

Biology Survival Guide

How to Study and Ace Any Biology Course

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2006 Edition



Biology Survival Publishing

- 1 -

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Dedication

My students are my teachers. I have learned and been inspired so much from them. For that, I dedicate this Guide to them.

TABLE OF CONTENT

FORWARD – THE WINNING EDGE IN BIOLOGY	11
THE END.....	13
STOP! DON'T READ THIS GUIDE.....	13
WIIFM	14
WHO ARE YOU?	14
<i>If You're Taking High School Biology...</i>	14
<i>If You're Taking College Biology...</i>	15
<i>If You're Taking Advanced Biology.....</i>	15
<i>If You're a Non-Traditional Student.....</i>	15
<i>If You're Preparing for a Test.....</i>	16
<i>If You're an Educator.....</i>	16
<i>If You're a Parent.....</i>	16
HOW TO USE THIS GUIDE	16
WHAT IS NOT IN THIS GUIDE	17
CHAPTER 1: THE SURVIVAL BASICS	18
THE BIOLOGY SURVIVAL MINDSET	18
<i>Mindset #1 – Take Control.....</i>	18
<i>Mindset #2 – Be Curious</i>	18
<i>Mindset #3 – Be Consistent and Be Persistent</i>	19
<i>Mindset #4 – Be A Professional.....</i>	19
THE BIOLOGY SURVIVAL INSTINCTS	19
<i>Instinct #1 – Think Biology at the Microscopic and Macroscopic Levels</i>	19
<i>Instinct #2 - Biology is Organized Hierarchically</i>	20
<i>Instinct #3 – Life is a Series of Solutions to Environmental Problems.....</i>	21
<i>Instinct #4 – Visualize Biological Structures and Processes.....</i>	22
<i>Instinct #5 – Follow the Energy.....</i>	23
<i>Instinct #7 – Biology is Also History</i>	24
<i>Instinct #8 – SEE THE BIG PICTURE.....</i>	25
<i>Instinct #9 – Speak the Language.....</i>	26
SUM IT UP	26
THE SURVIVAL TRICKS – LEARNING BIOLOGY ANY TIME AND ANYWHERE	26
<i>The iPod Biology.....</i>	27
<i>The Bathroom Biology.....</i>	27
<i>The Jacuzzi Biology</i>	27
<i>The Palmtop Biology</i>	28
<i>The Poker Chemistry</i>	28
<i>The Bedtime Biology.....</i>	29
CHAPTER 2: THE SURVIVAL GEAR	30

BIOMASTERY PREVIEW TEMPLATE	30
<i>BioMastery Preview Notes Upcoming Lecture</i>	31
<i>Lecture/Reading Note Template</i>	31
CHEAT SHEET TEMPLATES	33
PROBLEM-SOLVING WORKSHEET TEMPLATE	34
MOCK EXAM TEMPLATE.....	35
WEEKLY STUDY ORGANIZER TEMPLATE	36
<i>Four Rules for Using the Weekly Study Organizer</i>	38
<i>Seven Ways to Effective Time Management</i>	38
CHAPTER 3: THE BIOMASTERY SURVIVAL SYSTEM.....	40
HOW DOES IT WORK?.....	40
CREATING YOUR OWN STRATEGIES FOR YOUR BIOLOGY COURSE	40
STAGE #1: PREVIEW – PREPARING FOR THE LECTURE	40
<i>Survival Gear</i>	40
<i>Step by Step</i>	40
STAGE #2: LECTURE – HOW TO LISTEN AND TAKE NOTES EFFECTIVELY	40
<i>Survival Gear</i>	40
<i>Step-by-Step</i>	40
<i>How to Add Question Cues</i>	40
<i>How to Select Memory Keys</i>	40
STAGE #3 REVIEW – READ AND SOLVE WITH EASE.....	40
<i>Survival Gear</i>	40
<i>Step-by-Step</i>	40
STAGE #4: EXAM PREP – GET READY (ALMOST) EFFORTLESSLY	40
<i>Survival Gear</i>	40
<i>Step-By-Step</i>	40
<i>How to Create Chapter Cheat Sheets</i>	40
<i>How to Build a Master Cheat Sheet</i>	40
<i>How to Generate Your Own Mock Exam</i>	40
<i>Seven Day Exam Action Plan</i>	40
STAGE #5: EXAM-TAKING – SCORE HIGH WITH CONFIDENCE.....	40
<i>Step-by-Step</i>	40
CHAPTER 4: THE SURVIVAL GUIDE TO PREVIEW	40
HOW TO PREVIEW A TEXTBOOK.....	40
<i>Step 1: Read the Structure and Get the Big Picture</i>	40
<i>Step 2: Read the Introduction and Summary Paragraphs</i>	40
<i>Step 3: Read the Headers and Typographical Cues</i>	40
<i>Step 4: Read the First and Last Sentences of Each Paragraph</i>	40
<i>Step 5: Look at the Graphics</i>	40

<i>Step 6: Complete the Preview Worksheet</i>	40
CHAPTER 5: THE SURVIVAL GUIDE TO NOTE-TAKING	40
WHAT TO BRING TO CLASS.....	40
A GUIDE TO EFFECTIVE CLASSROOM LEARNING.....	40
TAKING NOTES IN CLASS AND IN READING.....	40
A SIMPLE NOTE ANNOTATION SYSTEM.....	40
WHAT TO DO AFTER A LECTURE.....	40
CHAPTER 6: THE SERVIVAL STRATEGY FOR TEXTBOOK READING	40
READ YOUR COURSE TEXT.....	40
<i>Skim First and Then Read Carefully</i>	40
<i>Avoid Daydreaming While You Read Your Text</i>	40
<i>Use a Timer and Break Often</i>	40
<i>Hang In, Don't Skip</i>	40
<i>The Think While You Read Approach</i>	40
<i>Take Notes While Reading</i>	40
<i>Follow the Text Organization</i>	40
<i>Don't Read Your Text Over and Over</i>	40
<i>Be an Active Reader</i>	40
<i>Throw Away the Highlighter</i>	40
<i>Re-read the Assigned Materials</i>	40
CHAPTER 7: THE SURVIVAL GUIDE TO HOMEWORK	40
BIOLOGY HOMEWORK TIPS.....	40
<i>Answer the Question You are Asked</i>	40
<i>Don't Look at the Answers</i>	40
<i>Do Your Homework by Yourself</i>	40
<i>No Answer? Look It Up</i>	40
HOW TO SOLVE BIOLOGY "ESSAY-ISH" QUESTIONS – THE BIG-CPA METHOD.....	40
<i>Step 1: Begin by Reading the Question Carefully</i>	40
<i>Step 2: Identify What the Question Asks You to Do</i>	40
<i>Step 3: Generate Relevant Ideas</i>	40
<i>Step 4: Make Connections Between the Relevant Ideas</i>	40
<i>Step 5: Plan Your Answer</i>	40
<i>Step 6: Answer It</i>	40
CHAPTER 8: THE SURVIVAL EXAM-PREP STRATEGY	40
EXAM-PREP TIPS.....	40
<i>Avoid Studying Too Hard the Night Before the Exam</i>	40
<i>Create Cheat Sheets</i>	40

<i>Beware of Test Prep Books</i>	40
<i>Translate Formulas into Words</i>	40
<i>Try to Generalize Concepts</i>	40
<i>Use Flash Cards</i>	40
<i>Make Your Own Mock Exam</i>	40
<i>Plan Ahead</i>	40
<i>Get the Unanswered Answered</i>	40
<i>Go to the Review Session</i>	40

CHAPTER 9: THE SURVIVAL GUIDE TO EXAM-TAKING ...40

TWO TYPES OF EXAM QUESTIONS.....	40
TOP STRATEGIES TO ACE YOUR NEXT EXAM.....	40
<i>General Exam Strategy 1: Arrive Early and Be Prepared</i>	40
<i>General Exam Strategy 2: Listen/Read the Instructions</i>	40
<i>General Exam Strategy 3: Start with a Memory Dump</i>	40
<i>General Exam Strategy 4: Skim the Entire Test</i>	40
<i>General Exam Strategy 5: Plan Your Attack</i>	40
<i>General Exam Strategy 6: Do the Problems in a Comfortable Order Unless</i>	40
<i>General Exam Strategy 7: Trust Your Instincts</i>	40
<i>General Exam Strategy 8: Use All the Time Allotted</i>	40
<i>General Exam Strategy 9: Keep Your Concentration</i>	40
<i>General Exam Strategy 10: Read the Whole Question</i>	40
<i>General Exam Strategy 11: Use Your Test Booklet</i>	40
<i>General Exam Strategy 12: Make Educated Guesses</i>	40
<i>General Exam Strategy 13: Write Something</i>	40
<i>General Exam Strategy 14: Think Before You Choose</i>	40
<i>General Exam Strategy 15: Re-Check Your Test</i>	40
<i>General Exam Strategy 16: Review the Graded Exam</i>	40
STRATEGIES FOR ATTACKING MULTIPLE CHOICE QUESTIONS.....	40
<i>Multiple Choice Exam Tactic 1: The "2 out of 5" Rule</i>	40
<i>Multiple Choice Exam Tactic 2: Scan the Choices</i>	40
<i>Multiple Choice Exam Tactic 3: Select the Best Answer</i>	40
<i>Multiple Choice Exam Tactic 4: Watch Out for the Word Trap</i>	40
<i>Multiple Choice Exam Tactic 5: Be Cautious of the Familiar</i>	40
<i>Multiple Choice Exam Tactic 6: Beware of the Absolute</i>	40
<i>Multiple Choice Exam Tactic 7: Dealing with Similar or Opposite Choices</i>	40
<i>Multiple Choice Exam Tactic 8: Eliminate the Wrong Rather Than Pick the Right</i>	40
<i>Multiple Choice Exam Tactic 9: Beware the Easy Answer</i>	40
<i>Multiple Choice Exam Tactic 10: Follow Your Instinct</i>	40
<i>Multiple Choice Exam Tactic 11: All of the Above or None of the Above</i>	40

STRATEGIES FOR ANSWERING ESSAY QUESTIONS	40
<i>Essay Exam Tactic 1: Ask Your Instructor About the Exam Type</i>	40
<i>Essay Exam Tactic 2: Analyze the Previous Tests</i>	40
<i>Essay Exam Tactic 3: Be Familiar with Essay Terms</i>	40
<i>Essay Exam Tactic 4: Answer the Question You are Asked</i>	40
<i>Essay Exam Tactic 5: Budget Your Time</i>	40
<i>Essay Exam Tactic 6: Go for Partial Credit</i>	40
<i>Essay Exam Tactic 7: Be Concise and Accurate</i>	40
<i>Essay Exam Tactic 8: Legible Handwriting Benefits You</i>	40
THE THREE SIMPLE RULES FOR TRUE/FALSE QUESTIONS.....	40
<i>True/False Exam Rule 1: All True and One False</i>	40
<i>True/False Exam Rule 2: Watch for Suggestive Words</i>	40
<i>True/False Exam Rule 3: When in Doubt Answer False</i>	40
BE SMART ABOUT FILL IN THE BLANK QUESTIONS	40
<i>Fill in the Blank Tactic 1: Either You Know It or You Don't</i>	40
<i>Fill in the Blank Tactic 2: Pick from Your Master List</i>	40
<i>Fill in the Blank Tactic 3: Don't Be Fooled by the Size of the Blank Space</i>	40
<i>Fill in the Blank Tactic 4: Return Later If You Can't Answer the First Time</i>	40
OPEN BOOK EXAMS.....	40
EIGHT TRICKS FOR BIOLOGY MEMORIZATION.....	40
SCIENTIFIC MEMORIZATION – THE AIR METHOD	40
<i>Step #1: Attention</i>	40
<i>Step #2: Impression</i>	40
<i>Step #3: Relation</i>	40
HOW TO CREATE YOUR OWN MNEMONICS	40
HOW TO MEMORIZE THE GEOLOGICAL TIME SCALE IN A FEW MINUTES	40
DRAW TO MEMORIZE	40
<i>Ladders and DNA Structure and Function</i>	40
<i>Playground Slides and Photosynthesis</i>	40
<i>Cell Cycle</i>	40
<i>Purines and Pyrimidines</i>	40
<i>The Phases of Mitosis</i>	40
<i>Heart Valves</i>	40
<i>Causes for Deviation from Hardy-Weinberg Equilibrium</i>	40
<i>Most Important Elements in Organisms</i>	40
CHAPTER 11: CORE SURVIVAL SKILLS.....	40
<i>Study Systematically</i>	40
<i>Make It a Habit</i>	40
<i>Impress Your Instructor</i>	40
<i>Find Yourself an Academic Mentor</i>	40

<i>Attend All the Lectures</i>	40
<i>Find Your Place to Study</i>	40
<i>Study at the Same Time Every Day</i>	40
<i>Keep Your Concentration</i>	40
<i>The 50-10 Approach to Studying</i>	40
<i>Study in a Group</i>	40
SURVIVAL SKILL #2: FIGHT COMPUTER DISTRACTIONS	40
<i>Don't Study in Front of Your Computer</i>	40
<i>Do You Rely on Google ?</i>	40
ARE YOU A COMPUTER POTATO?	40
DON'T TURN IT ON	40
SURVIVAL SKILL #3: FOCUS ON THE RELEVANT, NOT THE IRRELEVANT	40
<i>The Order of Your Core Study for an Exam</i>	40
SURVIVAL SKILL #4: PREDICT THE EXAM QUESTIONS	40
SURVIVAL SKILL #5: FOUR STEPS FOR SYSTEMATIC CRAMMING	40
<i>How to Cram Step by Step</i>	40
<i>Rules for Cramming</i>	40
SURVIVAL SKILL #6: THE BIG PICTURE AND CELL DIVISION	40
SURVIVAL SKILL #7: CONCEPT MAPS	40
CHAPTER 12: 10 TERRIBLE CONFUSIONS IN BIOLOGY	40
<i>Confusion #1 - Studying Biology is Just Memorizing</i>	40
<i>Confusion #2 - Theories + Hypotheses: What's the Difference?</i>	40
<i>Confusion #3 - Energy and Nutrient Cycling: Aren't They the Same?</i>	40
<i>Confusion #4 - Evolution is Random</i>	40
<i>Confusion #5 - Plants Photosynthesize so They Don't Need to Respire, Right?..</i> 40	
<i>Confusion #6 - Protein Structure - Too Complicated?</i>	40
CONFUSION #7 - SEGREGATION AND INDEPENDENT ASSORTMENT - WHAT'S THE BIG DEAL? ... 40	
<i>Confusion #8 - Osmosis, Diffusion, and Transport</i>	40
<i>Confusion #9 - Protostomes and Deuterostomes</i>	40
<i>Confusion #10 - Intron and Exon: Aren't They Oil Companies?</i>	40
CHAPTER 13: AN INSIDERS GUIDE TO YOUR INSTRUCTOR	40
CLOSE ENCOUNTERS OF A PROFESSORIAL KIND	40
<i>Professor #1 on Exam Questions</i>	40
<i>Professor #2 on Community College vs. Universities</i>	40
<i>Professor #3 on Student Evaluations of Faculty</i>	40
<i>Professor #4 on the "Axis of Evals"</i>	40
<i>Professor #5 on Cramming</i>	40
<i>Professor #6 on Biology</i>	40
<i>Professor #7 on Graphs and Biology</i>	40

<i>Professor #8 on Bad Students</i>	40
<i>Professor #9 on Giving Exams</i>	40
<i>Professor #10 on Problem Solving</i>	40
HOW TO DEAL WITH YOUR PROFESSOR.....	40
<i>Names and Titles</i>	40
<i>Be in Class and Be On Time</i>	40
<i>Participate Actively and not Reticently</i>	40
<i>Praise Your Instructor</i>	40
<i>Build Your Relationship</i>	40
<i>Show Your Interest</i>	40
<i>Reign in the Charm</i>	40
<i>Do the Assignment Properly</i>	40
<i>Separate Liking from Learning</i>	40
<i>Avoid Excuses</i>	40
HOW TO DEAL WITH FAST TALKERS AND ACCENTED ENGLISH.....	40
<i>How to Read Your Instructor's Mind</i>	40
<i>Word Clues</i>	40
<i>Old Exams</i>	40
<i>Eye Contact</i>	40
<i>Written on the Board or an Overhead</i>	40
<i>Interest Level</i>	40
<i>Pause for Questions</i>	40
<i>Reading Material</i>	40
<i>Summarizing</i>	40
<i>Just Ask</i>	40
<i>Stay Off the Student Blacklist</i>	40
CHAPTER 14: THE BIOLOGY SURVIVAL SOURCES.....	40
<i>Site #1: About Biology</i>	40
<i>Site #2: MP3 Biology Lectures</i>	40
<i>Site #3: Sing Your Way to Biology Mastery</i>	40
<i>Site #4: Rating Your Professors</i>	40
<i>Site #5: Tutors for Hire</i>	40
<i>Site #6: Biology Glossary</i>	40
<i>Site #7: Online Biology Book</i>	40
<i>Site #8: Power of 10</i>	40
<i>Site #9: Biology Prefixes and Suffixes</i>	40
<i>Site #10: AP Biology Essay</i>	40
CHAPTER 15: ESSENTIAL IDEAS OF BIOLOGY	40
SOME IMPORTANT BIOLOGICAL IDEAS.....	40

LET'S RECAP THE SURVIVAL SECRETS	40
FINAL TIPS FOR SUCCESS IN BIOLOGY	40
<i>Make a Commitment:</i>	40
<i>Do the Right Thing:</i>	40
<i>Be Tenacious:</i>	40
<i>Positivity beats Negativity:</i>	40
ABOUT THE AUTHORS	40

FORWARD – THE WINNING EDGE IN BIOLOGY

Biology must follow the laws of chemistry and physics. However, much of biology cannot be reduced to or predicted from chemistry and physics. It cannot be understood by a few fundamental laws like those of physics and it cannot be understood primarily through the organization and interaction of atoms like chemistry. Biology not only integrates the principles of chemistry and physics, it has its own unique organization, principles, laws, and theories. Biology is the ultimate multi-disciplinary science. Learning biology will be different from learning other subjects.

Learning biology requires both understanding and memorization. Memorization alone will not serve you well. If you try to memorize everything in biology as if it was just a list of key words, you will be confused and certainly bored to distraction. Biology is properly viewed as a series of solutions to the problems faced by living organisms in their environments. If you can identify the problem, you are more likely to understand the biological solution. Remember, biology is a who, what, where, when, how, and why kind of science.

Despite its complexity, do not be intimidated. In reality, you don't need to spend more study time in biology than other subjects if you adopt a smart study system. Understanding the "big picture" is the key to success. The details, often confusing in their complexity or overwhelming in their numbers will make sense if you can first understand the problem to which the details are the solution. The key to effective learning in biology is to memorize the least and to apply this knowledge to the fullest.

Many of you apply the same study methods from non-science subjects to science classes - and have difficulty in these classes. Even within the science disciplines, you might get in trouble by studying the same way in biology as in chemistry or physics. Biology is more information intensive than chemistry or physics and it has its own logic. It cannot be reduced to a few concepts and principles from which you can derive the answers to all questions. But if you master the logic of biology, you will survive and prosper.

If you are looking for an effective, high-yield way to study biology, this Guide is for you. Forget about plowing through many weighty textbooks and overwhelming yourself with unnecessary information. Our goal here is to spend minimum effort to achieve maximum results. Bring your biology learning into focus - you'll learn what you need to learn.

As most of you have experienced, biology is not so easy at first, yet it is very learnable if you know how. The very issue of how to study biology is the focus of this Guide. The survival skills you learn will accelerate your mastery of biology and improve your grade quickly. Ignoring them will guarantee that you stay stuck in a rut of inefficiency, which might lead to failure. If you follow the 5-stage systematic method outlined in this Guide, you will improve your learning significantly, with a better grade in less study time.

Let's get cracking! Get the winning edge today.

"Perhaps the most valuable result of education is the ability to make yourself do the thing you have to do, when it ought to be done, whether you want to or not. It is the first lesson that must be learned."

--Thomas Huxley

WHY READ THIS GUIDE?

Simple! Want to have a winning edge? Would you go into a knife fight with a machine gun? This Guide offers you the survival skills to succeed in biology.

“A moment’s insight is sometimes worth a life’s experience.”

--Oliver Wendell Holmes, the Professor at the Breakfast Table

The End

At the beginning of this Guide, I would like to put an end to something that stops you from being successful in biology. That something is what I call “Hop-and-Drop” - aimless study without a systematic method and a well-defined goal. I have seen many students, even those in college, who still have not learned the study skills required for success in biology. More often, I have observed others who apply the study methods for art, literature, or business courses to biology courses, but stumble and fail. Biology, largely, is a conceptual and factual subject, so the mind-mapping technique used in creative literature does not apply here at all. Your approach to learning needs to be adjusted. This Guide will walk you through the learning process step-by-step. The skills you learn now will last you a lifetime.

There is really only one thing you need to be academically successful, biology or not. The good news is that it is under your control - YOUR ATTITUDE:

- ✓ Attitude One: The desire to learn
- ✓ Attitude Two: The willingness to change

Since you have made the first step and committed yourself to this book, you are already qualified. The rest is downhill from here - just follow the signs and you will get to the finish line.

“When the student is ready, the teacher will appear.”

Stop! Don’t Read This Guide

If you are sailing through your biology course effortlessly with minimum study time and an A+ grade, you should stop reading this now and continue doing the same thing that has led to your success.

If you are not willing to put forth the effort to learn the effective way to study biology and follow this system to success, you should also stop now.

However, if you think you are struggling with biology or spending too much time studying this darn course, something must be changed! A definition of insanity is doing the same thing over and over and expecting a different result.

My suggestion is to read this survival Guide, follow the 5-stage system closely and use the templates provided with the Kit. This ensures that you will survive the class with a top grade in minimum time. Make a commitment to this system or else don't waste your time reading this Guide.

Success is a choice not an inner quality of one's self. Unless you decide that you are going to be successful in biology and willing to learn and to adopt a learning method specifically designed for biology, you will waste your time with this Guide. Just reading this Guide is not going to improve your grade...following a system that works will.

WIIFM

You might ask: "What's in it for me?" If you are taking biology and feeling a bit lost or spending a little too much time, this book is for you. I will hold you by the hand and walk you to the finish line.

The goal of this Guide is not to make you into a biology major. In fact, most of you are taking biology because you have to, but find yourself frustrated in taking this course. Unfortunately, you cannot fail this course. Failing will prevent you from achieving the academic success to which you aspire. The good news is that you have already overcome the first hurdle by acquiring this Guide, which means that you have decided to master the survival skills and banish failure.

There are three aims in studying biology: the first is to acquire a wealth of biology knowledge; the second is to acquire the problem-solving abilities; the third is to excel in your grade.

The BioMastery system is about how to best study to achieve the above three goals. You just follow the system and the system will take care of you. It's that simple!

Who Are You?

Feeling no biology in biology?

Having problems with problems?

You have come to the right place! Granted, most of you don't want to become biologists. This could be the last biology course you have to take. However, biology is in the way of your academic success. You simply are looking for a way to survive in the class. To some extent, biology is a difficult course to study. Having taught thousands of students, I noticed that smart students who do well in biology have one thing in common - they have mastered the biology study skills.

If You're Taking High School Biology...

Congratulations! You are about to learn a simple system to master biology. High school biology is the baseline of this book. You should feel right at home with the format of the book and the

information presented. Everything is in a step-by-step format with easy to follow instructions. It is designed to work with your introductory biology textbook.

You should be very proud of yourself for taking a big step - committing to follow through with a proven system. You are already ahead of many of your classmates with the information you are about to learn and the competitive edge you will have.

If You're Taking College Biology...

I have written this book for you - the college student who is struggling with biology, whether it is majors or non-majors introductory biology, molecular biology, genetics or any other biology course for that matter. College biology is one big step higher than what you learned in high school, with many more topics to cover in greater depth. It is a challenge for freshmen when the stakes are raised and you have to study more than you have before - unless you develop the study skills quickly. However, you cannot afford to fail in this class. If so, it will ruin your college career.

The good news is that you can now be in control of it by following this simple and proven system. You will tackle the study skills you failed to master in high school, and that will enable you to sail through this course. Your academic success will be assured.

If You're Taking Advanced Biology

If you are a biology major or a graduate student taking other biology courses, this is a must-read. It will build the foundation for you to become a great biologist with much needed instincts and scientific qualities. The system I've developed comes from taking or teaching over 50 different biology courses - from introductory biology to mathematical genetics to ecology. You will take many of these classes in your biology career. Using this simple system will save you much frustration and enhance your academic success.

If You're a Non-Traditional Student

If you are going back to school at age 25, 35, or 45 - you should refresh your study skills and rebuild your biology sense. This will be a great book to start with before delving into a weighty textbook and getting lost and overwhelmed by details. You will master the very basic skills and learn to think like a biologist. You will spend less time studying and memorization will come easier.

If You're Preparing for a Test...

If you are studying for a test - whether it is a standardized test or classroom test - this book provides many tips and tricks on how to prepare for the test and how to take the test, specifically for biology.

If You're an Educator...

As biology teachers, we have never been taught or required as part of the curriculum to show our students how to study biology effectively. Our job is to deliver the biology content and hope the students will master it somehow. We try hard to make the subject fun and learnable, but often our students struggle with the course.

This book will empower you to teach your students how to master biology step-by-step as you share the 5-stage BioMastery system, memory techniques, quick math review, problem solving template and 101 biology study tips in this most extensive how-to-study guide in biology. It works with any biology textbook and teaching curriculum. Spend a session or two on the topic of how to study biology and prepare your students for your course and biology courses to be taken in the future. This will stimulate their interest in the subject and significantly improve student performance. This will also bring you many more rewarding experiences.

If You're a Parent...

As a parent you want to help your kids through the tough academic times. Science, in general, and biology, in particular, is not easy for most kids who are struggling to survive academically. You no longer have to watch your kids struggle helplessly. This survival guide will coach your kids step-by-step on how to study biology effortlessly. It is the system that has been used by many smart biology students to ace many biology courses. It is a how-to book used by biologists and written by a biologist.

How to Use this Guide

This book is for anyone who is currently taking any biology course, from high school introductory biology and college biology survey courses to other biologically related or advanced courses. It is designed for students, although instructors can use the information and methods/templates presented here for lecture materials.

The material is presented in an easy-to-follow way and will be most effective when read from beginning to end. After that, one can pick it up and start reading anywhere, jumping straight to a specific topic. For example, read the Exam Prep section if you are getting ready for an exam.

I do encourage you to learn and adopt the BioMastery system presented here. It is best to follow the full 5-stage system and not skip any stage. The system is designed to work together

synergistically and progressively, which allows you to use the minimum study time and to obtain maximum results.

What is Not in this Guide

This book focuses on a no nonsense approach, with loads of specific recommendations for success in biology courses. It is an “all meat, no filler” book. Unlike other generic how-to-study books, I will not discuss how your brain works, how you should get your mind and body in shape, how you can set goals and get motivated, how to write long essays or speed read. These are very important issues that you can read about elsewhere. I will not cover study skills used for non-science classes. Most of the study skills books are written by literature or business educators. Very few, if any, how-to-study books are written by biologists or scientists, for that matter. For the first time a biology study skill book is available with a step-by-step simple system designed and written by a biologist for students who are taking biology courses.

CHAPTER 1: THE SURVIVAL BASICS

This is the first part of the Survival Guide which outlines the basics of mastering biology. What you learn in this part will build the solid foundation to your biology success. Learn to think like a biologist. Do not skip any section and be sure you understand each key point before moving onto learning the BioMastery system.

The Biology Survival Mindset

Success is about positive attitude...believe, then act, and finally achieve - the end result is success. You have control of every step toward you own success. Make a positive attitude part of your thinking now.

Mindset #1 - Take Control

There are two choices you can make every day to improve your grade and they are totally under your control:

- Take control of your attitude - Think positively about yourself and your abilities
- Take control of your time - Manage your time to your advantage

Make the decision that you will be controlling your own destiny. Follow the system, make the plan, and execute it consistently. Success will follow.

Mindset #2 - Be Curious

Observe things in everyday life and start noticing their biology association. Ask yourself questions. Why am I so attracted to high sugar soft drinks and sweets? The answer may be found in the distant past of human evolutionary history where high energy foods were relatively rare. It is likely that human brains evolved to “tell” their bearers to gorge on high energy foods when available.

Nowadays, high energy sources of food are common. Yet your brain still tells you to gorge on these energy sources. The consequences of this overindulgence may range from relatively benign tooth decay to life threatening obesity.

Biologists are keen observers. Observations lead to questions. Questions invite explanations and trigger the imagination. Train yourself in the biologist’s mindset and you will excel.

Mindset #3 - Be Consistent and Be Persistent

Biology may not be your favorite subject. But you really have to be consistent with your efforts day in and day out, leading to the final exam. This will eliminate last minute panic and loss of confidence before the exam.

Biology is about understanding how life is organized and how it persists. You will encounter difficulty in understanding this from time to time. You must be persistent in working out the required assignments and follow the steps according to the system.

“While motivation is essential to begin the path to success, only persistence will keep you on the path.” --Anonymous

The little extra effort you make could be the difference between an A and a B. A winner has to be only a little better. Stay focused!

Mindset #4 - Be A Professional

Treat studying as a professional job. A professional has to show up at work and be productive in order to get paid. The same applies to taking courses. Students must attend lectures and complete the course work; you will be rewarded with good grades. Be a professional student; handle each study task professionally.

The Biology Survival Instincts

No one is born to be a biologist...no “biology genes” in the human genome. Biologists develop their instincts via learning and experimenting.

However, one aspect of learning biology is your own intuition; after all you are a biological organism too, subject to the principles of biology. You will be able to relate some of your daily experiences to what you are taught in biology class. Your common sense may very well work for some aspects of biology.

On the other hand, there are aspects of biology where your common sense will be inadequate and it will be very useful to develop “biological sense”, the ability to see the logic in the reactions, mechanisms, structures, or behaviors you will be required to learn. In this section you will learn how to build on your basic instincts. This will enable you to develop “biological sense” and to look at biology from a whole new angle and understand the content covered in the lectures with a new dimension of imagination. For some situations in biology, imagination is the way to take you where you want to go.

Instinct #1 - Think Biology at the Microscopic and Macroscopic Levels

A good portion of what you learn in your biology class will be about events that you cannot see because they occur at a microscopic or even submicroscopic level. On the other hand, a good

deal of what you learn in your biology class will be about events that you can observe with your own two eyes. These are macroscopic events. What happens on the microscopic level is profoundly related to the events at the macroscopic level and vice-versa.

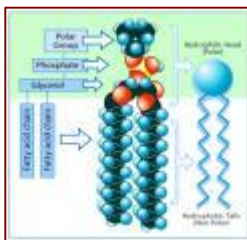
For example, in sexually reproducing species each new individual is formed by the fusion of a DNA-carrying egg and a DNA-carrying sperm.

The particular combination of DNA in the offspring may be a function of which adult female mated with which adult male, the phenomenon known as mate choice. Therefore, the DNA (microscopic) which persists in a population over long periods of time will be a function of choices made by adults during courtship and mating (macroscopic).

To learn biology you must recognize the microscopic and macroscopic and that they are often intimately entwined. Think connections!

Instinct #2 - Biology is Organized Hierarchically

Yes, life is organized! Each level of organization has its own properties and each level is more than the sum of the levels beneath it. This means that to understand how a cell membrane functions, you must understand its structure as well as the properties of the molecules which compose that structure. In this case the lower level is “molecules” and the higher level is “cell membrane”. Why higher and lower? Because molecules compose cell membranes.



Many of the molecules of the cell membrane have one of their ends attracted to water and the other end repelled by water. Knowing this fact, could one predict the existence of cell membranes? Probably not, but this property of molecules underlies the fact that cells have an “inside” and an “outside”.

So the higher level, the cell membrane, has a property (inside/outside) that the lower level does not. Inside/outside is not a property of molecules. The message is that if you put lower level stuff together you get new higher level stuff with new properties.

Cell membranes, of course, are important components of cells. It would be impossible to understand the vertebrate brain, an organ, without understanding that it is composed of cells called neurons, specialized to conduct electrical impulses. Knowing that there are cells specialized to conduct electrical impulses does not predict the existence of an organ that is capable of consciousness. Consciousness is not a property of neurons; it is a property of that extraordinary organ, the brain. But we would be hard pressed to understand consciousness (and we are!) without understanding that the brain is composed of cells that conduct electrical

impulses. Again, if you put lower level stuff together (neurons) you get, in this case, higher level stuff (the brain) with new properties (consciousness). Wow, that's pretty impressive!

More to the point, life is organized hierarchically and new and different properties emerge at higher levels based on, though very different from, the properties of the lower levels. To think like a biologist, you must consider the hierarchical organization of life.

Instinct #3 - Life is a Series of Solutions to Environmental Problems

Biologists understand that most of the phenomena they study are really life's solutions to particular problems posed by "environments" where the term environment is taken to mean any aspect of the living or non-living world that affects the subject under study. So the term can refer to all kinds of things like pH, water availability, temperature, or even the sex ratio of the population, or the type of prey available.

Living on land poses all kinds of problems for organisms, not the least of which is to keep from drying out and dying. And, of course, different organisms have solved this environmental problem differently. Let's look at one group of organism's solutions to living in especially dry environments.

Kangaroo rats are small rodents that occupy arid areas of western North America. Their environments are not only dry but oftentimes extremely hot. During the course of their little rodent lives, they may never have access to freestanding water. Even their food, dried seeds, contains very little water. Under similar environmental conditions, you would rapidly perish, yet these seemingly unremarkable rodents thrive. How? The trick is in their unusual physiology and their behavior, both of which promote the conservation of water.

Urination is one way organisms lose lots of water. You know this from your own experience because you relieve yourself multiple times daily. Urine is really just some waste products of metabolism dissolved in water. Kidneys produce urine but they also recycle water - the more efficient the kidney, the more water recycled. Kangaroo rats have unusually efficient kidneys. They are able to remove large amounts of water produced by normal metabolic processes and recycle the water for use by their cells.

This makes them less dependent on outside sources of water.

The relatively small amount of urine kangaroo rats do produce is highly concentrated - lots of waste product dissolved in very little water. That is a big step in solving the water conservation problem. But that is not the only way these rodents solve the water conservation problem. Their large intestines are also particularly adept at removing water. So the feces produced by kangaroo rats are very dry, limiting the amount of water lost by this form of waste removal.

Despite these physiological solutions to limiting water loss, kangaroo rats exposed to the hot, dry conditions rapidly desiccate and die. Their water-conserving physiology by itself is not enough to

save them. How, then, do they survive? Kangaroo rats have behavioral options, too. They live burrows which they dig.

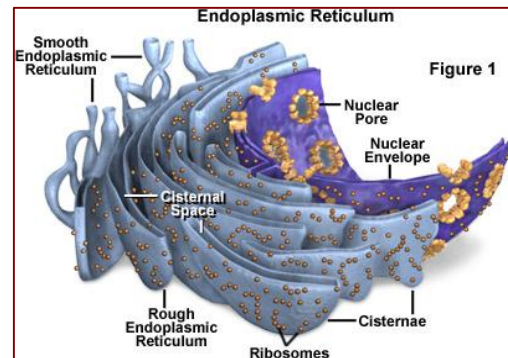
The typical temperature in a burrow is much cooler than the surface and the relative humidity may be near saturation underground. Under these conditions, much less water is lost from the body by evaporation than at the surface. In effect, kangaroo rats create their own environments - burrows that promote water conservation. If that is not enough, they are active primarily at night when the temperature is low and the relative humidity is high above ground. By their behavioral choices kangaroo rats may rarely experience hot, dry conditions despite being surrounded by them. That's a pretty good solution to a potentially deadly problem.

If you want to learn biology, think problems and solutions. Just about everything you study in biology is a solution to some kind of a problem. The three-dimensional shape of a protein and the shape of a woodpecker's beak; the inner membrane of the mitochondria and the tympanic membrane of the ear; the sex ratio of sibling fig wasps and the mating system of zebras - all are solutions to problems posed by environments.

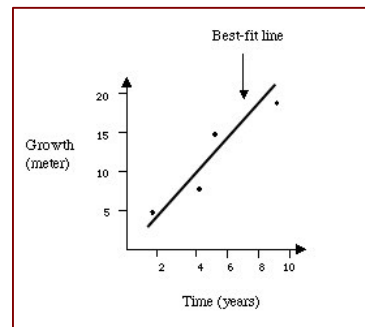
Instinct #4 - Visualize Biological Structures and Processes

Biologists are adept at understanding complex relationships of life. How? In part, by composing pictures, graphs, and flow charts to illuminate structures and processes. To make biology real to you and to develop biological sense, try to visualize it through pictures, graphs, and flow charts.

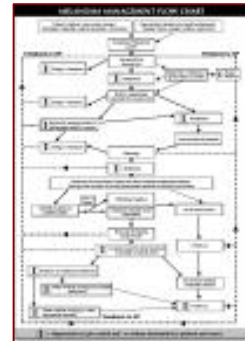
Think pictures. Try to imagine how structures look in three dimensions. For example, when you think about the cell, imagine a series of membranous sacks connected to one another surrounded by a larger membranous sack. In effect that is the endomembrane system, stretching from the nuclear envelope to the cell membrane. As you might imagine through your picture, it is involved in processing stuff in the cell and exporting stuff from the cell, among other functions.



Think graphs. You might be interested in how fast blue whales grow in the Pacific Ocean. A graph could provide key insights this phenomenon.



Think flow charts. Thinking about the large number and the complex relations between cells, tissues, and hormones is challenging. Flow charts are useful tools to help your thinking. To understand the production, release, and delivery of hormones to the tissues, a flow chart outlining the relations and interactions brain cells, brain hormones, glands and their cells and their hormones and the tissues they target is the only way to go. Try thinking about all these relationships without a chart. It's mind bogglingly difficult.



Instinct #5 - Follow the Energy

A good deal of the cellular machinery, anatomy, physiology, and behavior biologists study is devoted to the production or acquisition or conservation or use of energy. After all, it all comes to a screeching halt without enough energy. So whatever aspect of biology you are studying may involve energy either directly or indirectly.

How can a 500 kg crocodile survive, grow, and thrive when it routinely eats less than a 50 kg teenage boy eats over the course of a year? Why is there a thing in your cells that has its own molecules and also reproduces independently of your cells as if it's a stealth creature? Some humans have the unique capacity to store large amounts of fat in their buttocks. Some bacteria can enter a state of "suspended animation" for hundreds or perhaps thousands of years.

Why do the savannahs of East Africa support huge numbers of organisms while that icy desert, Antarctica, supports so few? Wolves can chase their prey for dozens of miles and cheetahs are hard pressed to chase their prey for more than a mile. Elephants routinely communicate with one another over very long distances without the benefit of cellular technology or the internet. How? Why do so many groups of complicated chemical reactions in cells produce the same molecule? Why do you breathe O₂ rather than N₂, after all there's a heck of a lot more nitrogen than oxygen in the air?

The answer to these questions or explanations of these observations has to do with energy, directly or indirectly. Keep energy in mind to think like a biologist.

Instinct #6 - Organisms are About Surviving and Reproducing

If you follow the energy as in Instinct #5, it will lead you to the name of the game in biology; survival and reproduction. That's what all the energy is for. After all, organisms are not rocks or clouds; living creatures are different from the non-living environment at least in part because of

what they do and how they do what they do - they survive and they reproduce copies of themselves.

Almost everything in biology is directly or indirectly about surviving or reproducing - from the intricate biochemical interplay of the clotting factors that heal the cut on your finger to the existence of your fingers; from the structure of DNA to the social structure of dolphin groups; and from the flush of sex hormones that changed your life at puberty to the gradual decrease in their secretion as you age, which will also change your life! Even the dictionary of the genetic code and codes of human behavior are related to surviving and reproducing. In this important biological sense, you are no different than the lowly bacteria in your gut or the mold growing on your shower curtain. Ouch, talk about putting us in our “biological” place!

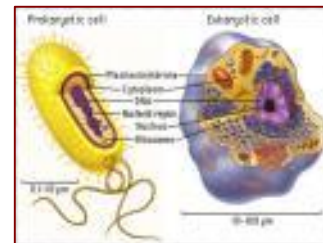
Clear biological thinking requires this understanding. Ask yourself how what you are studying is related to promoting survival or reproduction and gain a deeper and clearer understanding of it.

Instinct #7 - Biology is Also History

You know that past history contributes to the current state of affairs. You probably learned that in, well...history class! Life also has a history and that history profoundly influences all the biology we observe today.

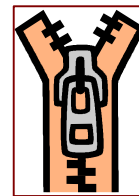
The evidence is indisputable that eukaryotic cells, the ones that compose your body, were not the first kind of cells to exist. That honor goes the prokaryotic cell, which arose about 3.5 billion years ago and, despite its relative simplicity, continues to dominate the planet. One of the most intriguing problems in biology is the origin of the more complex eukaryotic cell about 1.5 billion years ago. To solve this mystery you must understand that everything studied in biology has a history. Not much biological arises spontaneously, full blown and functional.

Scientists generally accept that eukaryotes arose from prokaryotes that ingested other prokaryotes but did not digest them. This is the endosymbiont theory of the origin of eukaryotes. Some of the parts of modern eukaryotes were independent prokaryotic cells that combined with other cells and evolved over long periods of geological time to become “eukaryotic”. In fact, it was recently reported that the endosymbiosis process is occurring among some microscopic organisms found on an Australian beach, giving scientists an opportunity to observe biological history in the making!



History can also help explain why some features of organisms seem poorly designed. If you were an engineer, it is unlikely that you would design the human birth canal as it is. Though the birth canal is quite “stretchy”, babies have ridiculously large heads compared to the width of the birth canal, even when it is maximally stretched. While being born may be a momentous event in your life, it also causes great pain and sometimes even mortality to mother and child.

If an engineer had designed a “baby delivery system”, a zipper across the mother’s abdomen would have been the way to go. At delivery time, simply unzip the mother’s abdomen, reach in, pull out the baby, and re-zip the zipper to close the abdomen. Whopping big baby heads are no longer a problem and the process is swift, painless, and safe for all.



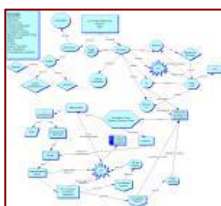
So why the suboptimal solution in reality? In a word - history! The offspring of our primate ancestors had a relatively small head compared to their mother’s birth canals so zippers or other contrivances to the same end were unnecessary to insure the safety of all parties. Just as we inherited our forward facing eyes, our manipulative hands, and our inquisitiveness about the environment and each other from our primate ancestors, we also inherited that darn birth canal. Despite the problem it posed for us, a species with ridiculously large brains as newborns (and as adults for that matter), we were biologically limited to modifying our primate ancestor’s anatomy, not totally reinventing a solution as an engineer would do.

Who would have guessed? Biology is an historical science. Keep that in mind as you develop your biological sense.

Instinct #8 - SEE THE BIG PICTURE

Before you are overwhelmed by the myriad detail and the arcane terminology of a complicated, multi-step biological process, SEE THE BIG PICTURE. First ask why, then ask who-what-where-when (whichever is appropriate) and, only after you have answered these questions, ask how. The “how” question is about the details. Do not jump into the details without answering why and who-what-where-when.

The first time you confront the subject of cellular respiration, I can almost guarantee that your reaction will be something like this -



(Heart sinking in chest) “*Gasp...*are they nuts?...they expect me to understand this mish-mash of diagrams, tables, dozens of chemical reactions, lots of new terms, and cell structures? Get real.” “*Sigh...*maybe I should be an art history major.”

To avoid changing your major, to relieve anxiety, and to minimize the confusion usually associated with learning this three part process - each process containing sub-processes, each sub-process involving lots of complicated chemical reactions as steps, each step for a different reason, the processes taking place in different parts of the cell, and so on - first ask “Why? What’s the point of all this stuff?” The point of all this biology is to produce chemical energy in the form of a molecule called ATP. ATP drives an awful lot of the cell’s chemical reactions. That’s it. All this complex cellular machinery and all these chemical reactions are to produce ATP.

Now you can ask where these processes take place, what is the point of each process, and identify the molecules that enter each process and the molecules produced by each process. You are establishing the biological logic to which the details will contribute. Having established the biological logic of each process, then you can begin to ask “how?” Now that we have the logic, we are ready for the details, and the details are much more likely to make sense now (and easier to commit to memory).

Remember that for success, go BIG PICTURE \square details, not the converse. If you attempt to try to learn about cellular respiration by starting with the particulars, the details, you are doomed to anxiety, confusion, and probably failure. Think like a biologist - see the BIG PICTURE first, then figure out how the details contribute to the BIG PICTURE.

Instinct #9 - Speak the Language

Mutualistic symbiosis, oxidative phosphorylation, chemoautotroph, Okazaki fragment, coelomate, sclerenchyma, parenchyma, and collenchyma...Biologists have their own language. They use Greek- or Latin-derived terms you’ve never heard and the meaning of words with which you are familiar is sometimes different in the language of biology than in everyday language. Even the word “theory” has a different meaning in science. It may seem as if you entered a foreign country when you study biology, with a language that initially seems impenetrable. To succeed you must learn and practice the terminology of biology. This is the killer instinct without which you will not develop biological sense. Learn to think and speak like a biologist.

Sum It Up

There you are...you now have the nine keys for developing biological sense. Pay close attention to them; they will likely be the difference between learning biology with ease and, well, a less desirable outcome.

Biology, like most sciences, is about why? and how? Each of the instincts contributes to answering these questions in its own way. SEE THE BIG PICTURE addresses these questions most directly. Pay particular attention to developing this instinct, but do not neglect the other instincts. Each will serve you well as you grow your biological sense.

The Survival Tricks – Learning Biology Any Time and Anywhere

To survive, and even prosper, you must be creative to make the best of your time, even the “in between” time. The following survival tricks, exclusive to this Guide, are unique ways to enhance your biology learning any time and anywhere.

NOTICE These survival tricks are not essential study tools. They are supplemental to your application of the 5-Stage System to your biology course. The 5-Stage System - pre-lecture, in lecture, post-lecture, test preparation, and test taking - is the focus of this Guide. Remember, the core study steps are the “cake” and everything else you learn from this Guide is the “icing”.

The iPod Biology

A good number of you learn best by listening rather than seeing or doing. Whatever your preferred mode of learning, you still learn a lot by listening. There are some advantages with this way of learning, what I call “drive time convenience”. With the increasing popularity of MP3 players, a new learning media is emerging to help you learn on the go!

Biology lectures in MP3 format are available on the web for free download (see the Survival Resource section). You can download these files into your iPod and listen to them on the go - on the road, exercising at the gym, or pretty much any time you choose. Learn to multi-task and be creative in using your iPod for more than just music and videos.

Another use of your iPod is with the trend to Podcasting over the web - MP3-based blogs. Educators may start using these audio media tools to communicate biology lessons directly to students.

For the ultimate in “bio-geekiness”, search for iPod compatible biology software. Imagine being able to access the life cycle of a slime mold or a comparison of chemiosmosis in respiration and photosynthesis. Cool!

The Bathroom Biology

Forget about your usual bathroom reading fare.

Print a diagram of the circulatory system, for example, and post it on the bathroom wall. Try to visualize how the blood flows through and returns to the heart. You’ll be amazed that while you body is preoccupied with one “biological activity”, your brain can still concentrate enough to learn. What a relief...pun intended!



Little by little, day by day, you will master the circulatory system and you will be able to trace blood flow through the body as if you were reciting the alphabet. Not too shabby for a few minutes a day.

The Jacuzzi Biology

You can read your outlines while you are enjoying the Jacuzzi. The relaxed state of mind and body you seek in the Jacuzzi can stimulate your thinking and memorization. You will learn how to create your own biology cheat sheets later on and, if you laminate them at your local Kinko’s, you will have a waterproof set of reading materials.



It’s a good time to connect the dots when you are relaxed. Look over the course materials as a whole on your laminated sheets and learn to see the connections between the concepts.

The Palmtop Biology

I am not talking about your Palm Pilot or PocketPC. Use your bare hands. Write a key formula, equation, or idea on the palms of your hands for your daily study. Read it over 10-15 times - whenever you get a moment. You will be surprised how effective this will be. Before you know it, a long list of things to memorize becomes a short list.

The Poker Chemistry

Buy a deck of playing cards, blank on one side. Come up with a list of the key things you need to know in your biology course. A poker deck works better than the usual 3 x 5 cards because the poker deck has some unique advantages as a study aid.

First of all, the deck has 52 cards - limiting you to the top 52 concepts, systems, mechanisms, reactions, equations, and so on. That's quite a substantial number. The size of each card forces you to write keys that trigger your memory, because of their limited space. With flash cards, you might tend to cram everything in the 3 x 5 space, trying to create a mini-textbook. That defeats the purpose of flash cards - they should be condensed versions of memory keys.



Second, the poker deck has a natural order built in that you can use to assign priorities. Use the face cards (Jack, Queen, and King) and the Aces for more important or more difficult keys and the rest for easier keys. You can even use their numerical order to help you keep track of their relationships.

You can also associate a particular card with a given concept, a memory technique known as the method of loci. A deuce could represent the constants of the logistic equation of population growth - the intrinsic rate of increase and the carrying capacity. Hey, that works out nicely...the two card associated with two constants.

Finally, there is my favorite reason to use poker cards - the smaller and round cornered poker deck is much easier to put in your pocket than the bigger, sharp-edged 3 x 5 cards.

Recite your deck daily. Separate the cards into two piles - "A" and "B" - with rubber bands. "A" contains the keys that you have already mastered and memorized. "B" holds the keys that you need to work on more. Over time you're "A" piles will get bigger as the "B" pile shrinks - visual evidence of your growing success. Think of the major boost to your confidence you will get as you walk into the final exam!

The Bedtime Biology

Get comfortable and do all your reading in bed...NOT! I am sure you've tried reading in bed before and discovered that bed is like a prescription sleeping pill. It's tough to read with your eyes closed. You definitely do not want to do your core studying there.

So what is "Bedtime Biology"? The last thing you read before you go to sleep should actually get in your long term memory bank easier. Read part of your cheat sheet or some of your memory key poker cards before you go to bed. Your brain will continue processing their information as you sleep. You might even dream biology. Follow this technique nightly, reading no more than three items per night.

Remember - the survival tricks are supplemental to the 5-Stage System. Use them to your advantage but they do not replace the real means to your success, the 5-Stage System, the key subject of this Guide.

CHAPTER 2: THE SURVIVAL GEAR

To be a successful biology student you must pay more attention to organizing your “gear” than you do to organizing your bedroom! An important element of your gear is a notebook. Each class merits its own notebook and biology is no exception.

Make sure you use standard 8 ½ x11 inch paper with a three ring binder. Why not use a yellow lawyer’s pad of paper - there’s a lot more space for writing? The problem is that you cannot safely revise and insert class handouts, weekly planner notes, preview notes, and so on. Stuff will just fall out of the pad to your detriment. You are likely to lose that important handout you need for the next test. You will certainly lose the one you got two months ago at the beginning of the course. Careless handling or a windy day could be disastrous. And, of course, an advantage of a three ring binder is that you can take pages out and spread them over your desk while you study and re-insert them safely when you are done.

Remember, the sequence of lectures follows the logic of biology and the content of consecutive lectures is usually related. You want your notes organized in the same way to take advantage of this fact. Use a three ring binder with standard size paper.



This Survival Guide provides you with a number of templates as part of your Biology Survival Kit. All the templates are designed for your three ring binder and to be printer friendly. Print as you need them. Print them on 8 ½ x11 paper and punch them...three holes, please. Now, they will fit your biology notebook and you don’t have to worry about losing them.

In this chapter, you are introduced to a series of templates which, if used properly and consistently, will improve your performance measurably and markedly. They are your “survival gear” to be used with the BioMastery System outlined in subsequent chapters. The BioMastery system is the set of instructions, the detailed blueprint if you will, describing how to use your survival gear, the templates. Your success begins here.

BioMastery Preview Template

This template is designed to prepare you for upcoming lectures. Filling it out takes about 15 minutes, not a terribly large investment of time. Your reward? You will be familiar with the content of the lecture - the ideas will not sound so strange and formidable because you are not walking into the lecture hall “cold”. You will not get lost during the lecture - your mind will not turn off as it tends to do when you get lost during a lecture.

This single page worksheet couldn't be simpler. It's divided into just two areas:

Key Concepts: This part of the worksheet is a column where you note key terms, or important mechanisms, or key concepts, or formulas/equations, or other important non-mathematical relationships, and so on.

Important Questions: Now that you've picked out the "key concepts", as above, you probably have questions about them. Write a question or two for each of them in this column. These questions are what you hope to get answered by the lecture material.

BioMastery Preview Notes Upcoming Lecture

#	Top 5 Key Concepts	Top 5 Burning Questions
1		
2		
3		
4		
5		
Extra		

Bring this template to lecture and check off each item as its related question(s) is answered. This template really makes quite a difference compared to coming to lecture with no preparation. Not only are you intellectually prepared, but you are psychologically prepared. You are focused because you have clear, specific goals - answering your questions!

Lecture/Reading Note Template

The BioMastery Lecture/Reading Note Template is designed to enhance your note taking in the biology lecture hall and from your biology textbook. And the design, once again, is simple. It is a

piece of lined paper divided into three areas, or “panes”, much better designed for your purposes than a plain old sheet of paper. The notes you make in these panes will become your own personal mini-textbook. When you use this template properly, the course will become a piece of cake!

Notes (Left Pane): This large pane is where you write your notes. Write your notes in an outline form. Try to record as much of the lecture content in this format as possible. Much of the material may be presented as bulleted points, flow charts, graphs, equations or pictures. These are ideal for the Notes pane because they condense a lot of information into a small space

Cues (Right Pane): Use this pane to write questions generated from the Notes pane on the left. These questions are your cues. Be sure to capture the main points from your notes in these questions. To aid you as you formulate your questions, think about them as potential candidates for test questions. By formulating questions from your notes, you are “confronting” the material, compared to simply stopping at the note-taking stage. Actively confronting the material forces you to think about it - and thinking leads to clarity. By thinking about the concepts and terms you gain understanding and, almost as a byproduct, you are memorizing too.

BioMastery Lecture Notes **Note:** ____

Notes: Use outline format	Cues: Add questions

Keys	
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In Lecture: Take lecture notes using the Notes area; Post-Lecture: Complete the Cues with Questions & Keys with lecture keys.

Keys (Bottom Pane): In the Keys pane, write a condensed outline of the information in the Notes pane. Here is where you boil the information down to its essence. Do not summarize or rephrase, just extract what you need so you have the major points and terms, defined in such a way that you understand them. This pane is also the place for the important tables, equations, graphs, and so on. What you write in this pane should trigger your memory. But remember - we are not interested in a laundry list, just the important and hard to remember keys.

The Notes pane is to be filled out during the lecture or while reading from the textbook or other important materials. The Cues and Keys panes are to be completed after the lecture or the reading session.

As you can see this template is straightforward in its construction, the Notes pane on the left, the Cues pane on the right, and the Keys pane at the bottom. Refer to the Stage 2 instructions of the BioMastery system in Chapter 3 for a more detailed, step-by-step guide for using this template.

Cheat Sheet Templates

The purpose of the cheat sheet is to produce concise study notes for test preparation. Cheat sheets are unequivocally not for cheating! Cheating is a very serious academic infraction and is likely to have serious consequences, up to and including suspension or expulsion. Do not cheat! Do not bring your cheat sheet to the classroom when an exam is scheduled.

Used properly, your cheat sheet will cut down your study time and you will achieve better exam results. Creating your cheat sheet is an extremely useful exercise and studying your cheat sheet is an effective way to prepare for an exam.

When you complete your BioMastery notes/reading template (see above) for lecture and textbook readings, you can easily create your cheat sheet. The cheat sheet template is a four column sheet for memory keys. You've already prepared your memory keys - just go to the Keys pane of your reading/lecture note template and copy them to your cheat sheet.

BioMastery Chapter Cheat Sheet Chapter:___

Key Concepts, Facts, Theories, Mechanisms, and so on are to be listed in this Cheat Sheet

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Think of your cheat sheet as your own version of CliffsNotes, except it's free. You remember CliffsNotes, don't you? They synopsise classroom material into bite-sized chunks relieving the purchaser of attending lectures, taking notes, reading the text, and doing the problems. Unfortunately (some might say, fortunately), CliffsNotes shortcuts are not available for your biology course, and I'd be surprised if they were useful if they existed, so create your own with the cheat sheet templates.

Problem-Solving Worksheet Template

The format of the problems posed to you in your biology course is dizzying - from multiple choice to fill in the blanks to matching terms to short answers to essays to the mathematical to the graphical and others. ARRGH! Clearly no single template can easily accommodate all these kinds of problems. So we provide you with a template one for "essay-ish" kinds of questions. You're on your own for multiple choice, fill in the blanks, and matching terms kinds of questions. But you already know how to solve them, the general solution involving eliminating choices you know or suspect are wrong and selecting from the choices that remain.

BioMastery BIG-CPA Problem Solving Work Sheet____

<i>Step #</i>	<i>Instructions</i>	<i>Solution</i>
1. <u>B</u> egin by Reading	<ul style="list-style-type: none"> • Read the question carefully 	
2. <u>I</u> dentify	<ul style="list-style-type: none"> • Identify the type of problem 	

3. <u>Generate</u>	<ul style="list-style-type: none"> • Generate the relevant ideas for your answer 	
4. <u>Connections</u>	<ul style="list-style-type: none"> • Make the pertinent connections between your ideas 	
5. <u>Plan</u>	<ul style="list-style-type: none"> • Plan your answer • Make an outline 	
6. <u>Answer</u>	<ul style="list-style-type: none"> • Carefully and thoroughly write your answer 	

The BIG-CPA Method is designed to help you formulate answers to questions that require more than simple regurgitation of information. These kinds of questions may ask you to interpret and/or synthesize information in a new way, usually in the form of an essay or at least something more than the typical short answer. BIG-CPA is a systematic approach and it will help you understand the question and design and execute a thorough answer, based on your knowledge of the subject. Head to Chapter 7 for the details and an example.

Mock Exam Template

This is a very useful template, even more so if you can think like your instructor. Try to imagine how your instructor would write the exam. If you've already taken an exam you have a pretty good idea about the format and the kind of detail to expect. Then pick out the topics/ideas that you think are fundamental, critical, important, or useful. And you will have a pretty good idea by now which ones they are, given your use of the other templates. Create questions in the style of your instructor. Go for it!



Use the template below to put together your mock exam.

BioMastery Mock Exam Exam:___

Exam Questions	Solutions	Exam Questions	Solutions
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Write down your best exam questions from Cues section of Lecture/Reading templates. Review Notes section and earlier exams.

Weekly Study Organizer Template

Organization and time management are the bane of many students. No matter what they try, things are all over the place and there is never enough time for all the things that need to be done. It's tough to excel in a biology course, or any science course for that matter, when you're scattered.



Maybe you just need a little help - help in the form of the work study organizer template. Learn to use the work study organizer template. Not only will it serve you well in biology courses, it will make your life easier in all your courses because students usually have fairly predictable schedules from week to week. Learning to develop organizational and time management skills will have a lasting impact later in your life too.

Biology: Weekly Study Organizer

Course:		Week Starting:	
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Directions: Print this template each week and put it to the 3-ring binder for your biology course. For each lecture day, check off the required BioMastery tasks before, during and after the lecture, as outlined in the Survival Guide, and weekly homework and other assignments. For non-lecture day, skip the Pre-Lecture and In-Lecture scheduling.

	Monday	Tuesday	Wednesday	Thursday	Friday
Pre-Lecture					
In-Lecture					
Post-Lecture (Completion of the lecture's Cues and Keys)					
Reading & Homework					
Others					
Homework Due Dates:			Upcoming Exam Dates:		
Chapter	Date(s)	Notes	Exam	Date(s)	Notes

Notes	
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Four Rules for Using the Weekly Study Organizer

Follow the rules below for the most effective use of the Weekly Study Organizer.

Scheduling: Fill in the daily task on your Study Organizer. Think of this as making an appointment with yourself and committing time to your course. Do this routinely. Life will be easier because you are beginning to manage your time.



Listing: Now that you've blocked out the time slot, list all the study items needed for each hour. Here comes the organization.



Subtasking: Break down each task into smaller bits, “subtasks”. Rather than writing a general statement like “read the text”, write down the sections to be read, their headers, and even the page numbers of each section. Here comes more organization.

Checking Off: When you finish your scheduled task, check it off from your daily list. Then pat yourself on the back for completing the task and using your new found organizational skills. Giving yourself credit reinforces your behavior.

Seven Ways to Effective Time Management

Use the weekly planner: Organize your study schedule on a weekly basis. Use the printable template to print out the copies you need and add them to your three ring notebook. Plan your weekly schedule on Sunday evenings and adjust it daily, if needed. Time...you own it!



Schedule firm activities first: Block off your class time, your work time, and time for any other routine activities. Don't forget to schedule time for sleep, meals, and, importantly, relaxation.

Schedule short study sessions before and after lectures: Set aside 20 minutes to preview the relevant sections of the textbook before the lecture and another 20 minutes to review your notes after the lecture. Doing this routinely gets the information into your memory easier. These kinds of “reinforcing” activities really have a big payoff because they save you hours of study time. That’s efficiency.

Avoid marathon study sessions: Studying a subject for hour after hour is usually an act of desperation rather than a useful approach. You will use your time more efficiently if you divide your study sessions into one hour blocks, with 50 minutes for study and 10 minutes for a break. Taking a 10 minute break actually increases your efficiency because - and you know this - you concentrate better when your mind is fresh and clear. A foggy mind is not an efficient mind.



Use a timer: A timer will make it easier to keep to your 50 minute study/10 minute break schedule. It’s a tool to help increase your efficiency and keep your mind clear.

Use your most productive hours for core study: You know when your mind is sharpest and clearest - for the early birds it’s the morning and for the night owls it may be after midnight. Take advantage of your natural rhythms to save time and increase your study efficiency. Schedule your most demanding tasks for when you are at your best and most likely to absorb and understand that complicated section from the textbook or prep for that comprehensive final exam. You know yourself best. Use that information to your advantage.

Be flexible: It is important to stick to your schedule, but being rigid about it may sometimes be counterproductive. Be flexible. Be ready to adjust your schedule should events dictate. Leave some “play” in the schedule, if you can. Your life is probably not always entirely predictable (fortunately), so keep this in mind as you schedule your week on Sunday evenings.

ABOUT THE AUTHORS

Wayne Huang received his master degree in physical organic chemistry from Ball State University, Indiana and PhD in computational chemistry from University of California, Irvine, with Professor Warren Hehre, whose advisor was John A. Pople (1999 Chemistry Nobel Prize Laureate).

He has co-authored numerous chemistry books (including textbooks used by many universities around the world). He has also pioneered a ChemWizard system - using math modules to solve chemistry problems in real time. He co-found MolecularSoft Corporation to develop and publish the popular Homework Wizard software - SoftChemistry. He is also the chief editor of "Chemistry Tips and Tricks", now a daily newsletter serving thousands of students. He is the "Chemistry Survival Coach" for his survival coaching program. He has also trained hundreds of chemistry professors across United States in the field of molecular modeling for chemical education.

His passion is to write books and develop learning tools to share with science students his breakthrough learning system, mostly recently the "Chemistry Survival Kit" and "Biology Survival Kit". He is also the creator of RapidMastery series - A fast-track to science mastery, including biology, high school chemistry, AP chemistry, College chemistry, organic chemistry and biochemistry, with more to come.

Theodore J. Nusbaum received a bachelor's degree in Biology from the University of Chicago, a master's degree in Ecology from Yale University, and a Ph.D. in Evolutionary Genetics from the University of New Mexico. Subsequently Dr. Nusbaum conducted research and taught at the University of California-Irvine.

Dr. Nusbaum has published a number of articles on evolution, senescence, stress, demography, physiology, and other subjects in various scientific journals and books. His research focused primarily on laboratory selection and postponed aging.

Dr. Nusbaum has also taught many biology courses to students in all grades from 6th through graduate school over the past 20 years in various private and public schools and he has trained hundreds of students in the methods of biological research. He has also worked with science textbook publishers on curriculum development. Dr. Nusbaum is keenly interested in developing methods for effectively teaching and learning biology