome," while David Page describes "Rethinking the Rotting Y Chromosome."
- On a more serious note, parents tell the sad but inspiring tales of their children who have familial dysautonomia (chapter 12) and Li-Fraumeni family cancer syndrome (chapter 18).

New Design, New Tables, and New Figures Throughout

- A bright, modern, bold design sets the stage for the fascinating topic of genetics.
- Tables present the main points to ease studying.
- New figures add historical depth, highlight genomic approaches to traditional ideas, introduce technology, present news, and even offer artists' renditions of genetics.

Teaching and Learning Supplements

McGraw-Hill offers various tools and teaching products to support the sixth edition of *Human Genetics: Concepts and Applications*. Students can order supplemental study materials by contacting their local bookstore. Instructors can obtain teaching aids by calling the Customer Service Department at 800-338-3987, visiting the text website at www.mhhe.com/lewisgenetics6, or contacting your local McGraw-Hill sales representative.

Digital Content Manager

This multimedia collection of visual resources allows instructors to utilize artwork from the text in multiple formats to create customized classroom presentations, visually based tests and quizzes, dynamic course website content, or attractive printed support materials. The digital assets on this cross-platform CD-ROM are grouped by chapter within the following easy-to-use folders:

- **Art Libraries**—All text art in a format compatible with presentation or word processing software.
- **PowerPoint Presentations**—Ready-made presentations cover each chapter of the text.
- **Active Art Library**—Key figures from the text are saved in manipulable layers that can be isolated and customized to meet the needs of the lecture environment. Build images from simple to complex to suit your lecture style.
- **Animations Library**—Numerous full-color animations of key processes are provided. Harness the visual impact of processes in motion by importing these files into classroom presentations or course websites.

Instructor Testing and Resource CD-ROM (ITRCD)

The ITRCD is a cross-platform CD-ROM providing a wealth of resources for the instructor. Supplements featured on this CD-ROM include a computerized test bank utilizing Brownstone Diploma testing software to quickly create customized exams.

This user-friendly program allows instructors to search for questions by topic or format, edit existing questions or add new ones, and scramble questions and answer keys for multiple versions of the same test.

Other assets on the ITRCD are grouped within easy-to-use folders. The Instructor's Manual is available on this CD. Word files of the test bank are included for those instructors who prefer to work outside of the test generator software.

Instructor's Manual

The Instructor's Manual, prepared by Cran Lucas of Louisiana State University, is available through the Instructor Resources of the Online Learning Center, (www.mhhe.com/lewisgenetics6). The manual includes chapter outlines and overviews, a chapter-by-chapter resource guide to use of visual supplements, answers to questions in the text, additional questions and answers for each chapter, and Internet resources and activities.

Overhead Transparencies

A set of 100 full-color transparencies showing key illustrations from the text is available for adopters.

For the Student

Genetics: From Genes to Genomes CD-ROM:

This easy-to-use CD covers the most challenging concepts in the course and makes them more understandable through presentation of full-color animations and interactive exercises.

Online Learning Center

Get online at www.mhhe.com/lewisgenetics6. The OLC offers an extensive array of learning and teaching tools. Explore this dynamic site designed to help you get ahead and stay ahead in your study of human genetics. Some of the activities you will find on the website include:

- Self-quizzes to help you master material in each chapter
- Flash cards to ease learning of new vocabulary

- Case studies to practice application of your knowledge of human genetics
- Links to resource articles, popular press coverage, and support groups

***Case Workbook in Human Genetics*, fourth edition, by Ricki Lewis**

This workbook is specifically designed to support the concepts presented in *Human Genetics* through real cases adapted from recent scientific and medical journals, with citations included. The workbook provides practice for constructing and interpreting pedigrees; applying Mendel's laws; reviewing the relationships of DNA, RNA, and proteins; analyzing the effects of mutations; evaluating phenomena that distort Mendelian ratios; designing gene therapies; and applying new genomic approaches to understanding inherited disease. An answer key is available for the instructor.

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