

BIBLICAL WORLDVIEW SHAPING

in Biology 6th Edition

*Why is life important?
What should we do and
how should we act in
response to that answer?*

Science, as the systematic study of the physical world through observation, helps us understand nature. Great effort is undertaken not merely to satisfy curiosity but primarily to provide a way for people to master their environment. This mastery is desired to preserve life and to see it thrive. This is a worthy goal because life, especially human life, is important.

Most worldviews agree with this reasoning, but the next step is where the paths greatly diverge. This textbook provides a thoroughly biblical answer to these questions in the realm of biology. It does so by using the four biblical worldview themes: Foundations, Ethics, Design, and Modeling.

Early in the course students will more often recall and explain these themes. As the themes are repeated, students will evaluate ideas within them, formulate a biblical understanding of them, and apply what they have learned about them to real-life situations. High levels of internalization are expected whenever the students are required to apply their learning.

KEY

- R: Recall
- E: Explain
- EV: Evaluate
- F: Formulate
- A: Apply

FOUNDATIONS

Science does not exist in a vacuum. It depends on a historical and philosophical basis that provides context and direction. This foundation is in God's Word, yet secular biology rejects God and His truth and embraces naturalism and evolutionary theory. In turn, naturalists ridicule others as unscientific and unobjective.

How can I be a good scientist without compromising with naturalism?

How can I effectively challenge false worldviews in biology?

CH 1	CH 2	CH 4	CH 5	CH 7	CH 10	CH 11	CH 13	CH 19	CH 20
R, E, EV	E	E, EV	EV	E	EV	F, A	F	F	EV

ETHICS

All life is precious to God; thus ethical choices in biology have significant potential for good or harm. Though God expects obedience, the world has created its own standards and criteria for bioethics. These guidelines often contradict or ignore His commands.

How differently would the principles of bioethics and biblical ethics answer a matter?

How can biblical principles, outcomes, and motives guide my decisions?

CH 1	CH 2	CH 5	CH 6	CH 15	CH 17	CH 18	CH 20	CH 23	CH 24	CH 25
E (2)	E	EV	F	F	F	F	EV	EV	A	F, A

DESIGN

All nature testifies to its Creator, including the living things studied in biology. Nevertheless, many reject such obvious truth. They assume that life spontaneously appeared and developed through natural processes over billions of years.

Why is it unreasonable to claim that life developed without a Designer?

How should I respond to the truth that life is designed by God?

CH 3	CH 4	CH 7	CH 8	CH 9
E, EV	F	E, A	EV	F
CH 14	CH 16	CH 19	CH 20	CH 25
F	F	F	E	EV

MODELING

As tools for describing natural phenomena, models can greatly aid scientific progress if they closely align with God's revelation. Models are only approximations, but secularists often cling to them as sources of truth, ignoring sin's influence on science and rejecting God's truth.

Which model best matches Scripture and observations from nature?

Are the underlying assumptions and goals of this model biblical?

CH 1	CH 4	CH 9	CH 10	CH 12
E	EV	EV	EV, F	EV

Scan this code for a fuller discussion of these themes.



NEW TO THIS EDITION

*If you have used previous editions of **BIOLOGY Student Edition**, you will notice some changes in 6th Edition.*

- The text focuses on big ideas identified by essential questions.
- Each section starts with key questions and a vocabulary list to facilitate prereading of the material. Students will know the important terms to learn and the questions that the section will answer.
- Emphasis has been placed on clearly explaining concepts and demonstrating how biological processes work.
- Each chapter is identified as foundational, key, or enrichment. Foundational chapters are crucial for students to develop a basic understanding of biology. Key chapters are very important and may contain material that appears on standardized tests. Enrichment chapters may be skipped with little adverse effect on students; use them if time allows, if a significant portion of your class is interested, or if you have gifted students who need differentiated instruction.
- Case studies and worldview investigations engage students' interest.
- Every chapter includes a mini lab activity. Each one is a short lab activity that reinforces the objectives of the section and generally requires less time and fewer materials than the lab activities in the Lab Manual.
- Ethics boxes found in many chapters present ethical dilemmas related to current topics in biology. Students formulate a biblical understanding of an issue and apply it. Students are provided with a good deal of support early in the Student Edition and become more independent as they continue through the remainder of the book.
- Each chapter ends with a chapter summary and review that presents in a few brief sentences the primary concepts of each section. This is followed by a set of chapter review questions. The reviews are divided into questions that require students to recall facts, those that compel them to demonstrate a thorough understanding of concepts, and those that require them to apply critical thinking skills.
- Chapter 10, which deals with the origins of life and changes in living things, has been expanded to four sections to deepen students' understanding of the two models presented: evolution and biblical creation.

*Additional changes and updates have been made to the **BIOLOGY Teacher Edition**.*

- The Lesson Plan Overview has been split and moved to the front of each chapter.
- Lessons are presented in the form of a four-part teaching cycle: engage, instruct, apply, and assess.
- The number and variety of instructional strategies and teaching tips have been increased.
- Resources typically made available in the past on the Teachers' Toolkit CD are instead available in BJU Press Trove.

TEACHER EDITION FEATURES

You have a lot of great material at your fingertips in this resource! *BIOLOGY Teacher Edition 6th Edition* features reduced student pages with side and bottom margins packed with educational content. Take a look at what it offers, whether you are a classroom teacher or a home educator.

Lesson Plan Overviews

A Lesson Plan Overview provides a one-stop planning center for each chapter. A Lesson Plan Overview immediately precedes each chapter. The detail in the overviews has been greatly enhanced for 6th Edition, integrating the accompanying Student Edition, Lab Manual, Teacher Lab Manual, and BJU Press Trove to give you an idea of how much time each chapter will take. Each overview includes the objectives, printed resources, digital resources, and assessments for each section. The schedule for each chapter includes a day of review and a test day.

LESSON PLAN OVERVIEW

CHAPTER 4: Interacting with the Biosphere (Key)

PPT Pres. PowerPoint Presentation LM Lab Manual EV ExamView

PAGES	OBJECTIVES	PRINTED RESOURCES & MATERIALS	DIGITAL RESOURCES	ASSESSMENTS
4.1 SUSTAINABILITY				
73–82	4.1.1 Trace the flow of materials through the biochemical cycles.	Teacher Edition • Case Study: <i>Ferretting Out the Growth Rate</i> • Mini Lab: <i>Predation and Populations</i> (p. 83) • Section 4.1 Review Answers Materials • beans • pipe cleaners • chalk	BJU Press Trove* • Link: <i>Are Fires Actually Good for Forests?</i> • PPT Pres.: Section 4.1 Slides	Student Edition Section 4.1 Review Assessment Section 4.1 Quiz
	4.1.2 Describe the factors that limit or promote population growth and biodiversity.			
	4.1.3 Analyze data on a population growth chart.			
	4.1.4 Distinguish between primary and secondary succession.			
	4.1.5 Formulate a statement on the significance of the predictability and orderliness of ecosystems. SW Design (formulate)			
LAB 4A FOREST OR FARM?—A MATHEMATICAL MODEL OF BIODIVERSITY				
LM 27–32	Carry out a field transect. Analyze the diversity of an ecosystem using Simpson's Diversity Index. Interpret the meaning of the Simpson's Diversity Index value for a particular ecosystem.			Lab Manual Lab Report
LAB 4B HALE HARDWOODS OR SICKLY CEDARS?—MONITORING FOREST HEALTH				
LM 33–38	Demarcate a forest plot. Measure tree circumference. Derive characteristic data related to forest health. Infer forest characteristics from indirect measurements.			Lab Manual Lab Report
4.2 THE HUMAN NICHE (2 DAYS)				
84–89	4.2.1 Explain the role that people play in managing the earth. SW Foundations (explain)	Teacher Edition • <i>Worldview Investigation: Creatures and Climate Change</i> (p. 90) • Section 4.2 Review Answers	BJU Press Trove • Link: <i>Ecological Footprint Calculator</i> • Links for Student Research • Instructional Aid: <i>Worldview Investigation Rubric</i> • PPT Pres.: Section 4.2 Slides	Student Edition Section 4.2 Review Teacher Edition <i>Worldview Investigation Rubric</i> (Appendix F) Assessment Section 4.2 Quiz
	4.2.2 Evaluate arguments about changes in the environment. SW Modeling (evaluate)			
	4.2.3 Evaluate bias in the field of ecology. SW Foundations (evaluate)			
	4.2.4 Relate different fields of science to ecology.			

*Digital resources for homeschool users are available on Homeschool Hub.

L-92a Chapter 4

Chapter Overviews— Chapter overviews give you a bird's eye view of the key concepts covered and will identify each chapter as either foundational, key, or enrichment material.

Section Overviews— A section overview alerts you to the essential question, objectives, biblical worldview shaping themes, materials, and main ideas for that lesson.

Outside Resources— Some notes alert you to where or how to find additional resources for teaching the material.

CHAPTER Objectives

- Summarize the attributes of living things.
- Relate the study of biology to worldview.
- Defend the necessity of a biblical worldview for making sound ethical decisions.
- Describe the process that scientists use to answer questions. (Lab 1A)
- Describe the care and use of a light microscope and identify its parts. (Lab 1B)

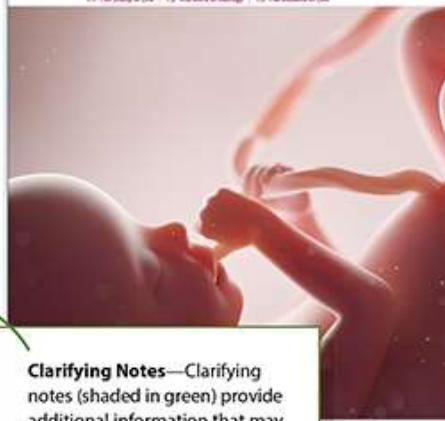
Chapter Overview

Chapter 1 is a foundational chapter that introduces biology and the reasons to study it. It also introduces the ideas that biology can be used to show love for others and that the work of biology can best be done within the context of a biblical worldview. Ideas that are revisited throughout the Student Edition. It is important that students finish this chapter with a clear understanding of how science works and how it should be viewed from a biblical perspective.

Looking Ahead to Lab 3B

If you plan to do Lab 3B with your students, be mindful that the activity requires a day for setup followed by four or five weeks for observation. (See the Lab 3B: Must You Be So Competitive? teacher note on page 63). That means that you will probably need to start the activity sometime during your coverage of Chapter 1, depending on your schedule. Plan your time accordingly.

1 THE LIVING CREATION



Clarifying Notes— Clarifying notes (shaded in green) provide additional information that may facilitate teaching the material.

SECTION 1.1 Overview
What makes something alive?

Objectives

- 1.1.1 Define biology.
- 1.1.2 Compare how naturalists and Christians view biology.
- 1.1.3 Explain the need for a worldview in the study of biology.
- 1.1.4 Summarize the six attributes of life.
- 1.1.5 Relate the six attributes of life to specific biological structures and functions.
- 1.1.6 Identify the sources of energy and information for a living organism.

Biblical Worldview Shaping Foundations (evaluate)

Christians and naturalists observe nature very differently because of opposing narratives on origins.

Foundations (explain)

A worldview provides presuppositions that profoundly affect a person's view of biology. (1.1.3) Remember that cells, reproduction, metabolism, organization, growth, and response are the six attributes of life. (1.1.4)

Printed Resources

- Review Section 1.1 Review Answers
- Assessment: Section 1.1 Quiz

Digital Resources

- Video: God's World
- Video: In the Beginning

Overview

Section 1.1 lays the foundation for further study of biology. The section defines what biology is, explores the importance of worldview in the study of biology, and considers the six attributes shared by all living things.

Ultrasound versus Sonogram

The chapter opener includes the term sonogram. Some students may be confused about the difference between a sonogram and an ultrasound because the two terms are sometimes used interchangeably. Ultrasound is the technology that is used to create a sonogram, the image that is produced.

Background Notes— Background notes (shaded in black) provide extra information that you can share with your students to enhance their learning.

TEACHER EDITION FEATURES

(continued)

Teaching Strategies—
A variety of instructional strategies are presented for each lesson to help teach, reinforce, and assess the information presented.

Formative Assessments—
Formative assessments help you determine whether your students have mastered the main ideas of a lesson or whether you need to reteach some material.

ASSESS

Section 1.3 Review
Assign the section review as a **formative assessment** to help students solidify their understanding of Section 3.

Section 1.3 Quiz
Use the Section 1.3 Quiz as a **formative assessment** to check students' understanding of Section 3.

Section 1.3 Review Answers

1. Environmentalism is the idea that natural resources need protecting, perhaps even without regard for humans. Conservation is the idea that resources should be used wisely, with thought given to their future availability. (p. 17)

Can Christians be Environmentalists?
The term environmentalism covers a broad spectrum of beliefs related to the environment and its care, and the definitions of environmentalism and conservation have a certain amount of overlap. A Christian may certainly hold some beliefs associated with environmentalism without being considered a hardcore environmentalist. But at the heart of environmentalist philosophy is a widely held belief in scientific naturalism.

2. No. Conservation includes both the wise use of and preservation of natural resources for future generations. (p. 17)

3. Answers will vary. Fish are a resource, and fulfilling the Creation Mandate requires that a balance be found between using a resource and making sure that it exists for future generations. (p. 18)

4. A worldview tells us whether our use of biotechnology is right or wrong. (p. 18)

(continued)

DIFFERENTIATED INSTRUCTION

The Conservation Movement
Despite the attention given by the media today to the concept of preserving or conserving natural resources, students may be surprised to learn that it is a relatively recent notion, dating back only to the mid-nineteenth century. Consider having interested students do an internet search on conservation movement history and present a brief synopsis of their findings to the class.

APPLY

LAB 1B: More Than Meets the Eye

Use this **guided discovery lab activity** to introduce students to the use and care of a light microscope. This activity introduces a skill that students will need later in the course. If you are confident that your students are already familiar with microscopes, perhaps from having used them in an earlier life science course, you may choose to skip this activity.

What should biology be used for? Biology can be a very useful tool! The study of biology helps us understand how God's world works so that we can exercise wise dominion over the creation. What we learn from biology can also be used to love and serve others.

Secular Bioethics

Use the **Secular Bioethics video** to introduce students to the topic of how ethical issues are addressed from a naturalistic worldview. This video is available as a digital resource.

Exceptions to Autonomy?

There are exceptions to the general rule of patient autonomy. A patient's decision may be overruled in instances when the patient is deemed incompetent to make the decision or when treatment may result in either harm to a third party or to the patient himself.

Differentiated Instruction—
These distinctive yellow notes highlight methods to help all students be successful in the class.

Scheduling

There is enough content in the Student Edition to keep any student engaged for the entire year. Because of the nature of biology, the material can be tailored for your particular class. Teaching the material at a rate of one section per lesson and providing one additional day for each lab activity, ethics topic, chapter review, and test will allow the entire content of the course to be covered. For students who need more time, it is suggested that you allot more days for covering the foundational and key chapters, then cover enrichment chapters as time permits. You can also choose a single lab activity for each chapter, devote an additional day to doing the activity, and still meet your school's requirements for time spent doing lab activities.

FEATURES OF THIS BOOK

This book is just for you!

We've designed it to help you learn. Flip through the following pages to see the features that we've designed into this textbook to help you succeed in biology. In the back of the book you'll see appendices, a glossary, and an index.

Opener—a short article that highlights issues and developments in biology that need to be examined from a biblical worldview



GENETICALLY MODIFIED FOODS **ETHICS**

Researchers who wear personal protection equipment are usually required by federal regulations to do so when working with certain chemicals that are used with both GM and non-GM crops, including some organic crops.



ISSUE
Genetically modified foods, otherwise known as “GM foods,” have been the center of ethical debate for quite some time. Those who support modifying the genes of crops see value in adding benefits to fit the needs of people and support a growing population. Others question the long-term effects on people and animals who consume GM foods. Many GM foods have been created with the intent of increasing a healthy food supply by reducing insects, pests, and diseases that are harmful to crops. They also have the benefits of adding nutritional value to foods and making produce more attractive.

When the first GM tomato became available in 1994, the market for GM foods began to widen. Research companies began expanding their testing, and new GM crops began preparing to come to market. Teams of researchers have studied the health effects of GM foods. Even with research suggesting that GM foods are safe to consume, people often wonder whether there has been enough testing and research done to truly understand the long-term effects. With all we know and don't know about GM foods, should we eat them?

Work through this issue using the guiding questions from the biblical ethics track.

1. What information can I get about this issue?
2. What does the Bible say about this issue?
3. What are the acceptable and unacceptable options of consuming GM foods?
4. What are the motivations of the acceptable options?
5. What action should I take?

Use the ethics box to answer Question 3.

33. Using the biblical ethics track guidance items, formulate as many as the Christian practices of consuming genetically modified foods. Be sure to address each by the track biblical principles, biblical narratives and biblical applications.

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Ethics Features—opportunities to apply a biblical worldview to ethical issues related to biology

MINI LAB

Starch and Fat Test

We have just learned about the properties and structures of organic compounds, but can we identify them in the foods we eat? Identify whether foods have fats and starches (or actually be sugar or soap and fat) food. Let's take a look at different foods and try to see whether we can correctly identify them as fats or starches.

Materials: 4.5 fat food samples • 4.5 starch food samples • water • large brown paper bag • small cups • permanent marker • iodine

PROCEDURE

Fat Test

1. Cut the brown paper bag so that you can spread it out and lay it on a flat, covered surface.
2. Using your permanent marker, divide the bag into sections according to the number of food items that you will be testing. Label each section with the names of the food samples being tested in that section. Be sure to include water as your control sample.
3. Place each fat food sample into its designated section on the paper. Some of the items will need to be spread onto the paper, while others can simply be placed into their sections. The samples will need to sit for about 15 minutes to allow them to dry. Use this time to make predictions as to whether these items will contain fat.
4. After the items are dry, remove each food sample. Check whether any oily residue is left behind. An oily residue indicates that the food sample contains fat. Compare your predictions to the results from each trial.

1. Were your predictions correct? What results surprised you?

Starch Test

1. Place the small cups on a flat, covered surface according to the number of food samples that you will be using. Label each cup with the name of the sample being tested and place the samples in their respective cups. Be sure to include water in one cup as your control sample.
2. Make predictions as to whether the samples will contain starch.
3. Put three drops of iodine on each sample. If the sample contains starch, the iodine will turn blue-black. Be sure to record the results.

2. Were your predictions correct? What results surprised you?

GOING FURTHER

1. The substance amylose, present in starch, causes the color of iodine to change from yellow-brown to blue-black. What do you think causes this?



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Mini Labs—short hands-on exercises to get you thinking and working like a scientist

FEATURES OF THIS BOOK (continued)

Worldview Investigations—inquiry-based investigations that help you think through controversial areas of biology through the lens of Scripture


Case Studies—opportunities to investigate specific areas in biology to apply what you have learned in a chapter

SAILOR BEC

Contaminants are the atmosphere of the sea, and much are the atmosphere of the land, right? Don't feel that in the next article, a member of the first big family and one of the very few marine insects. Though it lives on the ocean, it doesn't swim or walk on water! Ocean divers can photograph it on the surface of the ocean. They have little air-trapping hairs on their legs that act as life jackets to keep them afloat. They feel better back out though! Sailors in the air and containers below the surface are constantly trying to keep them up.

Ocean divers are getting an unexpected lift from the Great Pacific Garbage Patch, an area of floating plastic debris suspended in the water column trapped in a circular current in the North Pacific Ocean. Some experts estimate the patch to be the size of Texas. Much of the garbage has been broken down into very small pieces after being continually broken by waves action. Even though the particles are creating a problem for aquatic animals, they are providing a handy place for ocean insects to lay their eggs on the open sea. That is, in the garbage patch, ocean insects are thriving.

Biologists are concerned that the fecundity of the ocean could be affected by all this artificial material in the water. And as another level, scientists are finding that the ocean works with us as a storage vehicle for things made present in the world, such as caffeine. This could give scientists some clues about their pollution and toxic waste spread in the oceans and what we can do to keep our waters and insects pollution-free.



13.3 SECTION REVIEW

1. Give three ways that you can identify the walking stick shown below as an insect.
2. How does an insect use its wings to maintain homeostasis?
3. How does an insect breathe?
4. How does the shape of an insect's headparts relate to its function?
5. How does an insect find a mate?
6. Does an insect reproduce sexually or asexually? Explain.
7. How does an insect change over its life?

10 What are some ways that you can control insects without using pesticides that could be harmful to the environment?

Use the notes study guide to answer Questions 8–11.

8. How are insects able to survive on the ocean?
9. How does floating debris on the water affect marine life?
10. Explain how floating ocean debris may help scientists find new ways to keep our water clean.

Review Questions—Questions at the end of each section and chapter will give you practice in applying what you've learned in a section or a chapter. Problem-solving and extra-thought questions are marked with a purple box—you may need to think a little harder or do some research to answer these questions.

CREATURES AND CLIMATE CHANGE

Introduction
Several years ago it was reported that melanism (dark body) was back off the coast of California were coming onshore in droves. Many wondered what on this was related to a change in climate. What could have caused the shift behavior?

Task
Choose an migrating animal, such as a sparrow hawk, butterfly, or sea turtle, and try to determine whether there's a connection between the animal's behavior and climate change. Then decide whether humans should be part of the solution for helping it get back on its feet.

Procedure
1. Once you've chosen an animal, research to find out the following information about it:

- typical migration patterns, nesting habits, and habitat preferences
- size or changing migration patterns, nesting habits, and habitat preferences
- possible causes for the changing behaviors
- ways that people are helping it recover

Pay attention to words such as predicted, projected, forecasted, and potential. Many scientists that you'll find about the effects of climate change on animals may be projections into the future and not observed data.

2. Create a map that compares the animal's migration pattern in the past (due to twenty years ago) and its migration pattern now. Include an appropriate summary of the research that you did.

3. Suggest a possible way that your animal can be helped. For example, there are some general sea turtle rescue groups in California that rescue baby sea turtles back to health and then release them. There are also sea-fishing restrictions to help increase the fish populations that sea turtles like to eat.

4. Include a few sentences about how world events might affect a person's interpretation of data. Give your answer on the two questions below:

- Why do many scientists believe that changing migration patterns are caused by humans?
- What is the biblical role of people when it comes to helping the Creation flourish?

Conclusion
It makes sense that as Earth's climate changes, animal populations change too. This should try to help struggling animals as much as we can because they are creatures that are under our care. We should also keep in mind that "the earth is the Lord's" (Ps. 24:1) and that He is in control of every change.

CHAPTER REVIEW

Chapter Summary

13.1 ANTHROPOID INTRODUCTION AND ENNELECATES

- Anthropoids have open (diurnal) systems, compound or simple eyes, segmented bodies, nervous systems, and external reproductive organs.
- Characteristics are anthropoids with diurnal eyes, compound eyes, segmented bodies, nervous systems, and external reproductive organs.
- Characteristics are anthropoids with diurnal eyes, compound eyes, segmented bodies, nervous systems, and external reproductive organs.
- Some characteristics may be parasites or predators. Some characteristics serve as food for other animals, while some are used for the treatment of diseases and infections.

Terms
anthropoid • bones • abdomen • respiratory • compound eye • molting • antennae • chelicerae • pedipalp • book lung • spermatophyte

13.2 CRUSTACEANS

- Most crustaceans are aquatic, either fresh water or salt water. They have five pairs of walking legs and two pairs of antennae.
- Crustaceans have a hard exoskeleton that they use for protection, support, and movement.
- Most crustaceans reproduce sexually through external fertilization. Some crustaceans reproduce through internal fertilization.
- Crustaceans require their food from feeding on plants and animals or eating on hydrothermal vents for aquatic crustaceans.

Terms
crustacean • exoskeleton • walking leg • cheliped • mandible

13.3 INSECTS

- Insects are arthropods that have three body segments, six legs, one pair of antennae, and one pair of compound eyes. Most insects have wings.
- Insects have mandibles used for grinding food. Ground-up food gets broken down further by saliva and travels through the digestive system.
- Parasitic insects (phoretors) attach to a host. These phoretors are also used to consume the danger or infection to a host source for other insects in a colony.
- Insects begin in a fertilized egg and undergo metamorphosis to complete metamorphosis to reach adulthood.
- Insects are useful in their roles as pollinators, farmers, waste decomposers, and pest controllers. They are also used in medicine and forensic investigations.

Terms
Molting: trachea • trachea • spiracle • phoresis • metamorphosis • hemolymph • metamorphosis • nymph • complete metamorphosis • pupa

Chapter Reviews—handy statements that sum up the big ideas in each section of a chapter along with a list of each section's key terms

xxiv Features of This Book