

Preface

Another name for the *Student Study Guide for Campbell Biology*, Eleventh Edition, could be "A Student Structuring Guide." This guide is designed to help you structure and organize your developing knowledge of biology and create your own personal understanding of the topics covered in the text. Take a few minutes to learn about some strategies of successful students, as well as some strategies for using this study guide.

Strategies of Successful Students

What does it take to be a successful student? How can you learn more efficiently and earn better grades? And how can you enjoy your biology course more?

Every successful student tackles learning in his or her own unique way. But there are commonalities that can be shared and results from educational research that can inform you as you develop your own approach. Here is a short list of suggestions that may help.

Make it interesting. Biology is fascinating and so much easier to learn when you love it. Try to bring a sense of wonder to your classes and your studying. Appreciate how much has been discovered and how much we have yet to learn about the living world.

Focus in lecture. What does it mean to focus? Obviously sleeping and texting are out, but so is taking down every word your professor says without thinking. If a lecture outline is provided, take notes on it. (There is evidence that many students learn better if they take notes by hand.) Try taking notes on one page of a notebook and then on the facing page rework, elaborate, or at least make legible what you wrote down in class. Doing this shortly after class helps you review the material while it is fresh and develop an organized set of notes to use in studying for exams.

Make reading active. Research has shown that simply rereading material does not improve test scores, but interacting with the reading assignment does. How do you interact with the printed word? Ask yourself questions and look for answers. Rework every concept heading as a question before you start

reading. Make questions out of subheadings. If you are trying to answer a question, you are looking for meaning. Your brain is not just decoding words, it is working toward understanding those words.

Use your resources. What does your course provide—review sessions, office hours, tutors, study groups? Science is a social endeavor; interact with people as well as the material. Use the resources provided by your course and by your textbook: web sites, practice exams, tutorials. When possible, prepare for exams by practicing with questions from previous exams. Each professor has his or her own approach to writing questions. One way to improve your grade is to study how your professor asks questions.

Learn from your mistakes. Carefully review your exams—the questions you missed and even those you got right. If possible, go over the exam with an instructor. Review both *what* you missed and *why* you missed it so you can learn *how* to choose the correct answer on the next exam. Work to improve your test-taking skills. (See the section on tips for taking tests.)

Write your own questions. Making up your own questions forces you to do the same thing that your instructor does: determine what is most important and identify areas of common misunderstanding. Often your questions will closely resemble those that your instructor uses. If you have a study buddy, you can exchange questions and practice answering them. If your buddy's questions surprise you, discuss why he or she thought the material was important enough to be on an exam.

Try something new. If what you are doing isn't working, don't just keep trying to do it harder. Different study mechanisms work for different people. Experiment with new strategies. Research has shown that taking tests is an excellent way to learn. So answer all the questions in this study guide and go in search of more. Work with others and ask each other questions. Try studying in different locations and for differing lengths of time. Be creative and have fun learning.

Strategies for Using This Study Guide

This study guide is not a replacement for your textbook or biology class. However, it should help support and even streamline your learning process. Some students read the text chapters before lecture and then read the study guide chapters after class to reinforce and review. Others reverse that order, skimming the study guide before lecture and then carefully dissecting the text after the professor's presentation. Use this study guide to prepare for tests. With the textbook open so you can refer to essential diagrams, read the relevant study guide chapters for a quick review.

Each study guide chapter has the following seven sections:

- The listing of the **Key Concepts** from the text keeps you focused on the major themes of the chapter.
- The **Framework** identifies the overall picture; it provides a conceptual framework into which the chapter's information fits.
- The **Chapter Review** is a condensation of the textbook chapter, including a brief summary for each concept heading. All the bold terms in the text are also shown in boldface in this section. Interspersed in this review section are **Interactive Questions** that help you stop and actively review the material just covered.
- The **Word Roots** section presents the meanings of key biological prefixes, suffixes, and word roots. Examples of terms from the chapter are then defined. Breaking a complicated term into identifiable components will help you to recognize and learn many new biological terms.
- The **Structure Your Knowledge** section directs you to organize and relate the main concepts of the chapter. It helps you to piece together the key ideas into a bigger picture.
- In the **Test Your Knowledge** section, you are provided with objective questions to test your understanding. The multiple choice questions ask you to choose the best answer. Some answers may be partly correct; almost all choices have been written to test your ability to discriminate among alternatives or to point out common misconceptions.
- Suggested answers to the Interactive Questions, the Structure Your Knowledge section, and the Test Your Knowledge questions are provided in the **Answer Section** at the end of the book.

Using Concept Maps. What are the concept maps that appear throughout this study guide? A **concept map** is a diagram that organizes and relates ideas. The *structure* of a concept map is a hierarchically organized cluster of concepts, enclosed in boxes and connected with labeled lines that explicitly state the relationships among concepts. The *function* of a concept map is to help you structure your understanding of a topic and create meaning. The *value* of a concept map is in the thinking and organizing required to create it.

Developing a concept map requires you to evaluate the relative importance of a group of concepts (Which are most inclusive and important? Which are subordinate to other concepts?), arrange the concepts in meaningful clusters, and draw and label the connections between them.

This book uses concept maps in several ways. A map of a chapter may be presented in the Framework section to show the organization of the key concepts in that chapter. An Interactive Question may provide a skeleton map, with some concepts provided and some empty boxes for you to label. This technique is intended to help you become more familiar with concept maps and to illustrate one possible approach to organizing the concepts of a particular section.

You will also be asked to develop your own concept maps on certain subsets of ideas. In these cases, the Answer Section will present a suggested map. A concept map is an individual picture of your understanding at the time you make the map. As your understanding of an area develops, your map will evolve—sometimes becoming more complex and interrelated, sometimes becoming simplified and more streamlined. Do not look to the Answer Section for the “right” concept map. After you have organized your own thoughts, look at the answer map to make sure you have included the key concepts (although you may have added more), to check that the connections you have made are reasonable, and perhaps to see another way to organize the information.

Tips for Taking Multiple Choice Tests. When instructors write multiple choice questions, they ensure that at least one of the wrong answers sounds plausible. One way to avoid being caught by the plausible wrong answer is to read the stem of the question carefully without looking at the answers. Try to come up with a correct answer to the stem. Now when you read each answer carefully you are looking for one that matches what you already know

is correct. If you aren't sure about a question, try rereading the question and each choice individually. Don't do all of your thinking in your head. Write in the margins and blank spaces of your test. Draw yourself diagrams and pictures. Write down what you do know, and it may jog your memory. If you still are not sure, mark the question and come back to it later. As you work through related questions, you may find information that helps you figure out that question. And remember, there is no substitute for good preparation, proper rest and nutrition, and a positive attitude.

Biology is a fascinating, broad, and exciting subject. *Campbell Biology*, Eleventh Edition, is filled with

- 1.1 The study of life reveals unifying themes
- 1.2 The Core Theme: Evolution accounts for the unity and diversity of life
- 1.3 In studying nature, scientists make observations and form and test hypotheses
- 1.4 Science benefits from a cooperative approach and diverse viewpoints

CHAPTER OBJECTIVES

This chapter outlines the broad scope of biology, identifies themes that unify the study of life, and discusses the scientific construction of biological knowledge. A course in biology is neither a vocabulary course nor a classification exercise for the diversity of life. Biology is a collection of facts and concepts structured within theories and organizing principles. Recognizing the common themes within biology will help you structure your knowledge of the fascinating and challenging study of life.

CHAPTER REVIEW

Biology is the scientific study of life with *evolution*, the process of change that has shaped life from its origin on Earth to today's diversity, as its organizing principle. The properties and processes of life include highly ordered structure, evolutionary adaptation, response to the environment, regulation, energy processing, reproduction, and growth and development.

1.1 The study of life reveals unifying themes

Common Themes Emerge at Successive Levels of Biological Organization The scale of biology extends from the biosphere to molecules.

information organized in a manner that will help you build a conceptual framework of the major themes of biology. This *Student Study Guide* is intended to help you learn and recall information and, most importantly, to encourage and guide you as you develop your own understanding of and appreciation for biology.

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Write a brief description of each of the following levels of biological organization.

- a. biosphere
- b. ecosystems
- c. communities
- d. populations
- e. organisms
- f. organs and organ systems
- g. tissues
- h. cells
- i. organelles
- j. molecules

Biology today combines the powerful strategy of *reductionism*, which breaks down complex systems into simpler components, with *systems biology*, which studies the interactions of the parts of a system and models the system's dynamic behavior. The structural arrangement of and interactions among components at each level of biological organization lead to emergent properties at the next level. The form of a structure is usually well matched to its function. Structure and function are correlated at all levels of biological organization.

The cell is an organism's basic unit of structure and function—the lowest structural level capable of performing all the activities of life. Every cell is enclosed by a membrane. Cells of bacteria and archaea are prokaryotic cells, which lack a membrane-bound