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Biology Workbook

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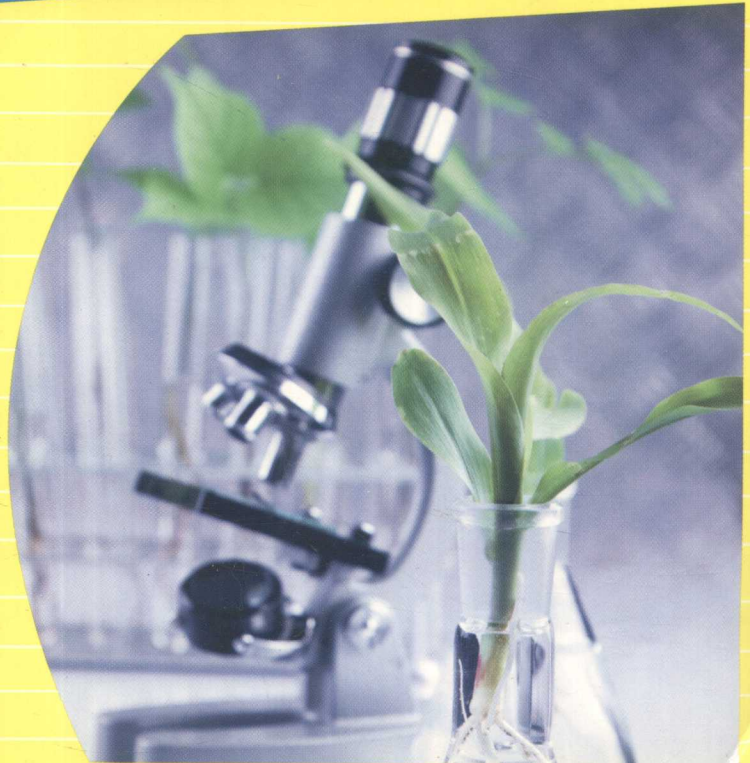
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Rene Fester Kratz, PhD

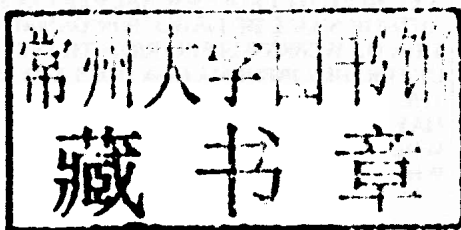
*Author of Molecular and Cell Biology For Dummies
and Biology For Dummies, 2nd Edition*



Biology Workbook

FOR
DUMMIES®

by René Fester Kratz, PhD



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About the Author

René Fester Kratz, PhD, grew up near the ocean in Rhode Island. From a young age, she wanted to be a teacher (because she loved her teachers at school) and a biologist (because her dad was one). She graduated from Warwick Veterans Memorial High School and went on to major in biology at Boston University. As a freshman and sophomore at BU, René got excited by subjects other than biology and even considered changing her major. Then, she met and studied under Lynn Margulis, who reignited René's love of biology and introduced her to the world of microbes. René graduated with a BA in biology from BU and went on to earn an MS and a PhD in botany from the University of Washington. At UW, René studied reproductive onset in *Acetabularia acetabulum*, a marine green alga that grows as single cells big enough to pick up with your fingers. When they enter reproduction, the cells of *A. acetabulum* form a flat disk or cup-shaped structure at the top, earning the alga the nickname of the "mermaid's wine glass."

René currently teaches biology and general science classes at Everett Community College in Everett, Washington. She spends most of her time introducing students to the wonders of cells and microbes as she teaches cellular biology and microbiology. René also has a strong interest in science education and science literacy for everyone. As a member of the North Cascades and Olympic Science Partnership, she helped create inquiry-based science courses for future teachers that are based on research on human learning. She loves teaching these courses because they make science accessible for all kinds of people. In the summer, René enjoys working with K-12 teachers on the improvement of science education in the public schools. She also enjoys writing about science and is the author of *Molecular & Cell Biology For Dummies*, *Biology For Dummies* 2nd edition, *Botany For Dummies* (all published by Wiley), and *E-Z Microbiology*, 2nd edition (Barron's Educational Press).

René loves living in the Pacific Northwest because she is near the ocean and her daffodils start blooming in February (when her family back East is still shoveling snow). She doesn't mind the rain and thinks the San Juan Islands are one of the most beautiful places on Earth. Her husband, two sons, and two very bad dogs help her remember what is truly important, and her "sisters" help keep her sane. René loves to scrapbook, stitch, garden, and read.

Dedication

Happy 70th birthday to my mom, Annette — without your support and encouragement, I wouldn't be where I am today. Love you always.

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On the home front, thanks to my husband, Dan, and my sons, Hueston and Dashiell, for all their love and support.

Contents at a Glance

Introduction	1
Part I: Getting the Basics.....	7
Chapter 1: Figuring Out the Scientific Method.....	9
Chapter 2: Solving Problems in the Chemistry of Life	21
Chapter 3: Identifying Cell Parts and Understanding Their Functions.....	43
Chapter 4: Tracking the Flow of Energy and Matter	55
Part II: Creating the Future with Cell Division and Genetics.....	79
Chapter 5: Divide and Conquer: Recognizing the Phases of Cell Division	81
Chapter 6: Predicting Future Generations with Mendelian Genetics.....	101
Chapter 7: Taking Genetics to the DNA Level	113
Chapter 8: Going Straight to the Source with DNA Technology	131
Part III: Making Connections with Ecology and Evolution.....	143
Chapter 9: Organizing the Living World.....	145
Chapter 10: Connecting Organisms in Ecosystems	153
Chapter 11: Evaluating the Effects of Evolution	169
Part IV: Getting to Know the Human Body.....	177
Chapter 12: Building Bodies with the Skeletal and Muscular Systems	179
Chapter 13: Giving Your Body What It Needs: The Respiratory and Circulatory Systems	189
Chapter 14: Processing Food with the Digestive and Excretory Systems	201
Chapter 15: Fighting Enemies with the Immune System.....	211
Chapter 16: Sending Messages with the Nervous and Endocrine Systems.....	221
Chapter 17: Making Babies with the Reproductive System.....	231
Part V: Going Green with Plant Biology.....	243
Chapter 18: Studying Plant Structures	245
Chapter 19: Pondering Problems in Plant Physiology	261
Part VI: The Part of Tens	271
Chapter 20: Ten Tips for Getting an A in Biology	273
Chapter 21: Ten (Plus One) Great Biology Websites	277
Index	281

Table of Contents

Introduction 1

About This Book	1
Conventions Used in This Book	2
Foolish Assumptions	2
How This Book Is Organized	3
Part I: Getting the Basics	3
Part II: Creating the Future with Cell Division and Genetics	3
Part III: Making Connections with Ecology and Evolution	4
Part IV: Getting to Know the Human Body	4
Part V: Going Green with Plant Biology	4
Part VI: The Part of Tens	4
Icons Used in This Book	5
Where to Go from Here	5

Part 1: Getting the Basics 7

Chapter 1: Figuring Out the Scientific Method 9

Developing Hypotheses	9
Practicing the Scientific Method	10
Designing Experiments	12
Making an Experiment Count	16
Building Theories	17
Answers to Questions on the Scientific Method	19

Chapter 2: Solving Problems in the Chemistry of Life 21

Mapping Atoms	21
Elemental Thinking	23
Figuring Out Molecules	25
Recognizing Macromolecules	28
Staying sweet with carbohydrates	29
Getting things done with proteins	31
Making plans with nucleic acids	33
Storing energy and building boundaries with lipids	36
Answers to Questions on the Chemistry of Life	40

Chapter 3: Identifying Cell Parts and Understanding Their Functions 43

Introducing Cells	43
Holding it all together: The plasma membrane	45
Getting in and out of cells	46
Creating proteins: Ribosomes	48
Taking a Tour of Animal Cells	48



Checking Out Plant Cells	50
Peeking at Prokaryotes	52
Answers to Questions on Cells	53

Chapter 4: Tracking the Flow of Energy and Matter 55

Figuring Out the Role of Food	55
Make it or break it	56
Feeling energized about energy	57
Getting a reaction	58
Transferring energy with ATP	60
Moving your metabolism with enzymes	61
Reduce, reuse, recycle	63
Photosynthesis: Cooking Up Carbohydrates	64
Light reactions of photosynthesis: Transforming energy from the ultimate energy source	66
Light-independent reactions of photosynthesis: Putting matter and energy together	67
Cellular Respiration: Extracting Energy from Food	69
Glycolysis and the Krebs cycle: Breaking down glucose to carbon dioxide...	70
Oxidative Phosphorylation: Transferring energy to ATP	72
Answers to Questions on Tracking the Flow of Energy and Matter	75

Part 11: Creating the Future with Cell Division and Genetics 79

Chapter 5: Divide and Conquer: Recognizing the Phases of Cell Division 81

Talking 'bout the Generations	81
Duplicating and Dividing Your DNA	82
Riding the Cell Cycle	86
Marching Through Mitosis	87
Getting Ready for Sexual Reproduction	91
Making Gametes by Meiosis	93
Contrasting Mitosis and Meiosis	96
Answers to Questions on Cell Division	98

Chapter 6: Predicting Future Generations with Mendelian Genetics 101

Getting Acquainted with the Lingo of Genetics	101
Discovering the Laws of Inheritance	103
Figuring Out Genetic Puzzles	106
Climbing the Branches of Your Family Tree	107
Answers to Questions on Genetics	111

Chapter 7: Taking Genetics to the DNA Level 113

Going with the Flow of Genetic Information	113
Making a Copy of the Genetic Code: Transcription	114
Locating genes within a chromosome	116
Doing transcription one step at a time	116
Putting on the finishing touches: RNA processing	117

Decoding the Message in mRNA: Translation	118
Deciphering mRNA codes with tRNA	120
Doing translation one step at a time	121
Measuring the Impact of Mutations	125
Answers to Questions on the Genetic Code	128

Chapter 8: Going Straight to the Source with DNA Technology 131

Discovering the Power of DNA Technology	131
Cutting DNA with Restriction Enzymes	132
Separating Molecules with Gel Electrophoresis	135
Copying DNA with PCR	137
Reading a Gene with DNA Sequencing	138
Answers to Questions on DNA Technology	141

Part III: Making Connections with Ecology and Evolution 143

Chapter 9: Organizing the Living World 145

Examining Relationships	145
Classifying Life	147
Figuring Out Relationships from Phylogenetic Trees	149
Answers to Questions on Classification and Phylogeny	152

Chapter 10: Connecting Organisms in Ecosystems 153

Ecosystems: Bringing It All Together	153
Describing Populations	155
Tracking Changes in Populations	157
Getting Along with Other Species	160
Discovering the Job Descriptions of Organisms	161
Following the Flow of Energy through Ecosystems	162
Recycling Matter within Ecosystems	164
Answers to Questions on Ecosystems	166

Chapter 11: Evaluating the Effects of Evolution 169

Defining Evolution	169
Predicting the Outcome of Natural Selection	171
Supporting the Theory of Evolution	172
Answers to Questions on Evolution	175

Part IV: Getting to Know the Human Body 177

Chapter 12: Building Bodies with the Skeletal and Muscular Systems 179

Moving Around with Friction and Gravity	179
Getting Support from Skeletons and Bones	180
This Joint Is Jumpin'	184
Flexing Your Knowledge of Muscles	185
Answers to Questions on the Skeletal and Muscular Systems	187

Chapter 13: Giving Your Body What It Needs: The Respiratory and Circulatory Systems	189
Catching Your Breath: Animal Respiration	189
Taking a Breath with the Human Respiratory System	191
In with the Good, Out with the Bad: Animal Circulatory Systems	192
Navigating the Human Heart and Circulatory System	193
Entering the cardiac cycle	195
Oxygenating the blood: Pulmonary circulation	196
Spreading oxygenated blood around: Systemic circulation	197
Answers to Questions on the Respiratory and Circulatory Systems	199
Chapter 14: Processing Food with the Digestive and Excretory Systems	201
Got Food? Understanding What Happens When Animals Eat	201
Moving Along the Human Digestive System	203
Filtering Fluids through the Urinary System	206
Exploring the Inner Workings of the Human Kidney	207
Answers to Questions on the Digestive and Excretory Systems	209
Chapter 15: Fighting Enemies with the Immune System	211
Microbial Encounters of the Best and Worst Kinds	211
Investigating Your Built-In Defenses	214
Fighting Back with Adaptive Immunity	216
Answers to Questions on the Immune System	219
Chapter 16: Sending Messages with the Nervous and Endocrine Systems	221
Mapping out Nervous Systems	221
Getting on Your Nerves	223
Getting in on the Action Potential	225
Regulating the Body with Glands and Hormones	228
Answers to Questions on the Nervous and Endocrine Systems	230
Chapter 17: Making Babies with the Reproductive System	231
Identifying the Parts of the Male Reproductive System	231
Identifying the Parts of the Female Reproductive System	233
Following the Female Ovarian and Menstrual Cycles	235
Fertilization through Birth: Developing New Humans	237
Answers to Questions on the Human Reproductive System	241
Part V: Going Green with Plant Biology	243
Chapter 18: Studying Plant Structures	245
Peering at the Parts and Types of Plants	245
Taking a Look at Plant Tissues	250
Growing Like a Weed: Plant Reproduction	254
Answers to Questions on Plant Structures	259

Chapter 19: Pondering Problems in Plant Physiology 261

Taking Minerals from the Soil	261
Pulling Water Through Plants	263
Sending Sugars from Sources to Sinks	264
Sending Signals with Plant Hormones	267
Answers to Questions on Plant Physiology	269

Part VI: The Part of Tens..... 271**Chapter 20: Ten Tips for Getting an A in Biology 273**

Put in Your Time	273
Make Vocabulary Flashcards	273
Pace Yourself	274
Study Actively, Not Passively	274
Phone a Friend	275
Test Yourself Before Your Instructor Tests You	275
Maximize the Easy Points	275
Ask for Help Upfront	276
Use Your Resources	276
Don't Leave It in the Classroom	276

Chapter 21: Ten (Plus One) Great Biology Websites 277

Dummies.com	277
The Biology Project at the University of Arizona	278
Genetic Science Learning Center	278
DNA from the Beginning	278
Life: The Science of Biology	278
The Biology Corner	278
Cells Alive!	279
The Virtual Cell	279
The Virtual Plant Cell	279
Quia.com	279
HHMI BioInteractive Holiday Lectures	279

Index..... 281

Introduction

Living things are all around you, from the bacteria that live on your skin to the green plants that cover the land to the majestic blue whales that swim through the ocean. You're aware of many of these forms of life, but have you ever taken a look at the single-celled creatures in a drop of pond water? Or thought about the many different ways your life depends on the actions of plants and bacteria? The journey to discover more about the living world around you is at the heart of biology.

A living organism can be as simple as a single cell or as complex as a human being, but no matter how different they may seem, all living things on Earth have fundamental similarities: They're made of cells that contain DNA, and they all grow, move, get energy, use raw materials, make waste, and reproduce. These similarities among all living things illustrate how all life on Earth is part of the same big family tree. And the differences in how each type of living thing achieves these same goals — well, the differences are what make biology fascinating.

Beyond increasing your appreciation for other kinds of life, the science of biology can help you understand your place in the living world. At first glance, you may think that people can do everything for themselves — get food from the grocery store, build their homes, and make their clothes — but a closer look quickly shows how dependent people are on the rest of the living world. People depend on plants and green bacteria to make the food that supports food chains that include agricultural species. These green organisms also make the oxygen that people need to sustain life. Bacteria and fungi in the soil break down dead organisms, recycling matter so that other living things can reuse it. Clearly, people can't survive on planet Earth alone.

I hope that you enjoy your exploration of the living world and come to appreciate the marvelous diversity of life on Earth. I also hope that the information in this book improves your performance in biology class, specifically (gulp!) your exams. This truly is a living planet, and the more that people understand the connections among living things, the better choices they'll make about the future of the world.

About This Book

Biology Workbook For Dummies is designed to help supplement your learning in a biology class or to use as a companion for your self-guided exploration of biology using *Biology For Dummies*, 2nd edition (Wiley). This workbook isn't intended to replace a textbook but rather to highlight essential information in an easy-to-understand format and quiz you on it. I provide many straightforward lists of the fundamentals you need to know about the various subjects you'd typically encounter in a biology class, along with problems on which you can practice and reinforce your understanding. I provide answers to all the practice questions and include explanations of why some answers are right or wrong.

If you're taking biology, your instructor may present material in a different order than the organization I use here, so be sure to take advantage of both the table of contents and the index to navigate where you need to go.

Conventions Used in This Book

In order to explain topics as clearly as possible, I keep scientific jargon to a minimum and present information in a straightforward, linear style. I break dense information into main concepts and divide complicated processes into series of steps.

To help you find your way through the subjects in this book, I use the following style conventions:

- ✓ I use *italic* for emphasis and to highlight new words or terms that I define in the text.
- ✓ I use **boldface** to indicate key words in bulleted lists and the action parts of numbered steps.
- ✓ I use monofont for web addresses so they're easy to recognize.
- ✓ When this book was printed, some web addresses may have needed to break across two lines of text. If that happened, know that I haven't put in any extra characters (such as hyphens) to indicate the break. So when using one of these web addresses, type in exactly what you see and ignore the line break.

Foolish Assumptions

As I wrote this book, I tried to imagine who you might be and what you might need to understand biology, and here are some assumptions I made:

- ✓ You may be a high school student taking biology and maybe preparing for an advanced placement test or a college entrance examination. For you, I've tried to extract the essentials about each subject and organize them into short lists that are easier to study than long paragraphs. I've also written problems for you to practice on and given you links to websites with great animations and tutorials.
- ✓ You may be a college student who isn't a science major but is taking a biology class to help fulfill your degree requirements. For you, I've tried to get the main ideas across with as little scientific jargon as possible. If you find that you get overwhelmed in your biology class, try reading a section in this workbook before you go to class to hear a lecture about the topic. That way, you'll have some of the big ideas in your mind before your instructor starts adding all the details. Also, many non-science students are a little shocked to find that their usual study habits don't work well for a science class, so be sure to read my tips in Chapter 20 on how to get an A in biology.
- ✓ You may be someone who just wants to know a little bit more about the living world around you. You may have picked up *Biology For Dummies*, 2nd edition, or some other biology text because you want to take a deeper look at the living world. For you, this workbook will make a nice companion and give you a chance to test yourself on the practice problems to see how well you're learning the information.

Whatever your reason for picking up this book, I've done my best to explain the topics of biology simply and effectively and to create some challenging practice problems to help improve your learning. I hope you find this workbook helpful.

How This Book Is Organized

I've arranged this book to follow the order of topics in many biology textbooks, with a few minor differences. Like all *For Dummies* books, each chapter is self-contained, so you can pick up the book whenever you need it and jump into the topic you're working on. After I explain a subject, I use that information in later topics. So if you don't read the book in order, you may occasionally have to refer back to an earlier section for some background information. When that's the case, I refer you to the appropriate section or chapter.

Part I: Getting the Basics

Biology is the study of life, but as I'm sure you know, life is complex. To simplify it, I break the all-encompassing subject of biology into smaller, more palatable chunks. To start, I explain the way that scientists study biology. This *scientific method* holds not only for biology but also for chemistry, psychology, physics, geology, and other sciences and social sciences. Knowing how scientists conduct, challenge, check, and recheck research makes it easier to appreciate the value of scientific information.

In this part, I spotlight the basic unit of life: the cell. Every organism — whether it's a human, a dog, a flower, a strep throat bacterium, or an amoeba — has at least one cell; most have millions. After you have a grasp of how cells are the powerhouses of bodies, I review the types of molecules that are important to their functioning. Included in this first part is the often-dreaded but oh-so-necessary review of basic chemistry. To learn biology, you must understand some basic principles of how chemicals function. After all, the bodies of every living organism are big sacs of chemicals. Chemical reactions generate every process that occurs in your body, such as those that occur during the metabolic processes in plant and animal cells. So in this part you delve into topics such as enzymes, energy transfer, and how plants make food from scratch, using just carbon dioxide and water!

Part II: Creating the Future with Cell Division and Genetics

Cells reproduce, giving rise to other cells. Sometimes cells make exact copies of themselves in order to repair, grow, or produce offspring that are genetically identical to the parent. Some organisms mix it up a little by engaging in sexual reproduction, creating offspring that have combinations of genes that are different from those of their parents.

But whether organisms reproduce asexually or sexually, the parents' traits are visible in their offspring. Ducks make ducklings, and from little acorns mighty oaks do grow. Offspring inherit their traits from their parents because parents pass DNA to their offspring. DNA contains the blueprints for proteins that do the work in cells and thus determine an organism's

characteristics. Biologists today are busy unraveling the mysteries of DNA, giving humans unprecedented power over the very stuff of life. This part walks you through all these topics and gives you plenty of chances to test yourself on what you've read.

Part III: Making Connections with Ecology and Evolution

All the amazingly diverse forms of life on Earth interact with one another. In this part, you become more aware of the living part of Earth as one big, interconnected ecosystem called the *biosphere*. Living things aren't just connected with one another today; they also have connections to the living things of the past. The science of evolution studies those relationships and uses them to understand present and future changes in the populations of living things on Earth today.

Part IV: Getting to Know the Human Body

Organisms respond to changes in their environment, trying to maintain their internal conditions within a range that supports life. Animals have many different systems that support this balance, which is called *homeostasis*. In this part, I explain most of the systems that support the structure and function of the human body and touch on how humans compare to other animals.

Part V: Going Green with Plant Biology

Our green neighbors are very quiet and sometimes get overlooked in the hustle and bustle of animal life. However, the importance of plants to life on Earth simply can't be overstated — they're the food makers, after all. Without plants (and green microbes), nobody else would have anything to eat! And when you take a good look (and you do in this part), plants are pretty interesting. Just like animals, they're made of cells and have systems to transport materials around their body and exchange matter and energy with their environment. Their structures are well suited to their lifestyle, and many plants are things of beauty. Just ask someone in your life who likes to garden! To test your green thumb, flip to the chapters in this part.

Part VI: The Part of Tens

This part contains two short chapters with lists of ten or so items. I give you tips for getting an A in biology and links for some websites that will help you do just that!