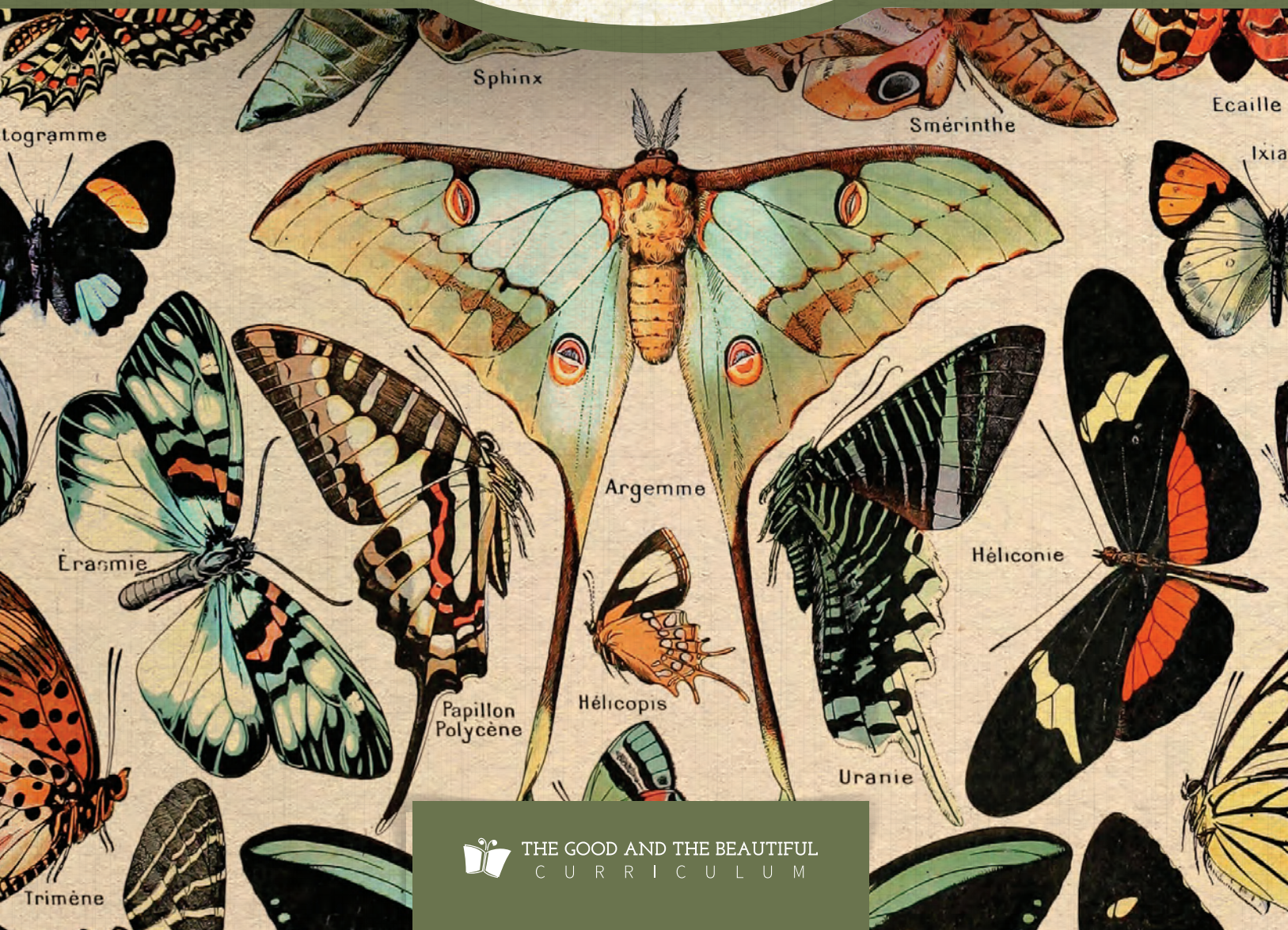
UNIT 1

HIGH SCHOOL BIOLOGY

Workbook



THE GOOD AND THE BEAUTIFUL
CURRICULUM

WORKBOOK

UNIT 1

Wonders of Life

Table of CONTENTS

Lesson 1: The Study of Life.....1

Lesson 2: Is Yeast a Living Organism? Lab.....4

Lesson 3: The Scientific Method.....8

Lesson 4: The Cell: Small but Mighty.....10

Lesson 5: Taxonomy: Classifying Life.....18

Lesson 6: The Major Groupings of Life.....22

Lesson 7: The Chemistry of Life.....26

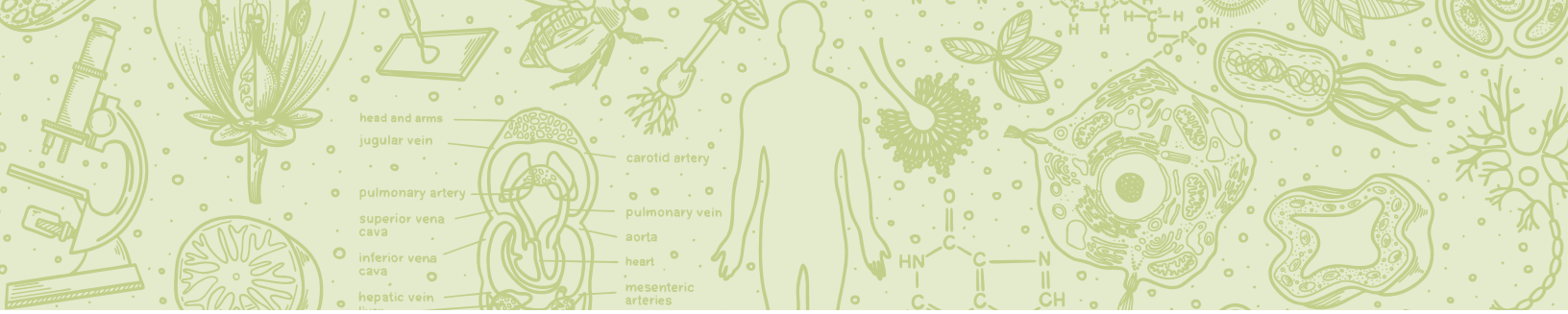
Lesson 8: Observing Potato & Liver Enzymes Lab....28

Lesson 9: Domains Archaea and Bacteria.....34

Lesson 10: Kingdom Protista.....36

Lesson 11: Kingdom Fungi.....40

Lesson 12: Unit 1 Review and Test.....42



About This Course

Biology is the study of life, and life is interwoven through the world all around you—even inside you. This course will help you explore the wondrous world of biology through six lenses:

Unit 1: *The Wonders of Life*
Unit 2: *The Wonders of Botany*
Unit 3: *The Wonders of Marine Biology*
Unit 4: *The Wonders of the Animal Kingdom, Part 1*
Unit 5: *The Wonders of the Animal Kingdom, Part 2*
Unit 6: *The Wonders of the Human Body*

The course has 120 lessons and is intended to fulfill one science credit with lab. You can complete it in a typical nine-month school year if you do four lessons per week. Complete the units in order because they build on each other.

Plan on each lesson taking about 30–60 minutes. Lessons with a lab or activity may take longer. Plan ahead to gather supplies.

Preparing to Use the Course

You will need . . .

- a printed copy of each unit's *High School Biology Workbook*, a total of six workbooks.
- a desktop or laptop computer.
- a free account to access the Good and Beautiful Homeschool app (computer version only) at courses.goodandbeautiful.com.
- a pencil and colored pencils kept on hand.
- a good-quality, standard compound microscope with at least 400x magnification.
- lab supplies listed starting on page vi.
- a way to keep your materials organized (optional), such as a magazine file or a 3-inch three-ring binder.

PARENT OR TEACHER

You will need . . .

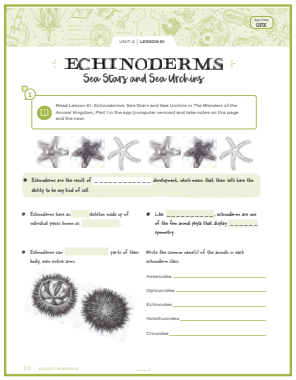
- the *High School Biology Tests and Quizzes* booklet.
- the downloadable *High School Biology Answer Key*, which includes answers for all workbook note-taking guides and Lab Reports as well as the answers to quizzes and tests.
- to help your student set up a free account to access the Good and Beautiful Homeschool app (computer version only) at courses.goodandbeautiful.com.
- to help your student gather lab supplies, including a microscope. See the supplies lists starting on page vi. Optionally, go to the Good and Beautiful Homeschool app (computer version only) or scan the QR code above to watch the Lesson 4 Microscope Lab video on choosing and using a microscope.

How to Use the Course

Begin each lesson by opening your workbook to that day's lesson number. Numbered bubbles on each page will tell you what to do and in what order. Each day's lesson will include one or more of the following:

- Reading from a *Wonders* book accessed on the Good and Beautiful Homeschool app (computer version only)
- Filling out notes in the workbook based on the reading
- Watching a lesson video (22 total in the course)
- Completing an activity (19 in the course)
- Completing a lab (11 experiments or scientific demonstrations) and filling out a Lab Report
- Optionally watching the lab video instead of completing it hands-on (ask your parent or teacher which you are to do)







Keep your workbooks, as they include your notes for the quizzes and tests. Keep your quizzes and tests for later study. You may wish to use a large three-ring binder or a magazine file.

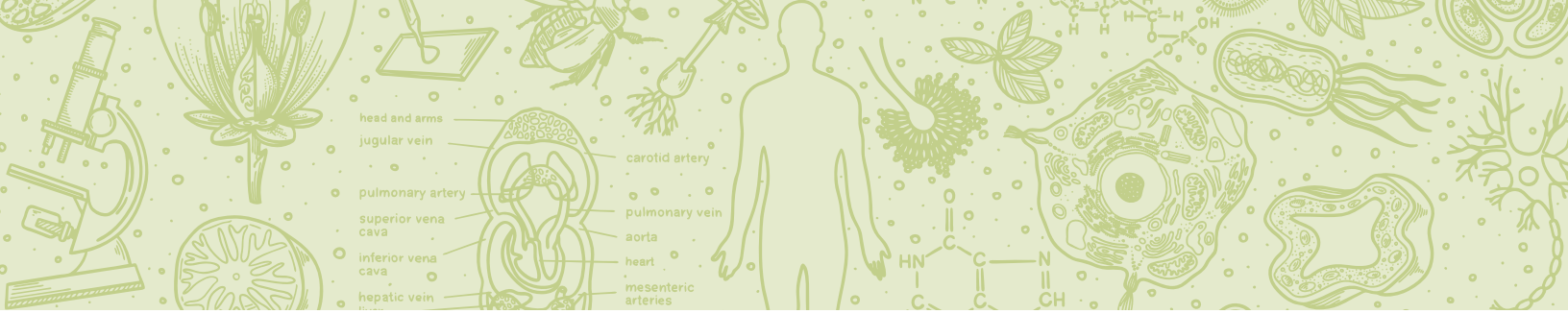
Quizzes and Tests

Each unit of the course contains a mid-unit quiz and a review and test. These cover topics from the unit's lessons, and the questions are drawn directly from the note-taking guides in the workbook. Quizzes and tests are open note, meaning that unless your parent or teacher directs you otherwise, you may use your workbook to help locate and answer each question. The more effort you put into thoroughly and neatly filling out your workbook notes, the better advantage you will have on the quizzes and tests.

The final exam is closed book with no notes allowed.

PARENT OR TEACHER

For a student bound for a STEM career or to make the course more challenging, you may choose to make the unit tests closed note, not allowing the student to look at their notes to take the test. For a greater challenge still, you could make the quizzes closed note, as well. The final exam is closed note. The *Wonders* book will not be utilized in any of the quizzes or tests.



STUDENT AND PARENT OR TEACHER

Labs and Activities

We understand that labs can sometimes be difficult for families to prepare for and prioritize, but we strongly recommend that all labs be completed. Ask your parent or teacher if you should complete the labs hands-on yourself or if you should watch the lab videos.

About the Lab Supplies

Aside from a microscope and optional dissection specimen and tools, this course was designed with lab supplies that are generally easy and relatively inexpensive to find. You may already have many items at home, and many others can be found at the grocery or hardware store. Look ahead to see what supplies are needed and when you'll need them to make it as easy and cost-effective as possible to obtain them. For example, Lesson 97 requires hydrochloric acid, also known as muriatic acid. If you have a neighbor who owns a pool or works with concrete, you might be able to ask for a teaspoon of the solution rather than purchasing a larger quantity than needed. (Note the important safety warnings for this chemical solution within the lesson where it is used.)

Supplies Needed

Unit 1: *The Wonders of Life*

Lesson 2

- ☐ 2 empty clear water bottles (8–20 oz)
- ☐ 1 c warm water
- ☐ Liquid measuring cup
- ☐ 2 packets (4.5 tsp, or ½ oz total) quick-rise instant yeast
- ☐ 2 large balloons
- ☐ 2 tsp white sugar
- ☐ Permanent marker to label bottles
- ☐ Funnel
- ☐ Timer

Lesson 4

- ☐ Microscope
- ☐ Plain white paper
- ☐ Blank microscope slides
- ☐ Masking tape
- ☐ Assortment of household materials to view (see page 16 for ideas)

Lesson 8

- ☐ Hydrogen peroxide (3%)
- ☐ 1 potato
- ☐ Chicken liver
- ☐ Knife and cutting board
- ☐ 6 test tubes in test-tube rack, or 6 small glasses or jars
- ☐ Masking tape and marker
- ☐ Large, flat tray or pan with a lip
- ☐ 2 plastic sandwich bags
- ☐ Funnel (if using test tubes)
- ☐ 2 small saucepans
- ☐ Spoon
- ☐ Strainer
- ☐ Tablespoon
- ☐ Stove

Unit 2: *The Wonders of Botany*

Lesson 15

- ☐ Small bag of potting soil
- ☐ At least 2 foam or flexible plastic cups
- ☐ Pencil, nail, or knife to poke holes in your cups
- ☐ At least 6 bean seeds that you soaked previously
- ☐ Permanent marker to label each cup
- ☐ Baking sheet or tray to protect surface beneath plants from water drainage
- ☐ Tablespoon
- ☐ Water
- ☐ Ruler
- ☐ Optional supplies (depending on your variable): avocado, plastic wrap, sandpaper, etc.



Lesson 18

- ☐ 3 large paper towels
- ☐ Waxed paper
- ☐ Baking sheet
- ☐ Paper clips

Lesson 21

- ☐ Small bag of potting soil
- ☐ 3 foam or flexible plastic cups
- ☐ Pencil, nail, or knife to poke holes in your cups
- ☐ At least 9 presoaked pinto bean seeds
- ☐ Permanent marker to label each cup
- ☐ Tablespoon
- ☐ Baking sheet or tray to protect surface beneath plants from water drainage
- ☐ 1 cardboard box (with lid) large enough to hold the plant, but not too large
- ☐ Extra pieces of cardboard to build a maze
- ☐ Strong tape, such as packing tape
- ☐ Scissors

Lesson 24

- ☐ 6–9 large fresh leaves, 2–3 each from three separate types of plants, preferably of different dark colors
- ☐ 3 tall glass jars or drinking glasses
- ☐ 3 skewers, straws, or small sticks
- ☐ Tape
- ☐ Rubbing alcohol or acetone-based nail polish remover
- ☐ 3 eyedroppers or pipettes
- ☐ Pencil
- ☐ Safety goggles
- ☐ Sharp knife and cutting board
- ☐ Chromatography paper (preferred) or white coffee filters
- ☐ Plastic wrap
- ☐ 3 small glass bowls and a spoon (or mortar and pestle)
- ☐ Ruler
- ☐ Scissors

Lesson 25

- ☐ One or more of the vegetables listed on page 48 (with the root section)
- ☐ Knife and cutting board
- ☐ Bowl or jar

Lesson 31

- ☐ Fresh-cut flower (with large parts, such as lily, tulip, or daffodil)
- ☐ Cutting board
- ☐ Magnifying glass (at least 10× magnification)
- ☐ Craft knife or sharp paring knife
- ☐ Optional: microscope
- ☐ Optional: face mask

Lesson 32

- ☐ Common household items, such as those listed on page 66
- ☐ Any type of seed, kernel, or bean

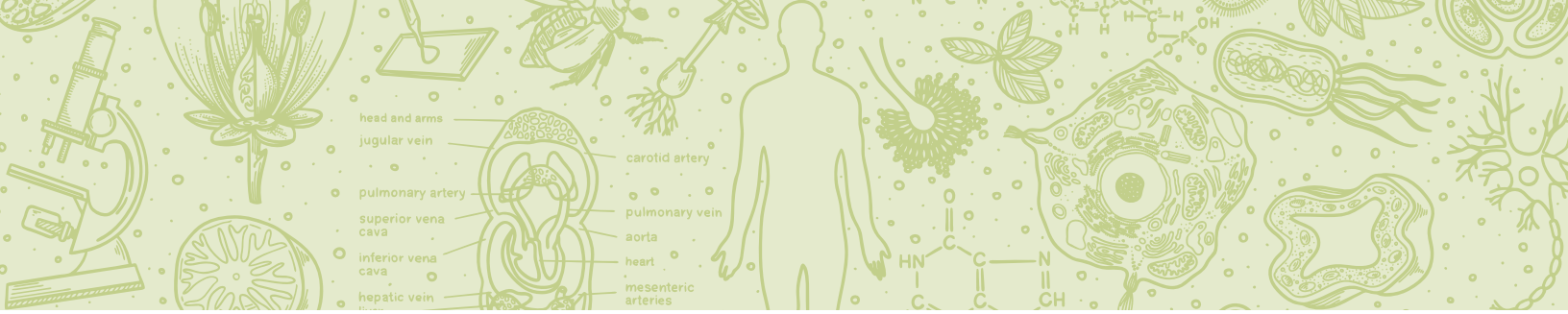
Unit 3: *The Wonders of Marine Biology*

Lesson 38

- ☐ 5 small cups or other containers (to hold ½ c water, do not have to be the same)
- ☐ 1 test tube
- ☐ Test-tube rack or narrow glass for holding the test tube upright
- ☐ ½ c measuring cup
- ☐ 1 Tbsp measuring spoon
- ☐ ½ Tbsp measuring spoon (or 1 tsp + ½ tsp measuring spoons)
- ☐ Pipette
- ☐ Food coloring (red, blue, yellow, and green)
- ☐ Salt (table salt works best)
- ☐ Cold water
- ☐ Spoon for stirring

Lesson 40

- ☐ Sand
- ☐ Water
- ☐ Spatula
- ☐ Small pebbles
- ☐ Sloped painter's tray OR a 9" x 13" baking dish



Lesson 41

- ☐ Glass casserole dish
- ☐ Teaspoon
- ☐ Measuring cup
- ☐ Spoon
- ☐ Meat or candy thermometer
- ☐ 2 tsp of any dark, powdery spice
- ☐ 1–2 Tbsp of light cereal pieces that will float
- ☐ About 4 c vegetable oil
- ☐ 2–4 ceramic mugs or half-pint jars of the same height (2 for a square dish; if you are using a 9" x 13" dish, you may need 4). You may use other sturdy heat-proof objects to support the dish, such as wooden blocks.
- ☐ 2–4 small candles or chafing fuel cans; these must be shorter than the objects you will use to support the baking dish.
- ☐ Lighter or matches

Lesson 44

- ☐ Casserole dish, bread pan, or paint tray
- ☐ Standard kitchen sponge
- ☐ Scissors
- ☐ Food coloring
- ☐ Cup of soil
- ☐ Watering can or pitcher of water
- ☐ Folded towel or other object to prop up the pan, if not using a paint tray

Lesson 45

- ☐ Small box or bin with a top opening about the size of the 10 x 10 grid Depth Chart and with a height approximately the same as the Depth Scale
- ☐ Tape
- ☐ Aluminum foil
- ☐ Colored pencils
- ☐ Various objects to make a seafloor within the box
- ☐ Long wooden skewer, ruler, chopstick, or knitting needle that is at least 9" long

Unit 4: *The Wonders of the Animal Kingdom, Part 1*

Lesson 59

- ☐ Live earthworm (find outside or from a bait shop)
- ☐ Paper towels
- ☐ Disposable plate
- ☐ Cotton swabs
- ☐ Rubbing alcohol

Lesson 62

Clam Dissection

- ☐ Preserved clam specimen
- ☐ Foam tray or other disposable work surface
- ☐ Small, sharp kitchen knife or scalpel
- ☐ Dissecting scissors
- ☐ Forceps or tweezers
- ☐ Dissection probe
- ☐ Disposable gloves (recommended)
- ☐ Cut-resistant gloves (optional)
- ☐ Apron
- ☐ Safety glasses or goggles (recommended)

Sea Star Dissection

- ☐ Preserved sea star specimen for dissection (If you search online for a specimen, also search "starfish specimen for dissection.")
- ☐ Foam tray or other disposable work surface
- ☐ Dissecting scissors
- ☐ Small, sharp kitchen knife or scalpel
- ☐ Forceps or tweezers
- ☐ Dissecting probe
- ☐ Apron
- ☐ Safety goggles or glasses (recommended)
- ☐ Disposable gloves (recommended)
- ☐ Magnifying glass
- ☐ Microscope and slide
- ☐ Cover slip
- ☐ Water
- ☐ Pipette or eyedropper



Bony Fish Dissection

- ☐ Preserved fish (or a caught fish if you prefer)
- ☐ Foam tray or other disposable work surface
- ☐ Dissection scissors
- ☐ Small, sharp kitchen knife or scalpel
- ☐ Dissection probe
- ☐ Forceps or tweezers
- ☐ Disposable gloves (recommended)
- ☐ Cut-resistant gloves (optional)
- ☐ Apron
- ☐ Safety glasses or goggles (recommended)
- ☐ Magnifying glass
- ☐ Microscope
- ☐ Slide and cover slip
- ☐ Water
- ☐ Pipette or eyedropper

Lesson 64

- ☐ Small paper bag or other opaque container
- ☐ 80–150 small objects of the same type—counted by your assistant (such as pennies, beans, cereal pieces, etc.)
- ☐ Permanent marker or small pieces of masking tape (to mark items)

Unit 5: *The Wonders of the Animal Kingdom, Part 2*

Lesson 92

- ☐ Calculator (optional)

Unit 6: *The Wonders of the Human Body*

Lesson 97

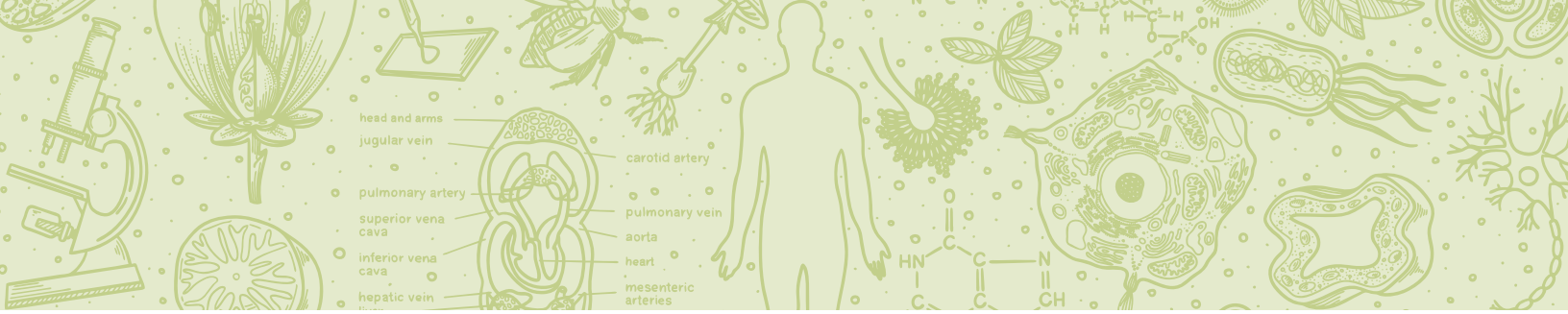
- ☐ Fresh onion
- ☐ Glass or jar
- ☐ Muriatic acid, also called hydrochloric acid (a few drops, available from pool or hardware stores)
- ☐ 3 disposable cups
- ☐ 3 pipettes
- ☐ Distilled water
- ☐ Methylene blue (available online as lab stain or medicine or in pet stores as fish treatment)
- ☐ Scissors
- ☐ Paper towels
- ☐ Tweezers
- ☐ Pencil with eraser end
- ☐ Microscope
- ☐ 2 glass slides
- ☐ Cover slip
- ☐ Goggles, gloves, and apron
- ☐ Newspapers or disposable tablecloth
- ☐ Timer

Lesson 103

- ☐ A willing volunteer
- ☐ 9 toothpicks
- ☐ Tape
- ☐ Ruler with millimeters
- ☐ 2 index cards
- ☐ Paper towel or hand towel
- ☐ Pencil
- ☐ Ice

Lesson 115

- ☐ 2 strawberries (fresh)
- ☐ 2 plastic zipper freezer bags
- ☐ Cup
- ☐ Spoon
- ☐ ½ c water (warm)
- ☐ 2 tsp dish soap
- ☐ 1 tsp salt
- ☐ Coffee filter or cheesecloth
- ☐ Pint or half-pint glass jar with ring
- ☐ 2 Tbsp rubbing alcohol (cold)
- ☐ Toothpick or coffee stirrer
- ☐ Teaspoon and tablespoon measuring spoons
- ☐ Timer



Microscope

A microscope is recommended for use throughout the course. Any good-quality, standard compound microscope with magnification of 400x or greater will do. For tips about how to choose and use a microscope and to find a link to our recommended microscope, view the video "Choosing and Using a Microscope" in Lesson 4. We strongly recommend that you use a microscope to complete the labs hands-on. If this is impossible or if your parent/teacher directs you, you may follow along in the lab videos instead.

Dissection Specimens

Lesson 62 is a dissection lab. You may complete a dissection hands-on or watch a provided video of a dissection. If you plan to do a dissection yourself, you will need to choose from the three options: sea star, clam, or bony fish. Procedures and videos are provided for each. Look for educational science suppliers online to purchase the specimen of your choice and dissection tools. Optionally, you may use a caught fish or a whole fresh fish available from some markets. Make sure a purchased fish is not already gutted.

Lab Safety

Activities and experiments in this course may require sharp objects, heat sources, and potentially harmful substances. Please use caution, follow instructions carefully, and ask an adult for help as needed. Look for and carefully follow caution and warning statements as you complete the labs. Cautions and warnings will be preceded by the symbols shown at right.



Origins and Worldview

The Good and the Beautiful curriculum is written from a nondenominational Christian viewpoint and takes a neutral stance on matters of doctrine that vary among denominations, including such matters as the specifics of the origins of life and age of the earth. This allows all families to use this course and add in their specific beliefs.

Lesson 93 of this course shares various ideas of the origins of life. While you and your family will have your worldview, this course gives information about multiple ideas so that you have some familiarity with the concepts you may encounter throughout life.

Scripture references throughout the course are from the King James Version of the Bible.

PARENT OR TEACHER

Please read the Origins and Worldview section above.

We strongly encourage you to preview Lesson 93 at the end of the Unit 5 *Wonders* book about the origins of life and decide how you would like to approach it. In the workbook for this lesson, your student is encouraged to discuss their thoughts, beliefs, and questions with you. We recommend having your child read a book based on your family's worldview to extend their learning.



Reproduction

In Unit 6 you will learn about the human body, including the basic facts about sexual reproduction. It includes a few tactfully illustrated diagrams of sexual anatomy. This course gives an overview of the biology of reproduction, but as a science course, it does not cover the aspect of human reproduction being the product of a loving relationship. You may wish to talk more about the topic with your parents.

PARENT OR TEACHER

Please read the Reproduction section at left. Note that this lesson builds on the basics of plant, microbe, and animal reproduction covered earlier in the course.

Grading

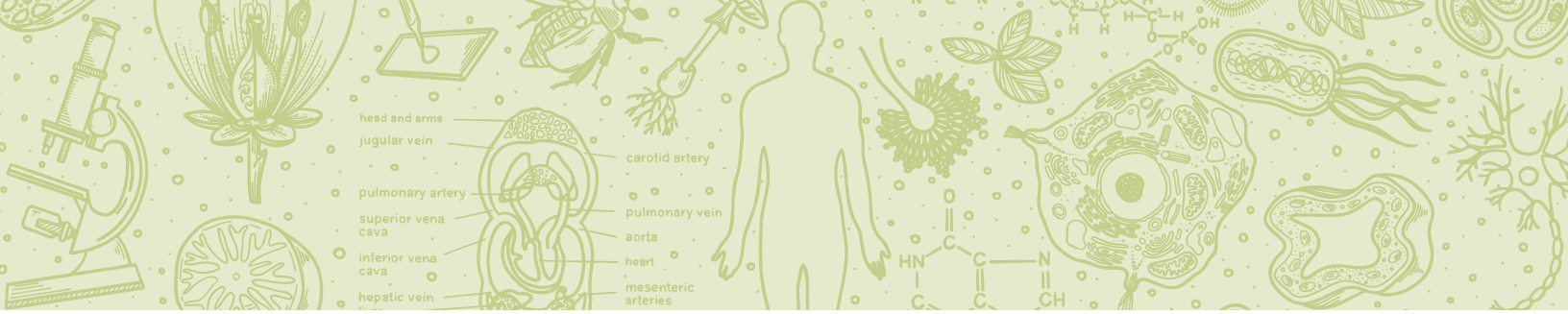
Your parent or teacher will grade your quizzes and tests and record the scores on the Grading Tracker at the front of the *High School Biology Tests and Quizzes* booklet.

PARENT OR TEACHER

You will grade quizzes and tests using the downloadable *High School Biology Answer Key* and record the scores on the grading sheet at the front of the Tests and Quizzes booklet. You do not need to check over all answers in the daily workbook note-taking guides, but you may choose to periodically check to ensure your student is completing the workbook notes thoroughly and neatly, as they will be referring back to the workbook during quizzes and tests, unless you opt for them not to use notes. All answers to workbook questions come directly from the daily *Wonders* book readings. If the student has read the book, they should be able to fill out the notes. There are no trick questions.

You will give points for complete and neat notes for each unit workbook, but you do not need to check the answers. If you do wish to see the answers, they are included in your downloadable *High School Biology Answer Key*. The incentive to fill these out neatly, carefully, and accurately is built into the course; students who put in more effort will do better on quizzes and tests.

Record scores on the Grading Tracker. Note that this is the suggested grading system, but you are free to design your own grading system or scale if desired.



High School Biology Lessons

Unit 1: *The Wonders of Life*

1 The Study of Life ▷
2 Is Yeast a Living Organism?
3 The Scientific Method
4 The Cell: Small but Mighty 🔍 ▷
5 Taxonomy: Classifying Life 🔍
6 The Major Groupings of Life 🔍
7 The Chemistry of Life
8 Observing Potato and Liver Enzymes Lab
9 Domains Archaea and Bacteria
10 Kingdom Protista 🔍
11 Kingdom Fungi
12 Unit 1 Test ▷

Unit 2: *The Wonders of Botany*

13 Introduction to Botany ▷
14 Plant Cells
15 Planting Seeds Lab
16 Germination
17 Plant Roots
18 Plant Stems 🔍
19 Identifying Leaves 🔍
20 Growth and Movement ▷
21 Phototropism Lab
22 Autotrophs and Heterotrophs ▷
23 Respiration
24 Why Do Leaves Change Color?
25 Plant Reproduction 🔍 ▷
26 Plant Classification
27 Nonvascular Plants
28 Vascular Plants
29 Gymnosperms
30 Angiosperms
31 Pollination of Flowers 🔍
32 Fertilization and Seed Dispersal 🔍
33 Fruits and Vegetables
34 Unit 2 Test

Unit 3: *The Wonders of Marine Biology*

35 Introduction to Oceans and Marine Biology ▷
36 Introducing the Five Oceans and Whales 🔍
37 Properties of Water and Fish Adaptations 🔍
38 Seawater and Sea Turtles
39 Marine Cycles and Decomposers
40 Motions in the Oceans: Tides, Waves, and Currents
41 Currents and Migration Lab
42 Intertidal Ecosystems
43 Estuary and Coastal Wetland Formation
44 Coastal Wetlands and Estuarine Communities 🔍
45 Topography of the Ocean Basins 🔍
46 Coral Reefs ▷
47 Polar Seas and Ice
48 The Polar Food Chain and Polar Mammals 🔍
49 Sunlit Zone
50 Twilight Zone ▷
51 The Deep Sea
52 The Ocean Floor in the Deep Sea
53 Ocean Exploration
54 Unit 3 Test

KEY

Video ▷
Lab
Activity 🔍



Unit 4: *The Wonders of the Animal Kingdom, Part 1*

55 Introduction to Kingdom Animalia
56 Porifera: Sponges
57 Cnidarians: Anemones, Corals, and Jellyfish
58 Mollusca: Snails, Octopuses, and Clams
59 Annelida: Segmented Worms
60 Arthropoda: Insects, Arachnids, and Crustaceans
61 Echinoderms: Sea Stars and Sea Urchins
62 Dissection Lab
63 Introduction to Chordata
64 Fish: Bony Fish, Eels, Sharks, and Rays
65 Amphibians: Frogs and Toads
66 Amphibians: Newts and Salamanders
67 Reptiles: Snakes
68 Reptiles: Lizards
69 Reptiles: Crocodilians
70 Reptiles: Turtles, Terrapins, and Tortoises
71 Unit 4 Test

Unit 5: *The Wonders of the Animal Kingdom, Part 2*

72 Introduction to Birds
73 Fitted for Flight
74 Feeding Strategies
75 Nests and Eggs
76 Bird Vocalization
77 Bird Migration
78 Bird Behaviors
79 Bird Conservation
80 Introduction to Mammals
81 Reproductive Strategies of Mammals
82 Bats, Echolocation, and Flight
83 Rodents, Rabbits, and Endothermy
84 Insectivores
85 Hoofed Animals
86 Elephants, Manatees, and Other Near Ungulates
87 Carnivores
88 Aquatic Mammal Characteristics
89 The Mammal Neocortex
90 Conservation
91 Ecology
92 Trophic Level Pyramid Activity
93 Theories of Origins and Adaptations
94 Unit 5 Test

Unit 6: *The Wonders of the Human Body*

95 Introduction to the Human Body
96 Cells, Tissues, and Organs
97 Asexual Reproduction Through Mitosis
98 Sexual Reproduction and Meiosis
99 Skeletal System
100 Muscular System
101 Central Nervous System
102 Peripheral Nervous System
103 Nervous System Activity
104 Circulatory System
105 Respiratory System
106 Digestive System
107 Renal System
108 Integumentary System
109 Immune System
110 Endocrine System
111 Reproductive System
112 Sensory Systems
113 Introduction to Genetics
114 Heredity and DNA
115 Strawberry DNA Lab
116 How DNA Replicates
117 Protein Synthesis
118 Health and Wellness
119 Unit 6 Test
120 Final Exam

The Study of LIFE



1 INTRODUCTION

With each breath you take, you rely on a delicate balance of other living things, and they on you. From the smallest microorganisms to the largest species, life is complex and interrelated.

We study biology, or life science, to discover **who we are in relation to all life**—and perhaps to discover what God's purpose is for us. This course will help you build a foundation for understanding, starting with one simple question: **What is life?** How are we similar to (and different from) other living things? Through pondering these topics, we can better determine how to live out the days, years, and lives we are privileged to experience.

BIOLOGY: THE BEAUTY OF THE LIVING WORLD

Step outside your door or look out a window into the living world beyond your home. When you pay attention to what surrounds you, you will be captivated by the beauty and intricacies of each living specimen and the many designs, features, and abilities among living things. We study the natural world to understand how every created thing fits into a larger plan. We see that there is diversity and complexity. Yet there is also purpose, order, and direction.

God created a splendid array of living creatures with incredible INTERCONNECTEDNESS, RELATIONSHIPS, and RESILIENCE. We study these patterns to understand our own INTERCONNECTEDNESS with the living world, RELATIONSHIPS with each other and our Creator, and RESILIENCE to prevail over the challenges of life. All life exists for a purpose greater than itself. Our individual lives have immense value and make sense in the scope of a larger plan.

You have been purposely placed on the earth at this time and gifted with life. You are on the brink of determining what you will make of your life and how you will impact the world surrounding you. What contributions will you make? How will your choices and actions affect the people and communities around you? Will you care for those around you and for the natural world? These ageless, fundamental questions are the reasons we study biology.

☑ Check the box next to the numbered bubble at the top of this page, and then go to the next step below. As you complete each numbered step, check its box.

2

If you have not yet read About This Course on the previous pages, read it with your parent or teacher.

During this course you will practice taking notes in this workbook. You will complete learning activities and conduct laboratory experiments. Your reading for this unit will be in *The Wonders of Life* book, which you will read online using the three-letter code at the top right of this page. Some lessons will include videos, quizzes, and tests. These resources will help you become familiar with this beautiful world around you. Turn the page, and let's dive in!



© Good and Beautiful

3 Be sure to read, watch, and observe all the materials carefully. Taking accurate notes will deepen your understanding of the material while preparing you for the online reviews, practices, and tests. All reviews and tests will allow you to look at your notes and will require all questions to be answered correctly before moving on, so take advantage of the provided note-taking pages. Carefully and completely filling out this workbook will shorten the time you spend taking tests. Read the section below.

TAKING NOTES

As you read, your note-taking guides will help you focus on main ideas. As you watch videos, you will need to take your own notes. Listen for the **main ideas**. Jot down **facts** and any new **vocabulary** words that you think are important to remember. Don't write in full sentences; it's best to use key words and short phrases. You can use bullet points, lists, outlines, abbreviated words, and even pictures or diagrams to help you remember what you learn.

4 Read the Ponder, Notice, and Wonder directions below. Now go to the Good and Beautiful Homeschool app (computer version only) to watch the video "What Is Life?" Enter the app code found at the top right of the previous page. Take notes below **before**, **during**, and **after** you watch.

REMINDER

The next lesson is a lab. Turn to page 4 and check that you have the needed supplies.

VIDEO: WHAT IS LIFE?

PONDER

Before you watch the video, describe how you would define life.

NOTICE

During the video, record main ideas, facts, and new vocabulary words.

WONDER

After watching the video, write down questions you have.

5 Now it's time for your first reading. In *The Wonders of Life* book, learn about the characteristics that define a living thing.

In the Good and Beautiful Homeschool app (computer version only), read Lesson 1: The Study of Life in *The Wonders of Life*. If you haven't already, enter the code at the top right of the previous page. As you read follow along using the note-taking guide on the next page in this book. Fill in the blanks and answer the questions. You will be able to use all your notes during your tests.

THE STUDY OF LIFE

Lesson 1 in *The Wonders of Life*

What does "biology" mean?

- *Bio* means "_____."
- *Ology* means the "_____ __."

Where do living organisms obtain energy that they can use to perform basic life functions?



CHARACTERISTICS OF LIVING THINGS

Living things . . .

1.

2.

3.

4.

5.

6.

Living organisms have many different methods for reproducing their own kind that fit into two categories: asexual and sexual reproduction.

Circle the true statement(s) and draw a line through the false statement(s).

A. Asexual and sexual reproduction both produce offspring that are unique individuals.

B. In sexual reproduction genetic information from two parents is combined in the offspring.

C. Only one parent contributes genetic information in asexual reproduction.

D. In asexual reproduction the offspring is genetically identical to the parent.

Which of these elements are essential to living beings? Circle all that are true.

Aluminum	Oxygen	Nitrogen	Boron	Phosphorus
Hydrogen	Helium	Sulfur	Zinc	Carbon

© Good and Beautiful

Is Yeast a Living ORGANISM? Lab

1

Today, you will perform your first lab. Ask your parent or teacher if you should do the lab hands-on or if you should watch the lab through the video on the Good and Beautiful Homeschool app (computer version only). Optionally, you may choose to do both. **This lab is the only assignment today; there is no reading.**

2

Gather the supplies for the lab.



SUPPLIES

- 2 empty clear water bottles (8–20 oz)
- 1 c warm water
- Liquid measuring cup
- 2 packets (4.5 tsp, or ½ oz total) quick-rise instant yeast
- 2 large balloons
- 2 tsp white sugar
- Permanent marker to label bottles
- Funnel
- Timer

3

Before we can determine whether yeast is a living organism, let's review the six characteristics of living organisms:

1. Can sense and respond to the environment
2. Grows and develops
3. Consumes energy
4. Can reproduce
5. Contains both DNA and RNA
6. Contains the following elements: carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur

Now begin the lab on the next page.



PROCEDURE

☐ **Step 1 –** Read through this procedure and the Lab Report on page 7 so you know what data to gather during the lab.

> Before you jump into a task, it is helpful to know where you are going. Read through all the directions and steps before starting in order to understand the overall goal.

☐ **Step 2 –** Label one empty clear water bottle with "Contains Sugar" and the other with "No Sugar."

☐ **Step 3 –** Using the funnel, add 1 tsp of white sugar to the bottle labeled "Contains Sugar."

☐ **Step 4 –** Using the funnel, add ½ c warm water to each bottle. (The water should be just barely above body temperature. To check it, put one finger in the water and notice if you feel much temperature difference.) Swirl the "Contains Sugar" bottle well to dissolve the sugar.

☐ **Step 5 –** Have the balloons ready to cover the opening of each bottle before moving on.

Using the funnel, add 1 packet (¼ oz or 2¼ tsp) of quick-rise instant yeast to the bottle labeled "Contains Sugar." Stretch a balloon over the top. Once the balloon is on the bottle, swirl the mixture well to mix the yeast.

☐ **Step 6 –** Using the funnel, add 1 packet (¼ oz or 2¼ tsp) of quick-rise instant yeast to the bottle labeled "No Sugar." Stretch a balloon over the top. Once the balloon is on the bottle, swirl the mixture well to mix the yeast.

© Good and Beautiful

LESSON 2

LAB REPORT

IS YEAST A LIVING ORGANISM?

OBSERVATIONS

	2 minutes	5 minutes	10 minutes
Bottle 1 Contains Sugar			
Bottle 2 No Sugar			

QUESTIONS

1. What is the purpose of adding sugar? Did it make a difference over time?

2. Check the box if the following questions about the characteristics of living things are true. Hint: For help with explanations, watch the lab video.

- ☐ A. Can yeast sense and respond to its environment?
- ☐ B. Can yeast grow and develop?
- ☐ C. Does yeast obtain and use energy?
- ☐ D. Can yeast reproduce?
- ☐ E. Does yeast contain both DNA and RNA? (Hint: It does!)
- ☐ F. Does yeast contain carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur? (Yes!)

3. Does yeast meet the requirements of a living organism? Why or why not?

© Good and Beautiful

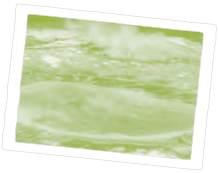
US National Parks VIRTUAL TOUR



Use the dichotomous key on the next page to fill out the major groupings below. Read First Park below, then go to the dichotomous key.



FIRST PARK: Your first stop is at Yellowstone National Park, where you visit the famous hot springs. You take a sample of water and use your microscope to discover tiny organisms living in the extremely hot water. The organisms have no membrane-bound organelles and no true nuclei. Use the key and what you read in *The Wonders of Life* to determine the major grouping of this organism and write it here.



➔ Domain _____



SECOND PARK: On your next stop at a small lake in Glacier National Park, you take another water sample from a cool lake and prepare a slide to inspect your findings. You see in it some one-celled organisms that are eukaryotic, having a true nucleus. You know they are distinct from plants and animals. You look them up in a guide you bought at the visitor center and determine that this organism can be found living only in water.



➔ Kingdom _____



THIRD PARK: At Mount Rainier National Park, you take a sample at a handrail along one of the trails. You also take a sample from a menu at a restaurant in the park and one from the bathroom door. You find the very same organism at all three places. These organisms have cells with no true nucleus and no membrane-bound organelles.



➔ Domain _____



FOURTH PARK: You visit Redwood National Park and see some of the largest living organisms on the planet. You place a tiny fiber from one under your microscope and see that it is multicellular. It is eukaryotic because each cell has a nucleus. Its cells also have vacuoles and chloroplasts, and each cell is surrounded by a fibrous cell wall. You are awed by this autotroph as it towers 91 m (300 ft) above you.



➔ Kingdom _____



FIFTH PARK: You stop at Grand Canyon National Park. You come across a multicellular organism with cells that have a nucleus but no cellulose cell wall. In addition, the specimen is moving across the dry canyon floor.



➔ Kingdom _____

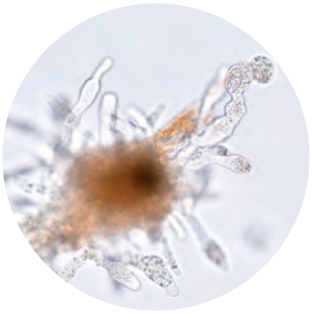


SIXTH PARK: At Petrified Forest National Park, you come across a rotting cactus. You take a sample of something growing on the remains and see eukaryotic cells. You suspect it is taking nutrients from this decaying plant.

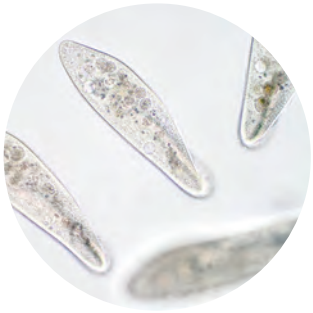


➔ Kingdom _____

Here are some microorganisms commonly found in pond water.



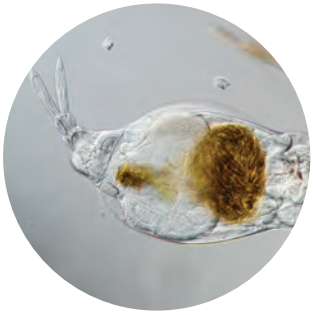
AMOEBA



PARAMECIUM



NEMATODE



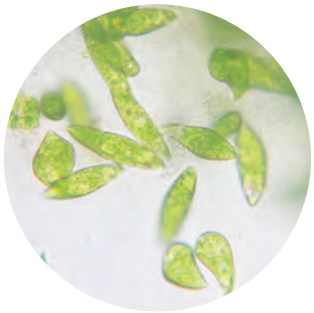
ROTIFER



HYDRA



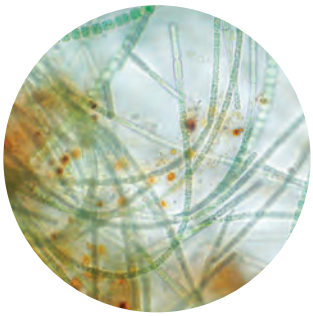
VOLVOX ALGAE



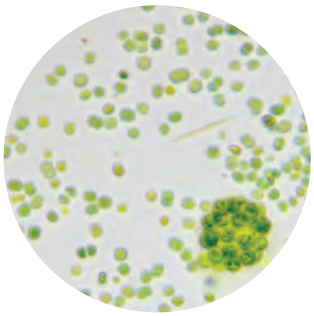
EUGLENA



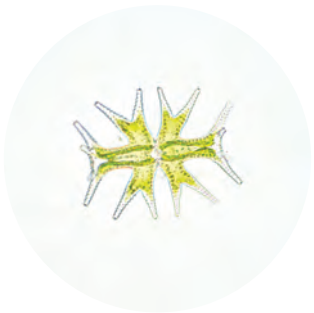
TARDIGRADE



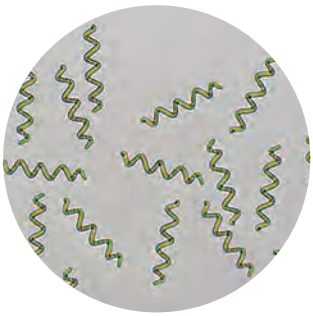
ANABAENA
CYANOBACTERIA



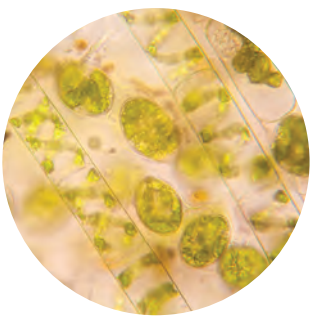
COELASTRUM
ALGAE



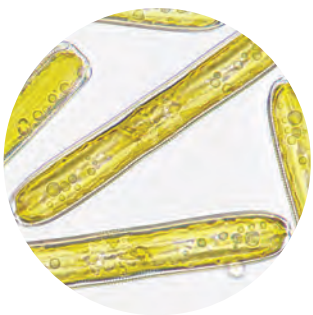
MICRASTERIAS
ALGAE



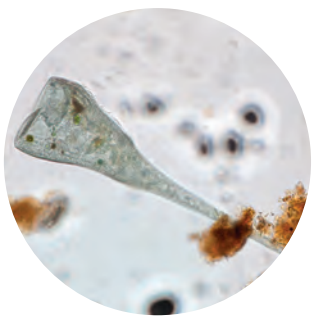
SPIRULINA
CYANOBACTERIA



SPIROGYRA
ALGAE



PINNULARIA
ALGAE



STENTOR
PROTOZOA



MOSQUITO
LARVAE

© Good and Beautiful

Kingdom FUNGI

1

Read Lesson 11: Kingdom Fungi in *The Wonders of Life* in the app (computer version) and complete the note-taking guide on the next page.

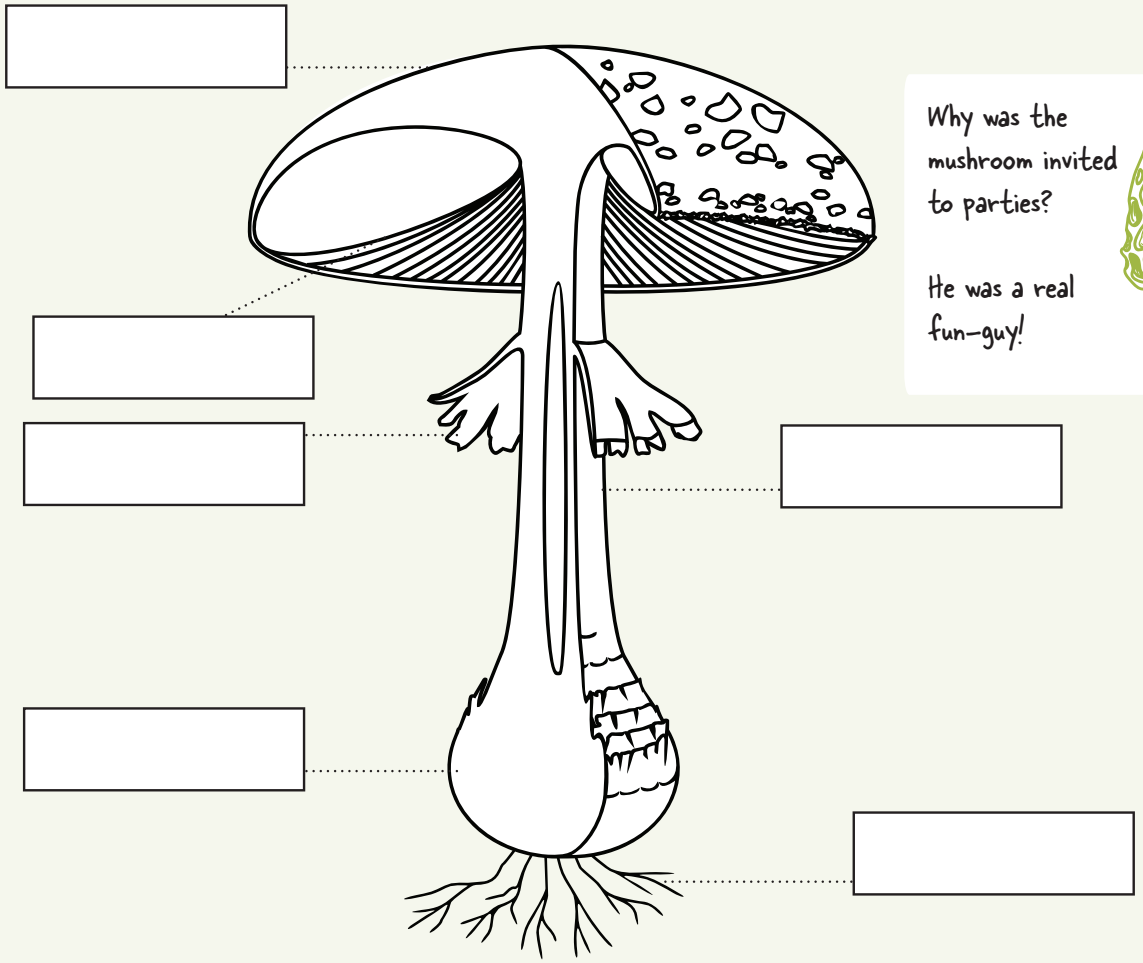
2

Label the parts of the mushroom below using your new skills as a ***mycologist***, a person who studies fungi.

TRY THIS!

The structure of a mushroom's gills serves a very specific purpose! Each gill provides maximum surface space for creating millions of spores! See for yourself by viewing a mushroom gill with your microscope.

Marvelous Mushroom Anatomy



Why was the mushroom invited to parties?

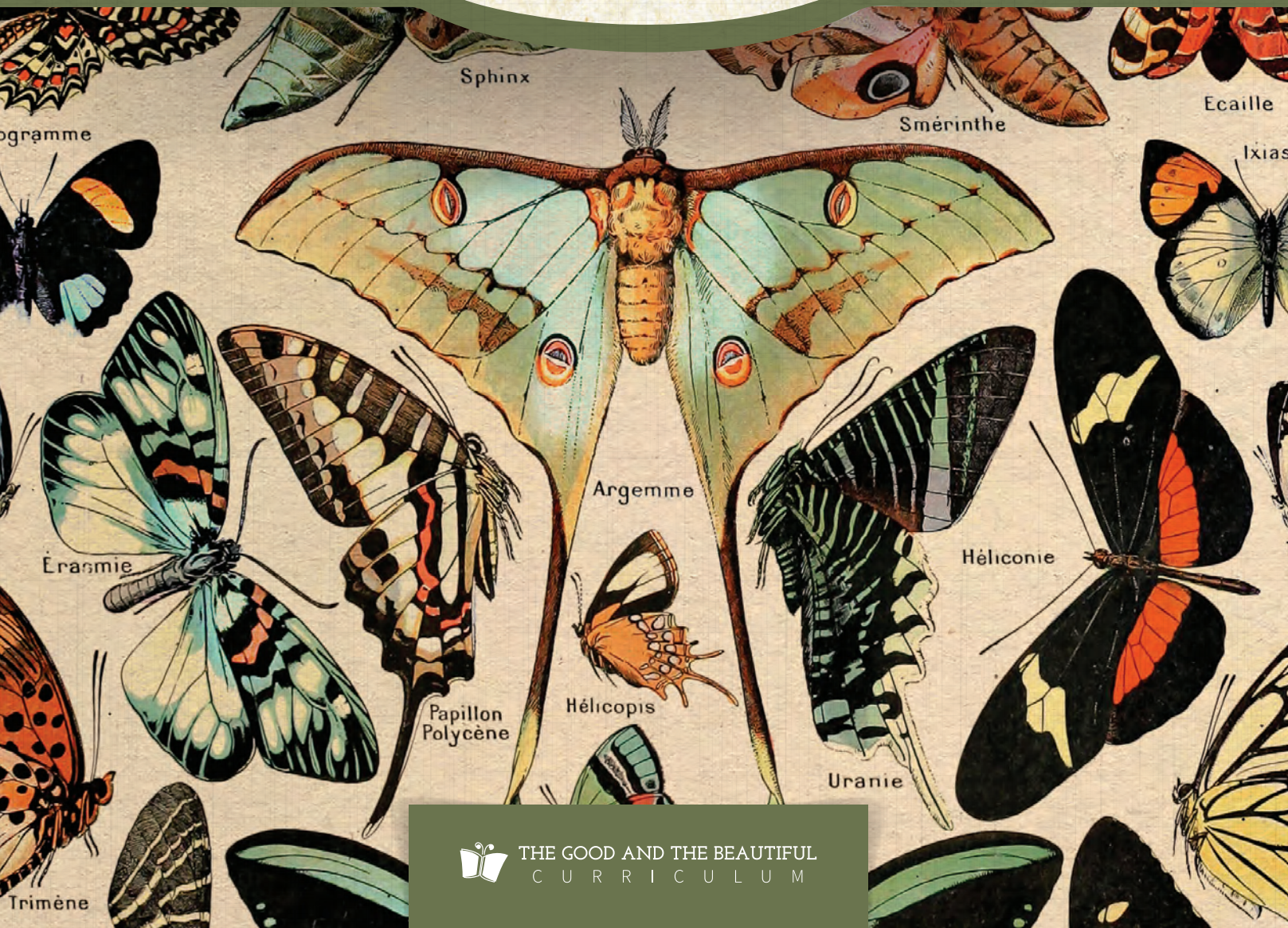
He was a real fun-guy!



UNIT 2

HIGH SCHOOL BIOLOGY

Workbook



THE GOOD AND THE BEAUTIFUL
CURRICULUM

WORKBOOK

UNIT 2

Wonders of Botany

Table of CONTENTS

Lesson 13: Introduction to Botany 1
Lesson 14: Plant Cells 3
Lesson 15: Planting Seeds Lab 5
Lesson 16: Germination 13
Lesson 17: Plant Roots 15
Lesson 18: Plant Stems 17
Lesson 19: Identifying Leaves 20
Lesson 20: Growth and Movement. 24
Lesson 21: Phototropism Lab 26
Lesson 22: Autotrophs and Heterotrophs 34
Lesson 23: Respiration 37
Lesson 24: Why Do Leaves Change Color? 40
Lesson 25: Plant Reproduction 46
Lesson 26: Plant Classification 49
Lesson 27: Nonvascular Plants 52
Lesson 28: Vascular Plants 54
Lesson 29: Gymnosperms 56
Lesson 30: Angiosperms 58
Lesson 31: Pollination of Flowers 60
Lesson 32: Fertilization and Seed Dispersal 66
Lesson 33: Fruits and Vegetables 68
Lesson 34: Unit 2 Review and Test 70

PLANT CELLS

1

Read Lesson 14: Plant Cells in *The Wonders of Botany* in the app (computer version), then answer the questions below and on the next page.

Eukaryotic: Cells with a _____ and organelles surrounded by a _____

QUESTION What makes a plant cell different from other types of cells?

Answer

- When the _____ is filled with _____, it makes the plant cell firm.
- Chloroplasts: Organelles filled with _____. This is where the process of _____ occurs.

Reference *The Wonders of Botany* to label each box in the plant cell diagram with the letter of the correct part and definition. Study the definitions.

a. Cell wall: Rigid; distinguishes a plant cell from an animal cell

b. Vacuole: Bubble in plant cell; can be turgid when filled with water or shriveled up if deprived of water

c. Cytoplasm: Jellylike substance that fills the cell

d. Nucleus: Command center of a cell; contains genetic information

e. Chloroplast: Disc-shaped green organelle that conducts photosynthesis

f. Mitochondria: Kidney-shaped structures that generate energy

g. Golgi complex: Sends proteins to other parts of the cell

h. Endoplasmic reticulum (ER): Transportation system for cell; detoxifies poisons

i. Ribosome: Located along the ER; builds proteins for the cell



© Good and Beautiful

PLANTING SEEDS
Lab

Lesson 15 is a lab only; there is no reading assignment. Ask your parent or teacher if you should do the lab hands-on or if you should watch the lab through the video on the app (computer version). Optionally, you may choose to do both.

Let's kick off our botany study by doing what botanists do best: growing and observing plants! By observing the way plants grow, you will gain a deeper appreciation for the miraculous detail that went into God's design for life on Earth.

SUPPLIES

- Small bag of potting soil
- At least 2 foam or flexible plastic cups
- Pencil, nail, or knife to poke holes in your cups
- At least 6 bean seeds that you soaked previously
- Permanent marker to label each cup
- Baking sheet or tray to protect surface beneath plants from water drainage
- Tablespoon
- Water
- Ruler
- Optional supplies (depending on which variable you select): avocado, plastic wrap, sandpaper, etc.

Plan to check your seedlings daily for the next two weeks and record their progress on pages 10–11.

We are going to grow our own test subjects using the scientific method.

1ST The first step in the scientific method is to **Make Observations**. As you think about growing and observing plants, what have you observed that may help or hinder the process of plant growth? Variables are factors that can change the outcome of an experiment. Think about the variables that could influence the growth of seedlings.

2ND Consider potential variables in the chart on the next page, along with the accompanying questions. Use this table as a springboard to create your own question for the second step of the scientific method: **Ask a Question**.

© Good and Beautiful



Potential Variables	Soil	Temperature	Moisture	Seed
Potential Questions	How does the type of soil impact plant growth? Can I plant something else with the seed to improve its growth? If so, what?	What happens if seeds are too cold or too hot? What is the ideal temperature for planting seeds?	Does humidity help or hurt seedling growth? How does increasing or decreasing moisture impact my plant?	Is there something I can do to the seed before planting to help it grow? Can I tell a seed will grow just by looking at it?

Write your question below. You can choose one from the table above or create your own.

_____

_____

_____

_____

3RD The third step of the scientific method is **Research the Question**. Set a timer for eight minutes to research the question you wrote above. Ask a parent or teacher for permission if you would like to research online. Take notes using the chart below. Don't forget to include the books or websites you used to research. *(To decrease bias and increase reliability, look for websites that end in .edu, .org, or .gov.)*

Notes
Resources Used *(books, websites)*

LESSON 15

LAB REPORT

SEED AND PLANT OBSERVATIONS

DRAW CONCLUSIONS

7TH Now that two weeks have passed and you've gathered data from your control and experimental groups, it is time for the seventh step of the scientific method: **Draw Conclusions**. Answer the questions below.

QUESTIONS

Summarize the results of your experiment. _____

_____

_____

_____

_____

How did your experiment compare to your prediction? _____

_____

_____

If you were to repeat this experiment, what would you change? _____

_____

_____

How would you improve your experimental design? _____

_____

_____

What was the hardest thing about this experiment? _____

_____

_____

What was your favorite thing about the Planting Seeds Lab? _____

_____

_____



4

Identify the leaves below using the dichotomous key on the next page.

TREE LEAF IDENTIFICATION ACTIVITY
USING A DICHOTOMOUS KEY

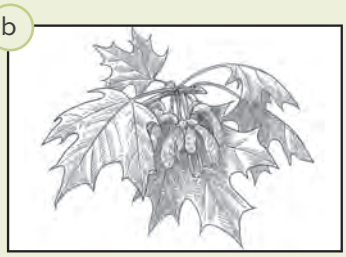
In this activity you will identify some common trees by looking at their leaves as pictured below. To find the name of the tree, use the Tree Leaf Dichotomous Key on the next page. Write the name of each tree below the picture of its leaves. *Note: This dichotomous key was designed specifically for this activity and will not work with all types of leaves.*

a



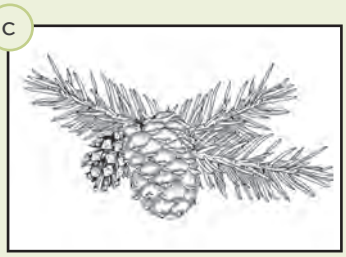
(name of tree)

b



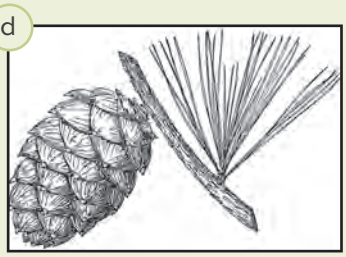
(name of tree)

c



(name of tree)

d



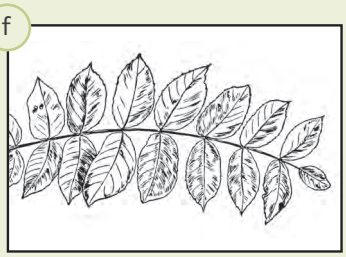
(name of tree)

e



(name of tree)

f



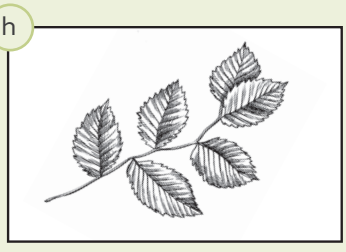
(name of tree)

g



(name of tree)

h



(name of tree)

i



(name of tree)

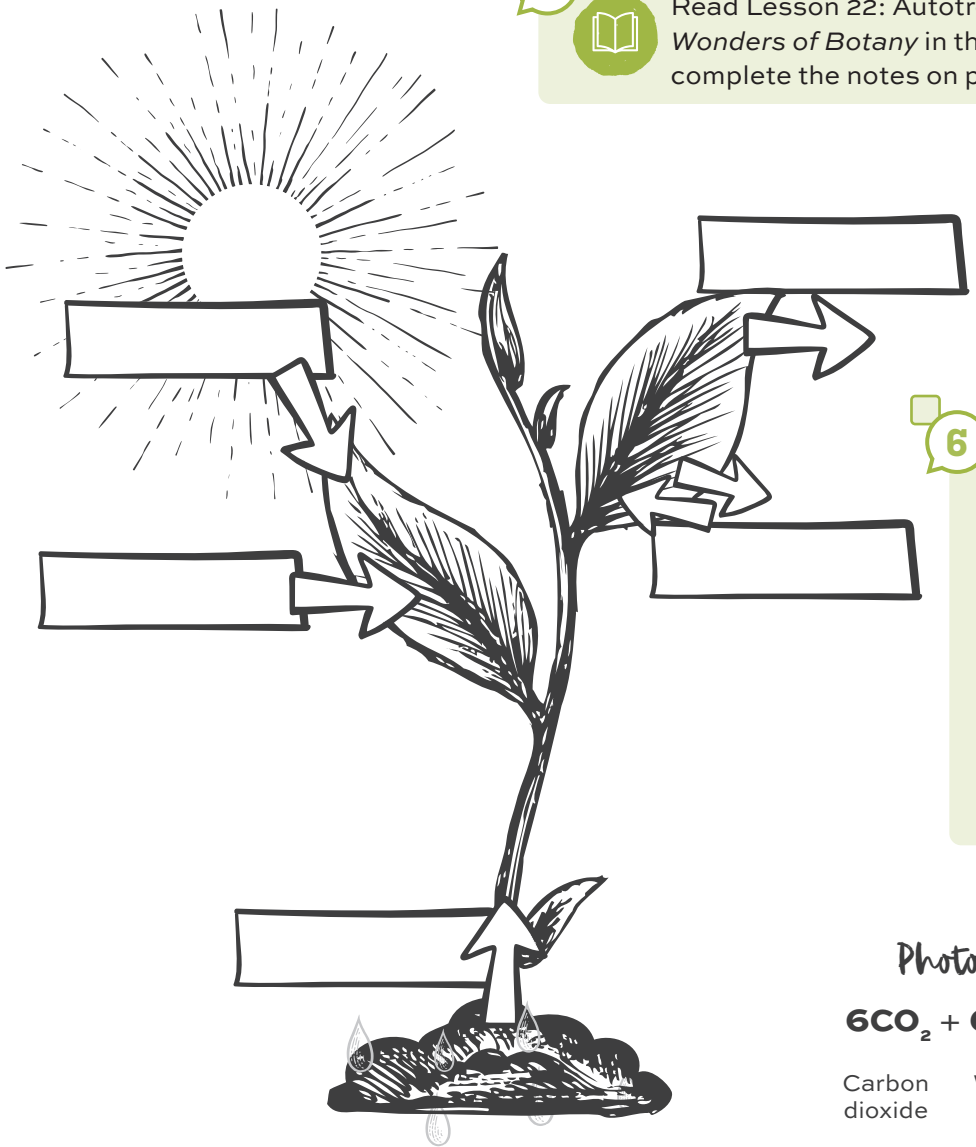
3

In this lesson you will learn about plants that are autotrophs, which use the process of **photosynthesis** to create their own food using energy from the sun. In this process water gathered through the roots and from the air, along with carbon dioxide absorbed through the stomata, is broken down and re-formed into sugar molecules and oxygen. You will also learn about heterotrophic plants that obtain nutrients in other ways.



4

Read Lesson 22: Autotrophs and Heterotrophs in *The Wonders of Botany* in the app (computer version) as you complete the notes on page 36.



5

Using *The Wonders of Botany*, label the photosynthesis diagram to the left.

6

In Unit 1 we learned about elements on the periodic table. Study the chemical equation for photosynthesis below. The larger numbers tell how many of each molecule must react with how many other molecules. The smaller, or subscript, numbers tell how many atoms of each element are present.

Photosynthesis Equation

$$6CO_2 + 6H_2O \xrightarrow{\text{Light}} C_6H_{12}O_6 + 6O_2$$

Carbon dioxide | Water | Sugar | Oxygen

© Good and Beautiful

ANGIOSPERMS

1

Read about the history of botanical gardens below in Botany in Action.



2

Read Lesson 30: Angiosperms in *The Wonders of Botany* in the app (computer version) and complete your notes on the next page.

BOTANY IN ACTION

Gardens have served as the setting of significant events in Biblical accounts. The Old Testament book of Genesis describes the Garden of Eden, a lush earthly paradise in which God lovingly placed the first created man and woman, Adam and Eve. And on the night of Jesus's betrayal, Christ sought solace as He prayed in the Garden of Gethsemane. Historical records also describe the Hanging Gardens of Babylon, one of the Seven Wonders of the Ancient World, which suggests humans have had a fascination with extravagant gardens since the earliest of days.

A botanical garden is a specific type of garden. By definition, the purpose of a botanical garden is for the collection, display, preservation, cultivation, and appreciation of living plants, and for encouraging education, research, and sharing of botanical knowledge. To fortunate visitors they are lavish natural areas that evoke wonder and fascination with the diverse plant kingdom. Botanical gardens reflect the profound influence plants have on us—our lives are inextricably linked to plants for most of our material needs. It is not an exaggeration to claim that the achievements and prosperity of individuals, countries, and entire civilizations have been determined in large part by plants!

In the sixteenth and seventeenth centuries, the botanical garden's focus was mainly on medicinal plants. It then transitioned to become a museum of sorts for many newly discovered specimens brought from far-off lands as a result of colonization—explorers trudged across the globe, collected samples of unusual plants never before seen in their homelands, and carried them back home for study. Over time botanical gardens attracted curious men and women who were interested in improving and expanding the newly devised classification systems and fascinated with various aspects of botany.

The role of botanical gardens continues to evolve. Today, many gardens have programs that focus on cataloging plant diversity and creating seed banks. Astoundingly, botanical gardens have collected living specimens and seeds from nearly one-third of the planet's vascular plant species! Many gardens provide educational programs and collaborate with other institutions on biotechnology and genetic research. Some gardens document human uses for plants, help restore native plants, work to lessen the impacts of agriculture on natural systems, and improve crop species to help combat world hunger.

The 3,000 botanical gardens of the world attract hundreds of millions of visitors each year who experience the diverse splendor of the plant kingdom while also being educated about the value plants bring to our lives. Through their research and educational programs, botanical gardens continue to inspire new generations to safeguard the beautiful biodiversity of our planet and appreciate our dynamic relationship with plants.

REMINDER

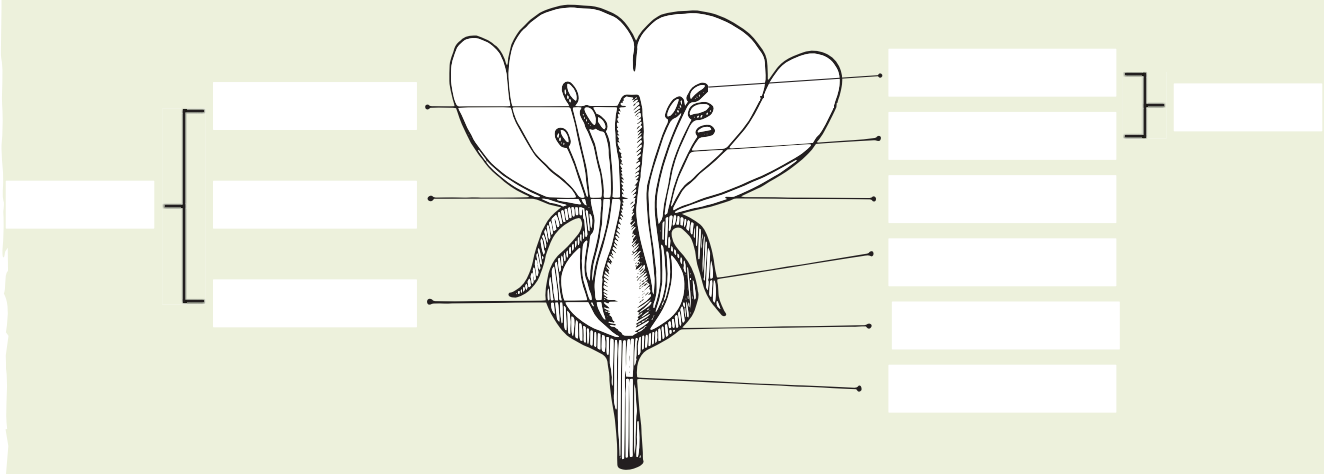
Lesson 31 contains an activity that needs unusual supplies, including fresh-cut flowers. Turn to page 62 and check that you have the needed supplies.

ANGIOSPERMS NOTES

Lesson 30 in *The Wonders of Botany*

- What function do flowers perform for angiosperms? _____
- The anther and filament make up what part of a flower? _____
- The pistil of a flower is made up of what three parts? _____, _____, and _____

Label the flower's anatomy.



Parts to label

- ☐ The male reproductive parts of the flower: the anther, filament, and stamen
- ☐ The female reproductive parts: the stigma, style, ovary, and pistil
- ☐ The part of the stem that holds the flower: pedicel and receptacle
- ☐ The green structures that protect the flower before it blooms: sepals
- ☐ The petals, which vary in color, shape, size, and arrangement

Draw dots on the ovary to represent the ovules, or egg cells, that will become the seeds.

Match each plant type with the proper description.

Annual	In the first growing season, this plant grows roots, stems, and leaves. In the second growing season, it produces flowers, fruit, and seeds. Then the plant dies.
Perennial	This plant grows all spring and summer. In the winter its flowers and foliage die back, but each spring they grow back from the roots.
Biennial	A new seed is planted each year. The seed sprouts and produces fruit and seeds. Then the plant dies.

© Good and Beautiful

FLOWER DISSECTION

If possible, get a few different types of flowers for this activity so you can observe how flower parts look in different species. You may not be able to find all the parts on all different types of flowers. It is easiest to find all the parts on a lily.

SUPPLIES

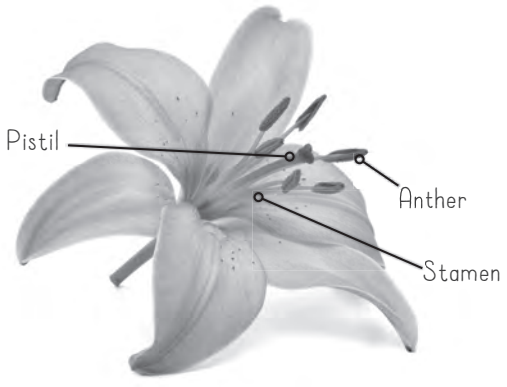
- Fresh-cut flower (those with large parts, such as lily, tulip, and daffodil, work best)
- Cutting board
- Magnifying glass (at least 10× magnification)
- Craft knife or sharp paring knife
- Sketching materials (paper, colored pencils)
- Optional: Mask if you have pollen allergies
- Optional: Microscope if you would like to observe the parts of the flower at a higher magnification

PROCEDURE

☐ **Step 1 –** Read through all the instructions for this activity.

☐ **Step 2 –** Gather all the supplies listed above.

☐ **Step 3 –** Lay the flower on the cutting board. Turn to page 64 of this book. Sketch your flower.



Unit 2 Review & TEST

1 Review Strategies

Review is an integral part of learning, allowing you to examine and analyze the information that has already been presented. Pick two strategies to help you review what you've learned in this unit and use them to study. Think about which strategies you want to use in the future.

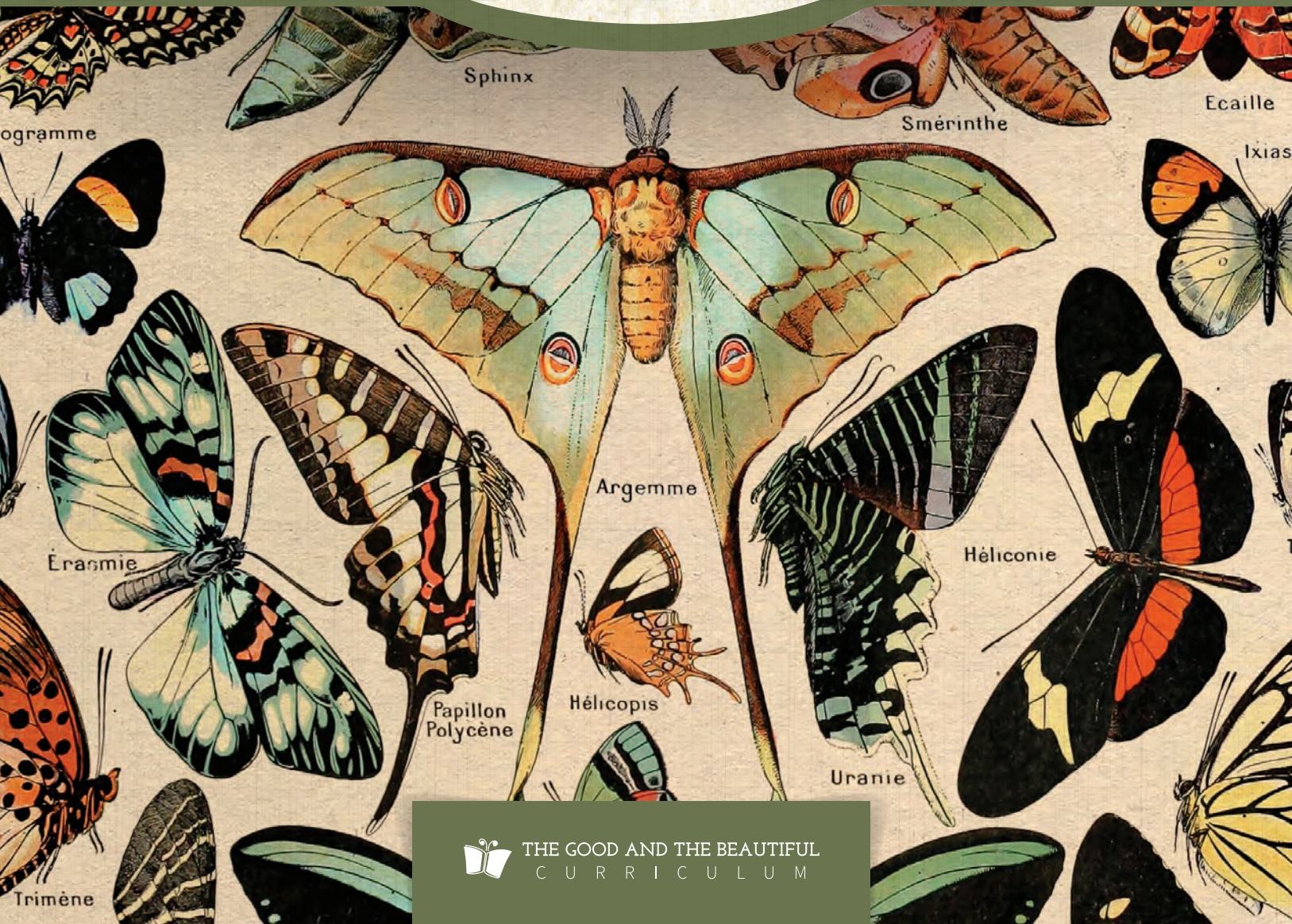
Pick **TWO** Strategies to Practice

- ☐ **Scan Notes -** Start at the beginning of your workbook and read through all the note-taking pages. Use a highlighter to mark concepts you think are important. Try to recall information before reading it.
- ☐ **Create Flashcards -** Identify concepts that are new or difficult. Create flashcards with the concept on one side and the explanation on the other. Set a timer and quiz yourself. Ask a family member or friend to help.
- ☐ **Draw Diagrams -** Select an interesting concept from *The Wonders of Botany* and creatively sketch a diagram outlining the things you find most important.
- ☐ **Memorize Mnemonics -** Memory aids, or mnemonics, help us remember information by associating it with something memorable. Create your own mnemonic.
- ☐ **Inspect Illustrations -** Flip through your workbook and *The Wonders of Botany*. Pause at each illustration or diagram. Try to describe what is happening before looking at clues in the writing.
- ☐ **Gratitude to God -** Ponder the miracle of life. How do you see God's hand as you've studied botany? Review *The Wonders of Botany* and your workbook. Do something to show your gratitude to God.
- ☐ **Relate to Your Life -** Review all the work you have done so far. Think about how you've seen the wonders of botany in your life.
- ☐ **Think About Titles -** Start at the beginning of *The Wonders of Botany* and read each title and header. Pause to recall concepts you learned.
- ☐ **Reflect and Review -** Go through your activities and labs. Reflect on what you learned. Take some time to review your work.
- ☐ **Teach a Friend -** Sharing things we learn is a beautiful way to connect with others and cement knowledge in our minds. Pick a topic. Discuss it with a friend. Record a video. Write a poem. Make your learning meaningful.

UNIT 3

HIGH SCHOOL BIOLOGY

Workbook



THE GOOD AND THE BEAUTIFUL
CURRICULUM

WORKBOOK

UNIT 3

Wonders of Marine Biology

Table of CONTENTS

Lesson 35: Introduction to Oceans and Marine Biology 1
Lesson 36: Introducing the Five Oceans and Whales 5
Lesson 37: Properties of Water and Fish Adaptations 10
Lesson 38: Seawater and Sea Turtles 14
Lesson 39: Marine Cycles and Decomposers 20
Lesson 40: Motions in the Oceans: Tides, Waves, and Currents 22
Lesson 41: Currents and Migration Lab 27
Lesson 42: Intertidal Ecosystems 34
Lesson 43: Estuary and Coastal Wetland Formation 36
Lesson 44: Coastal Wetlands and Estuarine Communities 38
Lesson 45: Topography of the Ocean Basins 41
Lesson 46: Coral Reefs 50
Lesson 47: Polar Seas and Ice 53
Lesson 48: The Polar Food Chain and Polar Mammals 56
Lesson 49: Sunlit Zone 60
Lesson 50: Twilight Zone 62
Lesson 51: The Deep Sea 64
Lesson 52: The Ocean Floor in the Deep Sea 66
Lesson 53: Ocean Exploration 68
Lesson 54: Unit 3 Review and Test 70

Properties of WATER and FISH ADAPTATIONS

1

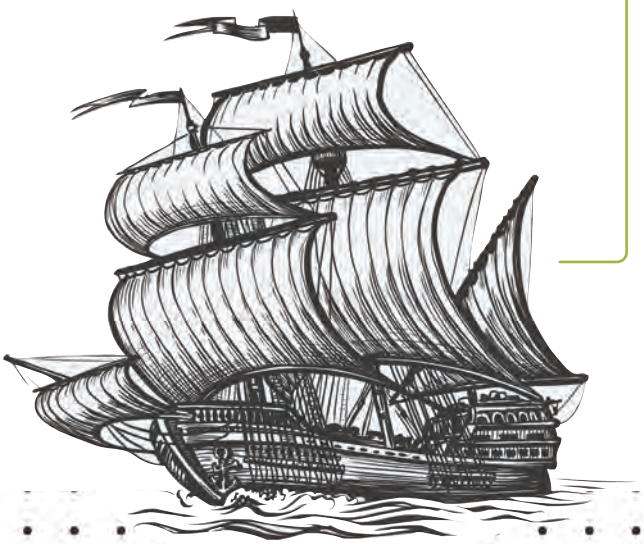
There might be a lot of water in our oceans, but none of it is drinkable. Read Diving Deeper: Salty Seas below to learn why.

DIVING DEEPER: Salty Seas

The famous line from Samuel Taylor Coleridge's poem "The Rime of the Ancient Mariner" reads, "Water, water everywhere, nor any drop to drink." Although the oceans hold about 97% of the water on our planet, none of it is safe for humans or other land animals to drink because of its high salt concentration. Sailors long ago found that drinking seawater had the opposite effect of quenching thirst, causing severe and rapid dehydration and even death.

For as long as humans have gathered around bright fires and listened in hushed reverence to stories and oral histories, people have tried to explain God's creation and the processes that make up our world.

In today's lesson you will learn how salt and other dissolved minerals cycle through the ocean.



2

Read Lesson 37: Properties of Water and Fish Adaptations in *The Wonders of Marine Biology* in the app (computer version). Complete the question to the right and the note-taking guide on the next page.

- Water naturally occurs in which three physical states?







PROPERTIES OF WATER AND FISH ADAPTATIONS

Lesson 37 in *The Wonders of Marine Biology*

- Explain hydrogen bonding:

- Draw a simple water molecule.

- Cohesion between water molecules creates . . . . . , which allows some tiny creatures to sit on the ocean's surface.

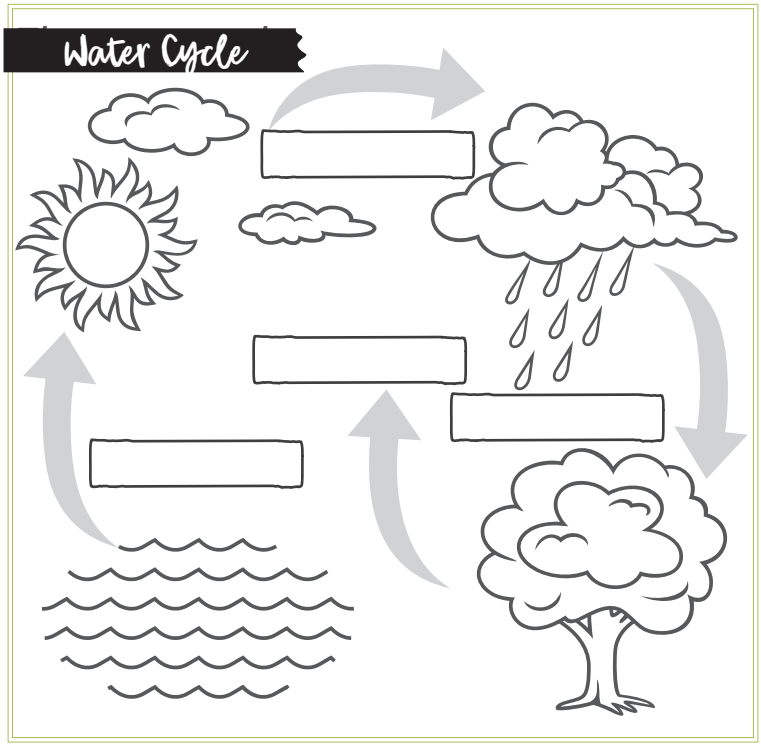
- Which of these is a result of hydrogen bonding?
  - ○ Stronger surface tension
  - ○ Vertical movement and water circulation
  - ○ Prevention of sudden temperature changes
  - ○ All of the above

- The hydrologic cycle, also commonly referred to as the water cycle, is responsible for

  1.

  2.

- Label precipitation, evaporation, condensation, and transpiration on the diagram below:



- Match each term with its definition.

  a. Gills
  b. Operculum
  c. Lateral line
  d. Swim bladder

  ___ Covers the gills; opens and closes so the fish can breathe even when not in motion

  ___ The specialized breathing apparatus that allows fish to take in oxygen from water

  ___ An oxygen-filled sac that expands and contracts, giving fish the ability to rise, sink, and hover in the water

  ___ Allows the fish to perceive subtle changes in the water around it

Turn the page for a fish activity.

© Good and Beautiful

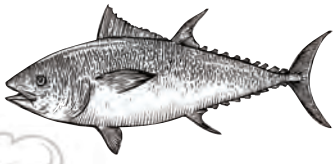
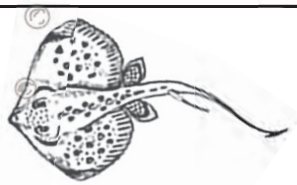
3

Complete the activity below.

At first glance it might seem that fish are all basically the same, with just a few variations in features, such as color and size. A closer inspection reveals many more differences than similarities. Fish, in fact, are the most diverse group of vertebrates (animals with a backbone or spinal column) on Earth and can be found in almost every body of water. Different characteristics and features can indicate where and how a fish lives.

Study the charts below to learn what body shapes, tail shapes, and mouth orientation can tell us about a fish's habitat and how it functions.

Body Shapes

Name	View	Description
Fusiform		torpedo shaped; streamlined for active swimming
Compressiform		flattened from side to side; quick and agile; schooling fish; can maneuver through corals
Depressiform		flattened from top to bottom; slow moving for bottom dwelling
Filiform		long, thin body; slithers like a snake; flexible body for hiding and burrowing

Tail Shapes

Name	View	Description
Lunate		crescent shaped; reduced drag; excellent acceleration; reduced maneuverability
Forked		reduced drag; suited for long-distance swimming
Emarginate		reduced drag; effective maneuverability and acceleration
Truncated		short bursts of speed; constant slow swimming
Round		sharp turns; quick starts; slower; creates drag

Mouth Orientation

Name	View	Description
Superior		mostly positioned toward water's surface; angled upward; feed on prey above
Terminal		end of snout; feed on prey in front; may be angled slightly upward
Inferior		mouth is angled downward; shorter lower jaw; feed on prey at the bottom of the body of water

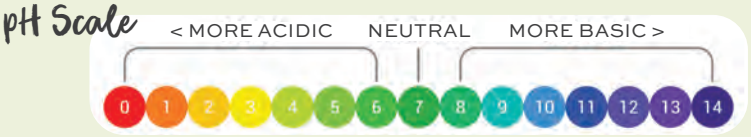
SEAWATER and Sea Turtles

1. Read What is pH?: Acidity in Seawater below.

2. Read Lesson 38: Seawater and Sea Turtles in *The Wonders of Marine Biology* in the app (computer version) and complete the note-taking guide on the next two pages.

What is pH?

ACIDITY IN SEAWATER



To understand the acidity of seawater, which affects the organisms that live in the water, it helps to understand the pH scale. Scientists use the pH scale to measure how *acidic* or *basic* a liquid solution is compared to pure water, which is considered neutral. The term pH stands for the **p**otential of **h**ydrogen ions (hydrogen ions are positively charged hydrogen atoms), and the pH scale tells you how many of those hydrogen ions are in a solution compared to pure water.

Acids have more hydrogen ions than pure water does, while bases have fewer. The pH scale is exponential, so a liquid with a pH of 6 has 10 times more hydrogen ions than water at neutral 7. The lower the number on the pH scale, the more acidic a liquid is. Moving in the opposite direction, a liquid with a pH of 8 has 10 times fewer hydrogen ions than water at neutral 7, and as the numbers get larger, the solution becomes more basic.

Examples of common substances that are acidic include tomatoes, lemon juice, and stomach acid. Examples of common substances that are basic include baking soda, soap, and bleach. Both acids and bases react with other substances because acids have extra hydrogen ions, and bases have fewer hydrogen ions. The presence or lack of these ions causes them to be attracted to other atoms, inducing them to react.

Seawater is naturally slightly basic, with a pH of about 8, so it has fewer hydrogen ions than pure water. However, changes in the atmosphere can make seawater more acidic. When extra carbon dioxide is put into the atmosphere, either from natural sources such as forest fires or from human activity such as burning fossil fuels, that extra carbon dioxide dissolves into seawater and bonds with water and the minerals calcium and carbonate in the water, creating carbonic acid. The carbonic acid lowers the pH of the ocean, making it more acidic.

Even a slight change in pH affects marine organisms. Many marine invertebrates, such as conches and clams, use calcium and carbonate to make their shells, but when the calcium and carbonate are turned into carbonic acid, marine organisms can no longer use them to create their shells. The increase in acidity can also dissolve existing seashells of marine creatures.

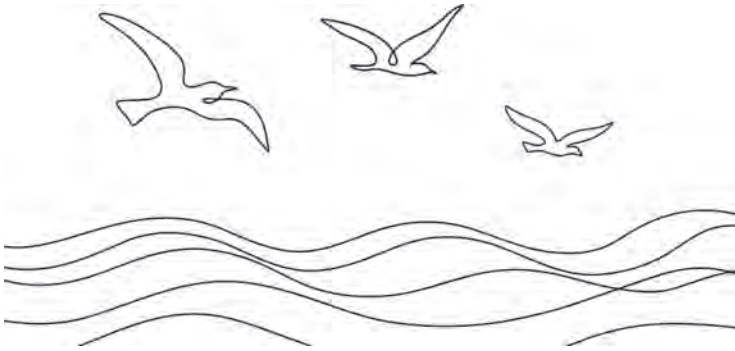
Additionally, the cells of living creatures can tolerate only a narrow range of pH values. If water becomes either too acidic or too basic, certain animals and plants struggle to survive in it. For example, a change in the pH of seawater changes the pH of the blood of fish, their bodies have to work harder to get rid of the extra acid, and they may not have as much energy to swim, grow, or reproduce. The pH of ocean water shows how perfectly God has designed our planet.

CURRENTS
and Migration Lab

Lesson 41 is a lab only; there is no reading assignment. Ask your parent if you should do the lab hands-on or if you should watch the lab through the video on the app (computer version). Optionally, you may choose to do both.

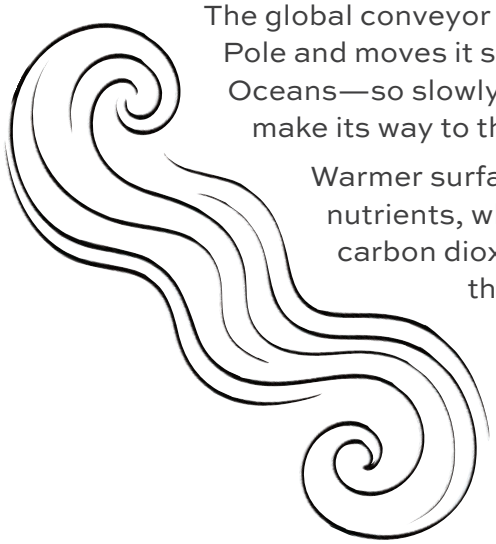
CAUTION: **Because this lab uses an open flame, use caution. Make sure that your work area is sturdy and flat. Clear your space of all other items. Oil is flammable; do not let it spill onto the flames. Hot oil can cause burns.**

1 Read the information about ocean waters below.



Ocean waters are constantly in motion, with both shallow and deep ocean currents flowing from one part of the ocean to another, cycling nutrients, moving marine creatures, and affecting the weather. While shallow currents are caused by wind, deep ocean currents exist because of differences in water temperature and salinity. Colder water is denser than warmer water, and saltier water is denser than fresher water. Denser water sinks, causing a deep ocean current.

As water approaches the North and South Poles of the earth, it becomes colder and denser. Some of it freezes and forms freshwater ice, leaving salt behind and making the remaining water saltier and denser. These cold, salty waters sink toward the bottom of the ocean, and warmer water replaces them. This movement produces a convection current—the movement created when warmer fluid rises and colder fluid sinks.



The global conveyor belt system of ocean currents takes deep, cold water from the North Pole and moves it south, down to Antarctica, and on toward the Indian and Pacific Oceans—so slowly that it can take 1,000 years for water from the North Atlantic to make its way to the North Pacific.

Warmer surface waters contain a lot of oxygen but very little carbon dioxide or nutrients, while the colder and deeper waters contain less oxygen but are rich in carbon dioxide and nutrients. The global conveyor belt allows oxygen to reach the deeper ocean while carbon dioxide and nutrients reach the surface, supporting the ocean's food chain. The movement of colder and warmer waters supports ocean ecosystems and affects the world's climates.

In this lab you will create a model of ocean currents that illustrates how density and temperature affect currents.

© Good and Beautiful

LESSON 41

LAB REPORT

MARINE CURRENT DEMONSTRATION OBSERVATIONS

QUESTIONS

Write the answers to the following questions.

1. Where in the dish do the particles move the fastest? Where do they move the slowest? How do you explain these variations in velocity?

2. How does your model differ from real ocean currents?

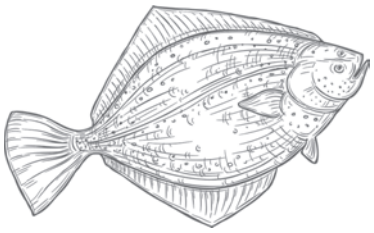
3. Imagine that the cereal pieces in the model represent migrating animals, such as blue whales. How might migrating animals use ocean currents to their advantage?

4. How could you modify the model to learn more about currents? Suggest two modifications.

© Good and Beautiful

TOPOGRAPHY OF OCEAN BASINS

Lesson 45 in *The Wonders of Marine Biology*



- _____ feed on dead and decomposing matter.
- While _____ are usually found on the continental slope and are caused by _____, undersea _____ are much larger chasms on the _____ _____.
- The description and analysis of the physical features of an area is referred to as _ _ _ _ _ _ _ _ _ _ _.
- Match the description to the correct landform. Write the landform's letter in the box.

A	Canyons	☐ 1.	Large V-shaped chasms on the abyssal plain caused by a tectonic plate subducting under another
B	Trenches	☐ 2.	Found near trenches; the majority are located in an area of the Pacific Ocean known as the "Ring of Fire"
C	Seamounts	☐ 3.	Rifts that begin on the continental slope caused by erosion or geologic disturbances
D	Undersea volcanoes	☐ 4.	Underwater mountain ranges formed at tectonic plate boundaries
E	Mid-ocean ridges	☐ 5.	Incredibly biodiverse undersea mountains created by volcanic activity

Complete the activity on the next pages.



FAMOUS MARINE BIOLOGISTS: ERNEST SHACKLETON (1874–1922)



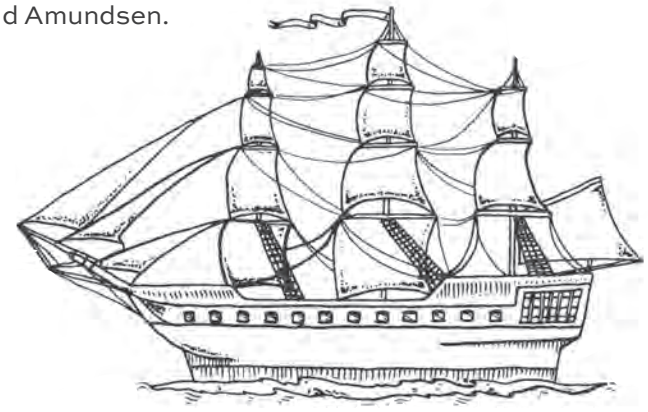
Ernest Henry Shackleton was born in 1874, the second of 10 children. He spent his early years on the family farm in Kilkea, Ireland, before moving to Dublin and eventually London while his father studied to become a doctor. Shackleton, however, would not follow in his father's footsteps. Adventure and travel beckoned, and he left school at the age of 16 to join the merchant navy.

Ten years later a new experience lured Shackleton into a new career: explorer. He joined the British National Antarctic Expedition, a joint venture between the Royal Society and the Royal Geographical Society, to explore Antarctica and be the first group to reach the South Pole, if possible. More commonly known as the Discovery Expedition after the name of their ship, the expedition departed in 1901, led by Captain Robert Falcon Scott. On this trip extensive scientific advancements were achieved, including the discovery of penguin colonies, snow-free valleys, and the Polar Plateau, which houses the South Pole. Although Shackleton and another explorer traveled farther south than any other person at the time, they failed to reach the South Pole by some 800 km (500 mi). The expedition eventually ran out of food and supplies and was forced to turn back in 1902.

The Discovery Expedition had a profound effect on Shackleton. Shortly after his return to England, he decided to organize his own attempt to reach the South Pole. Unlike the previous trip, this expedition would be organized on a private basis with little government support. In early 1908 the explorers left New Zealand and sailed south. On January 16 the ship entered a deep bay in the Antarctic continent called the Sea of Ross. Twelve days later the ship was stopped by frozen seas that prevented them from proceeding farther south. Undaunted, the team carefully lowered an automobile, the first car in Antarctica, onto the ice in order to continue their exploration. The team also used ponies and sled dogs as they established a base and continued their explorations.

On October 29, 1908, Shackleton and three others continued their attempt by land to reach the South Pole, along with four remaining ponies, after others perished. Twenty-eight days later, the men surpassed the previous attempt and forged into brand-new territory. As they moved south, the surface of the glacier they traveled became increasingly rugged and difficult to cross, and one by one, the ponies had to be euthanized. The men struggled as the days passed, and the rations grew short. Personality conflicts emerged, and the men bickered fretfully.

Finally, 67 days into their trek, even Shackleton had to admit that the South Pole was out of their reach. He pressed on for five more days, leaving all non-essential equipment behind to make better speed, intent on getting within 100 nautical miles, or 185 km (115 mi), of their target. On January 9, 1909, they stopped, as close as they would ever be to the South Pole, a mere 180 km (112 mi) away. Shackleton returned home without the victory he sought but was still proclaimed a hero and even knighted by King Edward VII. Although he would complete other Antarctic explorations, Shackleton would never attempt to reach the South Pole again. That feat was accomplished three short years later by Norwegian explorer Roald Amundsen.

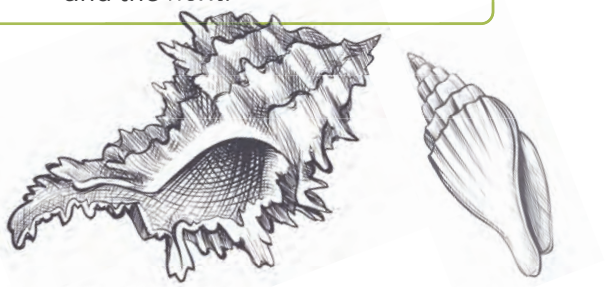


© Good and Beautiful

SUNLIT ZONE

1

Read Lesson 49: Sunlit Zone in *The Wonders of Marine Biology* in the app (computer version) and take notes on this page and the next.

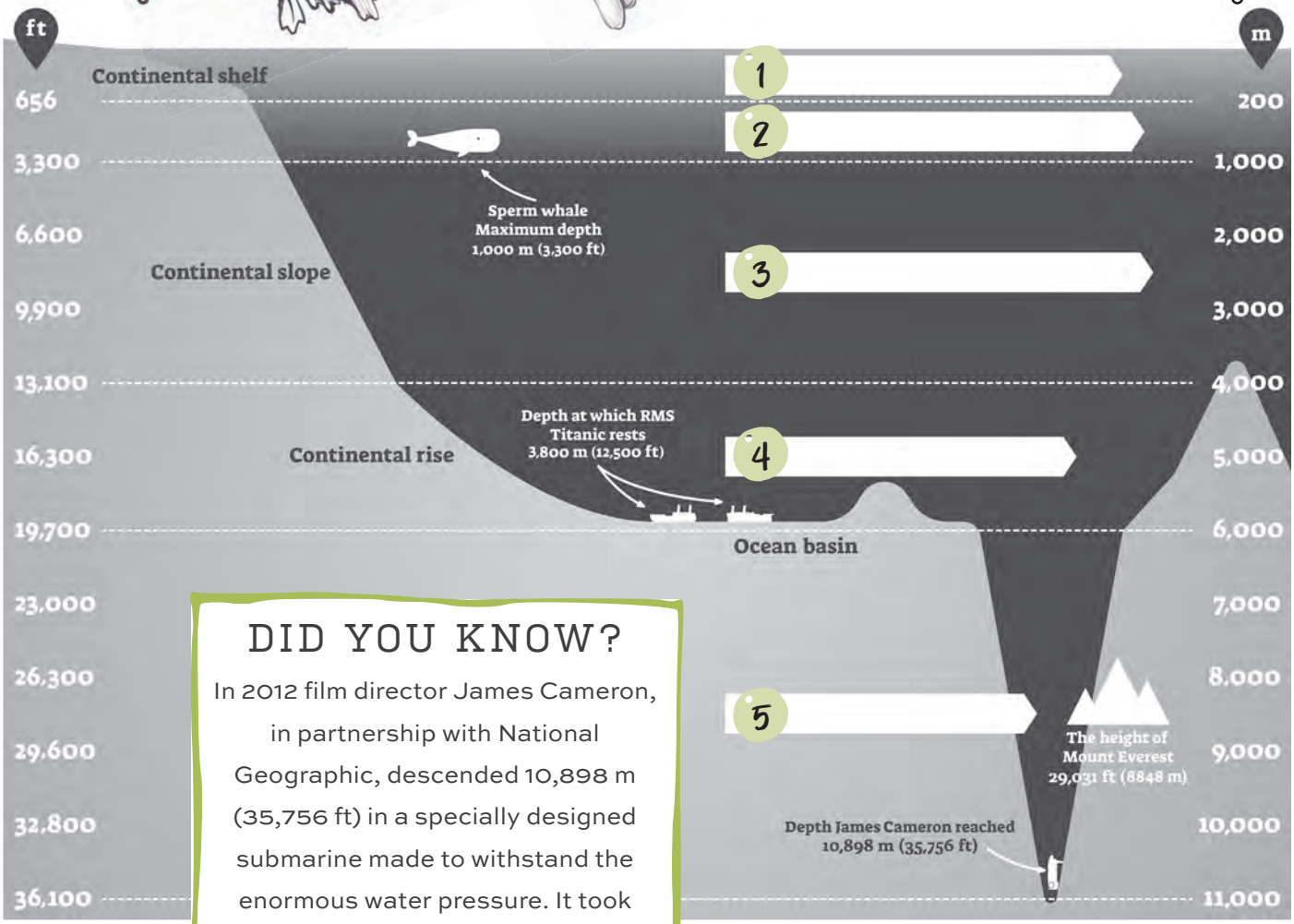


2

Using the word bank below, fill in the blank boxes marked 1–5 on the diagram.

WORD BANK

TRENCHES
ABYSS
SUNLIT ZONE
MIDNIGHT ZONE
TWILIGHT ZONE



DID YOU KNOW?

In 2012 film director James Cameron, in partnership with National Geographic, descended 10,898 m (35,756 ft) in a specially designed submarine made to withstand the enormous water pressure. It took 2 hours and 36 minutes to reach the seafloor.

SUNLIT ZONE

Lesson 49 in *The Wonders of Marine Biology*

- _____ _____ define the depth layers of the sea from the surface to the seafloor.

- Also called the sunlit zone, the _____ _____ is the only zone that receives direct sunlight and is therefore the warmest zone. Although it is the [smallest|largest] zone, it houses the majority of life in the ocean.

- The [aphotic|photic] zone describes anywhere in the ocean that the sun's rays can penetrate. The majority of the ocean exists in the total darkness of the [aphotic|photic] zone.

- Draw lines to match the words to their descriptions.

PLANKTON	creatures that can swim and navigate through the waters independently
PHYTOPLANKTON	microscopic algae and bacteria that employ photosynthesis and are the basis of all marine food webs
NEKTON	the primary consumers of phytoplankton; include protozoans, copepods, and krill
ZOOPLANKTON	creatures that cannot swim but float along with the currents

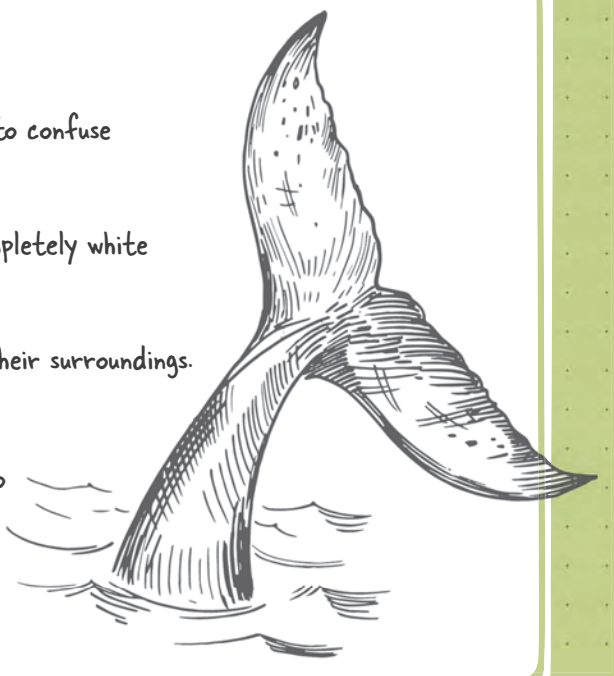
- Identify the creature defense.

_____ Some butterflyfish use false eyespots to confuse predators.

_____ A hammerhead shark has an almost completely white belly, and its back is gray–brown.

_____ Seahorses can change color to match their surroundings.

_____ The two-spot goby fish hunkers down on the seafloor and extends its fins to look like a hard-shelled crab.



© Good and Beautiful

THE DEEP SEA

1

Read Lesson 51: The Deep Sea in *The Wonders of Marine Biology* in the app (computer version) and complete the note-taking guide on the next page.

2

Read Ocean Zones: Root Words below.

Ocean Zones: Root Words

Many of the words we use in science come from Greek and Latin roots. Let's look at a few that are used in marine biology.

Bathypelagic

Bathos, meaning "depth," and *pelagos*, meaning "sea" = deep sea

Abyssopelagic

Abussos, meaning "bottomless pit," and *pelagos*, meaning "sea" = bottomless sea

Hadalpelagic

Hades, referring to the mythological god of the underworld, and *pelagos*, meaning "sea" = underworld sea

Trenches make up the world's hadal, or hadalpelagic, zone.

THE DEEP SEA

Lesson 51 in *The Wonders of Marine Biology*

- Label the bottom three zones that make up the deep sea from shallowest to deepest, using their scientific and common names.

Scientific Name	Common Name

- List a few defining characteristics of the deep-sea zones.

. . . . . .

. . . . . .

. . . . . .

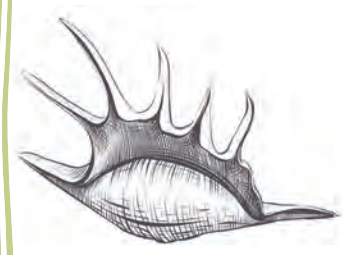
. . . . . .

. . . . . .

- Part of the Mariana Trench and 11 km (7 mi) below the ocean surface, the lowest point on the planet is the _____ _____.

- Most organisms in the deep sea often swim back and forth between zones, as there is little difference between zones.

○ True ○ False



- Why is traditional reproduction so difficult in the deep sea?

. . . . . .

. . . . . .

- Name these two accepted ideas that explain abyssal gigantism.

_____: Bigger animals have survived longer by learning to be efficient, and efficiency is a very necessary trait in the deep sea.

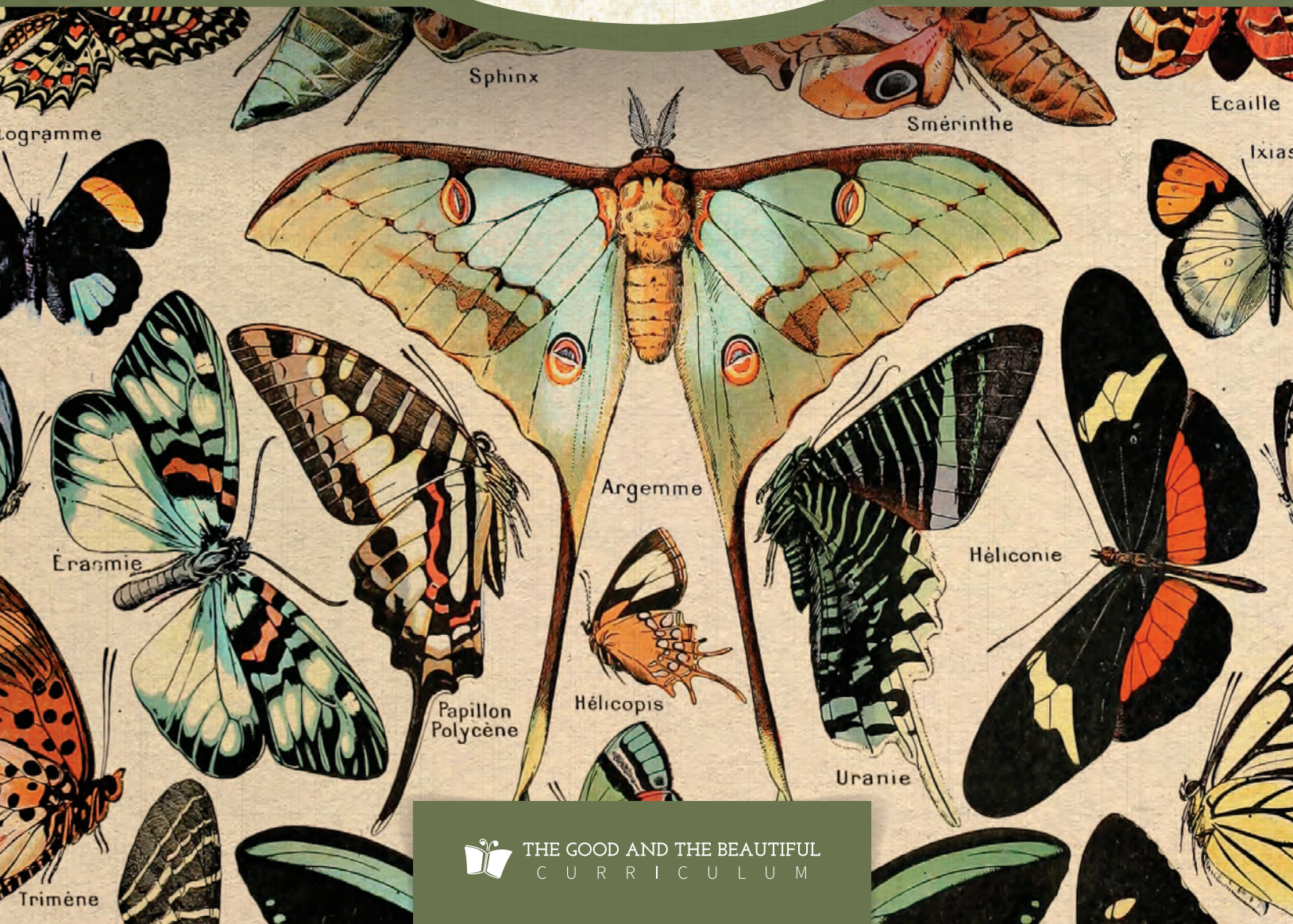
_____: Larger creatures tend to do better in colder environments, while smaller creatures seem to thrive in warmer environments.

© Good and Beautiful

UNIT 4

HIGH SCHOOL BIOLOGY

Workbook



THE GOOD AND THE BEAUTIFUL
CURRICULUM

WORKBOOK

UNIT 4

Wonders of the Animal Kingdom

PART 1

Table of CONTENTS

Lesson 55: Introduction to Kingdom Animalia 1

Lesson 56: Porifera: Sponges 3

Lesson 57: Cnidarians: Anemones, Corals, and Jellyfish 5

Lesson 58: Mollusca: Snails, Octopuses, and Clams 7

Lesson 59: Annelida: Segmented Worms 9

Lesson 60: Arthropoda: Insects, Arachnids, and Crustaceans 14

Lesson 61: Echinoderms: Sea Stars and Sea Urchins 16

Lesson 62: Dissection Lab 18

Lesson 63: Introduction to Chordata 34

Lesson 64: Fish: Bony Fish, Eels, Sharks, and Rays 36

Lesson 65: Amphibians: Frogs and Toads 42

Lesson 66: Amphibians: Newts and Salamanders 48

Lesson 67: Reptiles: Snakes 50

Lesson 68: Reptiles: Lizards 52

Lesson 69: Reptiles: Crocodilians 54

Lesson 70: Reptiles: Turtles, Terrapins, and Tortoises 56

Lesson 71: Unit 4 Review and Test 58

ANNELIDA

Segmented Worms

1. Before you start today's lesson, turn to page 11 and check that you have the needed supplies for the earthworm observation activity.

2. Read Lesson 59: Annelida: Segmented Worms in *The Wonders of the Animal Kingdom, Part 1* in the app (computer version) and take notes in the white section below and on the following page.

3. Go to the app (computer version) to watch the video "Wriggling World of Worms." Take notes below.

VIDEO: Wriggling World of Worms

Before you watch the video, answer Question #1 below. **After** the video, answer Question #2.

Question #1
How do you think earthworms affect their ecosystems for better or worse?

Question #2
List one positive and one negative impact earthworms have on their environment.

All annelids share the same cylindrical, _____ anatomy. Their bodies are composed of round compartments stacked side by side, connected by powerful muscles that _____ and _____ to allow mobility.



Circle the function of nephridiopores.

A. Absorbing oxygen and releasing carbon dioxide

B. Giving the worm shape and structure and keeping its organs from getting crushed in tightly packed underground soil

C. Pumping blood, which travels throughout the body inside blood vessels

D. Similar to the way kidneys work, getting rid of additional waste in the system

© Good and Beautiful

ANNELIDA NOTES

Lesson 59 in The Wonders of the Animal Kingdom, Pt. 1

As you read the lesson, label the parts of the earthworm using the words below.

AORTIC ARCHES

ANTERIOR END

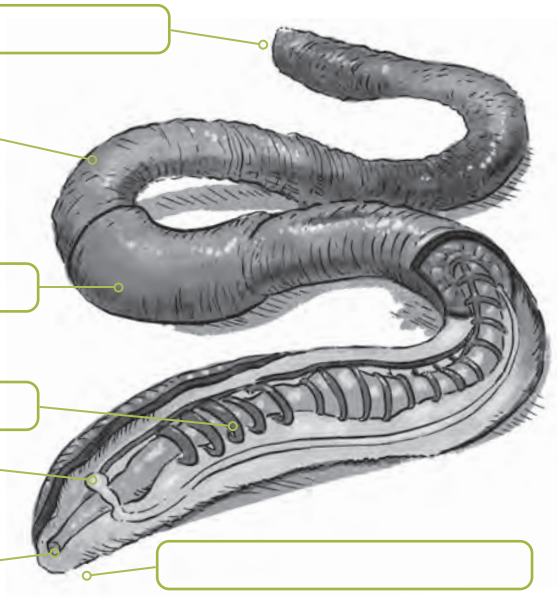
CUTICLE

GANGLIA

MOUTH

POSTERIOR END

CLITELLUM



Draw lines to match each annelid class to its location and an example.

Hirudinea	Oceans	Earthworms
Oligochaeta	On land or in fresh water	Leeches
Polychaeta	Variety of locations	Tube worms

- In earthworms the bulging outer band used for reproduction is called the

  ○ Cuticle ○ Aortic pouch

  ○ Setae ○ Clitellum

- Earthworms are _____, which means that they have both male and female reproductive organs.

- _____ is the process by which worms break down organic waste and convert it into usable fertilizer.

- Circle the correct answers:
  Marine worms are distinguished by their [suckers | bristles], and leeches are characterized by their [suckers | bristles].

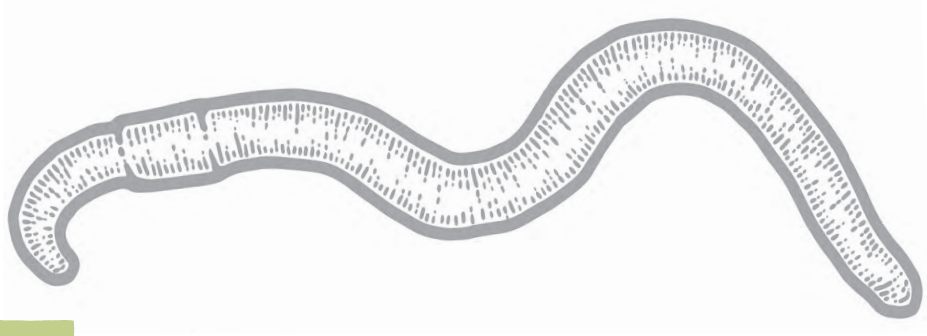
3

Complete the Observation of a Living Earthworm Activity on the following pages.

LOOKING AHEAD

Lesson 62 is a dissection lab. Ask your parent or teacher if you should dissect an organism hands-on or if you should watch the video only. If you will perform the dissection, work with your parent or teacher to decide which specimen you will dissect: clam, sea star, or bony fish. The sea star and bony fish include microscope work. Begin to gather the specimen and supplies. Plan to have adult supervision.

OBSERVATION OF A LIVING EARTHWORM ACTIVITY



PROCEDURE

☐ **Step 1 –** Read through all steps of the procedure and accompanying questions on page 13 to understand the overall goal of this experiment.

☐ **Step 2 –** Gather the supplies needed for this activity.

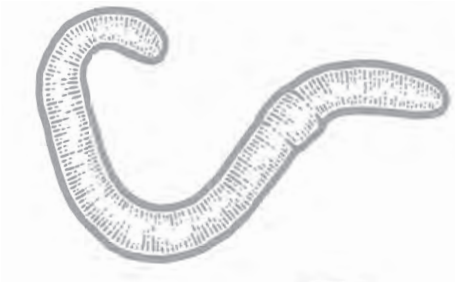
SUPPLIES

- Live earthworm (obtain from under a rock or log, or from a bait shop)
- Paper towels
- Disposable plate
- Cotton swabs
- Rubbing alcohol

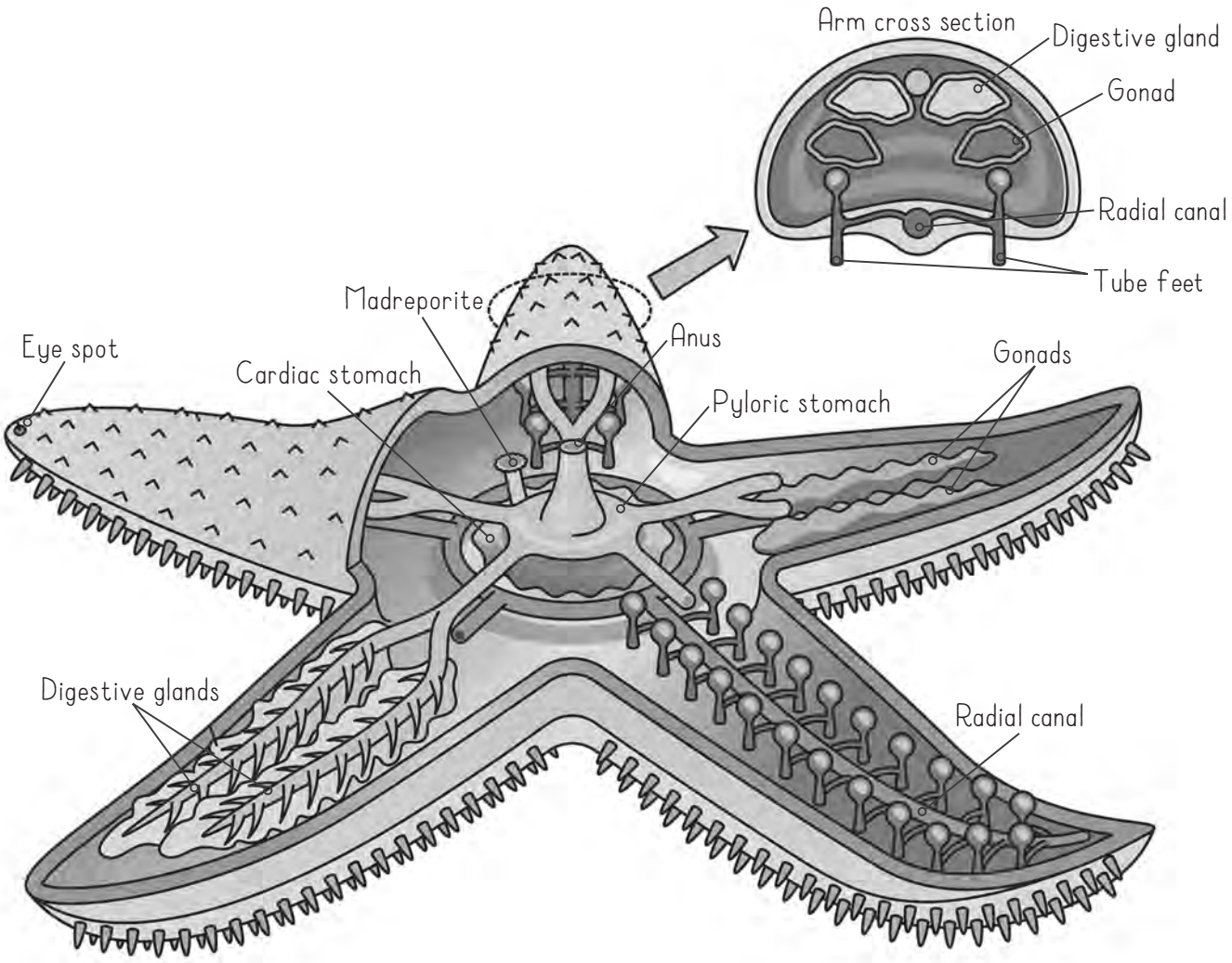
CAUTION: Use caution with rubbing (isopropyl) alcohol. Prevent contact with eyes and skin, and do not ingest or inhale. If alcohol gets on skin, wash with soap and water. Flammable; keep away from flames.

☐ **Step 3 –** Moisten a paper towel and place it on the disposable plate.

☐ **Step 4 –** Place one earthworm on the moist paper towel. Observe the worm as it moves. Place a clean cotton swab in the path of the earthworm. Complete Question 1.



© Good and Beautiful



Sea Star Anatomy

Option 2: Sea Star Dissection

PROCEDURE

CAUTION: Preserved specimens use preservatives or fixatives that may cause eye, skin, and respiratory system irritation, depending on the solutions used. Work in a well-ventilated area. Wear gloves, goggles or safety glasses, and an apron. Prevent contact with eyes and skin, and do not ingest or inhale. If there is skin contact, wash with soap and water. For eye contact, flush with water. Follow all safety precautions from the specimen provider.

☐ **Step 1 –** Read through all steps of the procedure and accompanying Lab Report on page 28 to understand the overall goal of this experiment. Ask your parent or teacher to supervise and assist you with this lab.

☐ **Step 2 –** Gather your supplies.

SUPPLIES

- Preserved sea star specimen for dissection *(If you search online for a specimen to purchase, also search "starfish specimen for dissection" for more results.)*
- Foam tray or other disposable work surface
- Dissecting scissors
- Small, sharp kitchen knife or scalpel
- Forceps or tweezers
- Dissecting probe
- Apron (to protect clothes)
- Safety goggles or glasses (recommended)
- Disposable gloves (recommended)
- Magnifying glass
- Microscope and slide
- Cover slip
- Water
- Pipette or eyedropper



☐ **Step 3 –** Put on your gloves, apron, and safety glasses. Before you begin, observe the specimen. Place the sea star specimen onto the dissection tray with the ***aboral side*** up. This is the side without the mouth, the top side. Identify and observe the following external structures of the sea star: ***arms, eye spots*** (at the tips of the arms), and ***spines***.



☐ **Step 4 –** Locate the ***central disc***. Use the magnifying glass to help locate and identify the ***madreporite*** (also called the sieve plate). It is a small, round, hard plate slightly off to the side of the central disc, like a large dot. The madreporite is used to regulate how much water enters and exits the water vascular system.

☐ **Step 5 –** Complete Question 1 on the Lab Report.

© Good and Beautiful

LESSON 62

LAB REPORT

SEA STAR DISSECTION

1. Sketch the aboral side of your sea star specimen. Label the external features identified in Steps 3–4.

Aboral side

2. Sketch the oral side of the sea star. Label the parts identified in Steps 6–7.

Oral side

3. What is the purpose of the pyloric stomach?

4. What is the purpose of the cardiac stomach?

5. If you were able to identify the sex of your sea star, circle it here:

Male Female

6. What type of symmetry does the sea star specimen have? _____

7. Count and record the number of arms on your specimen. _____

AMPHIBIANS

Frogs and Toads

1

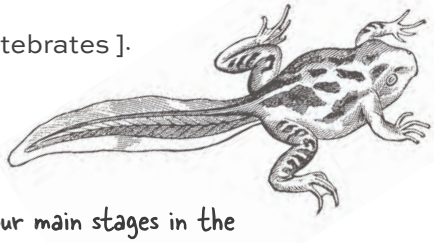
Read Lesson 65: Amphibians: Frogs and Toads in *The Wonders of the Animal Kingdom, Part 1* in the app (computer version). Complete the notes on this page and the next.

- Circle the correct answers:

  Just like fish, amphibians are

  [endothermic | ectothermic]

  [vertebrates | invertebrates].



- List the five main characteristics of amphibians.

  1.

  2.

  3.

  4.

  5.

- Draw and label the four main stages in the metamorphosis of a frog.

- Draw lines to match each characteristic as belonging to either a frog or a toad.

Frog	Slender build
	Shorter back legs
	Dry skin
Toad	Long, powerful legs
	Plumper body
	Bumpy/warty skin

AMPHIBIANS NOTES

Lesson 65 in *The Wonders of the Animal Kingdom, Pt. 1*

- How do amphibians protect their skin from sun exposure and water loss?

- Briefly explain two ways adult amphibians access oxygen.





- What is the main reason frogs make their chirping or croaking sounds?



- O To identify a food source
- O To scare away predators
- O To attract a mate
- O To mark their territory

- What makes a frog's tongue sticky?

- O The tongue has tiny hooks to catch prey.
- O The tongue isn't sticky; it wraps around prey.
- O The saliva is watery until it hits the air; then a chemical reaction makes it sticky.
- O The tongue is always covered in sticky saliva.

- Which part of a poison dart frog is poisonous? O Skin O Eggs O Tongue O Saliva

- _ _ _ _ _ _ _ _ _ _ are carnivorous amphibians found in wet, tropical locations that are often mistaken for _ _ _ _ _ .

- Caecilians are powerful _ _ _ _ _ _ _ that use their strong _ _ _ _ _ and a pointed _ _ _ _ _ to push through soil.



2 Complete the Frog Anatomy Activity on the following pages.

© Good and Beautiful

FROG ANATOMY

For this activity, you will study the internal anatomy of a frog. Remove the next page. Match the numbers below and on page 47 to the diagram. Color each body part as instructed. Read about the function of each part of the frog's anatomy.

SUPPLIES

- Colored pencils

☐ #1 – BRAIN

Color the brain pink.

The brain is the center of the nervous system and controls all functions in the body. A frog's brain has similar structures to a human brain. Different parts of the brain control different functions, such as breathing, digestion, movement, sight, and hearing.

☐ #2 – LUNGS

Color the lungs sky blue.

Adult frogs have three ways to obtain oxygen from air or water. When a frog is underwater, it "breathes" exclusively through its skin, and when it is on land, a mucus layer allows it to continue to obtain oxygen through its skin. Only adult frogs have lungs, and they are not well developed. Frogs can take air into their lungs, but they do not have diaphragm muscles, so they push air into and out of their lungs with their mouth muscles. The mouth also has a lining that can extract oxygen from the air directly, so frogs use their skin, mouths, and lungs for respiration.

☐ #3 – HEART

Color the heart red.

The heart pumps blood throughout the frog's body, carrying oxygen from the lungs to the rest of the body. A frog heart has two atria, which are chambers that take in blood. One takes in oxygen-rich blood from the lungs, and the other takes in oxygen-poor blood from the body. The heart has one ventricle, a chamber that pumps blood back out to the lungs and to the rest of the body. Because the frog's heart has just one ventricle, oxygenated blood mixes with deoxygenated blood, making the frog's heart less efficient. Humans have four chambers in their hearts, including two ventricles, while a frog has only three chambers.

☐ #4 – LIVER

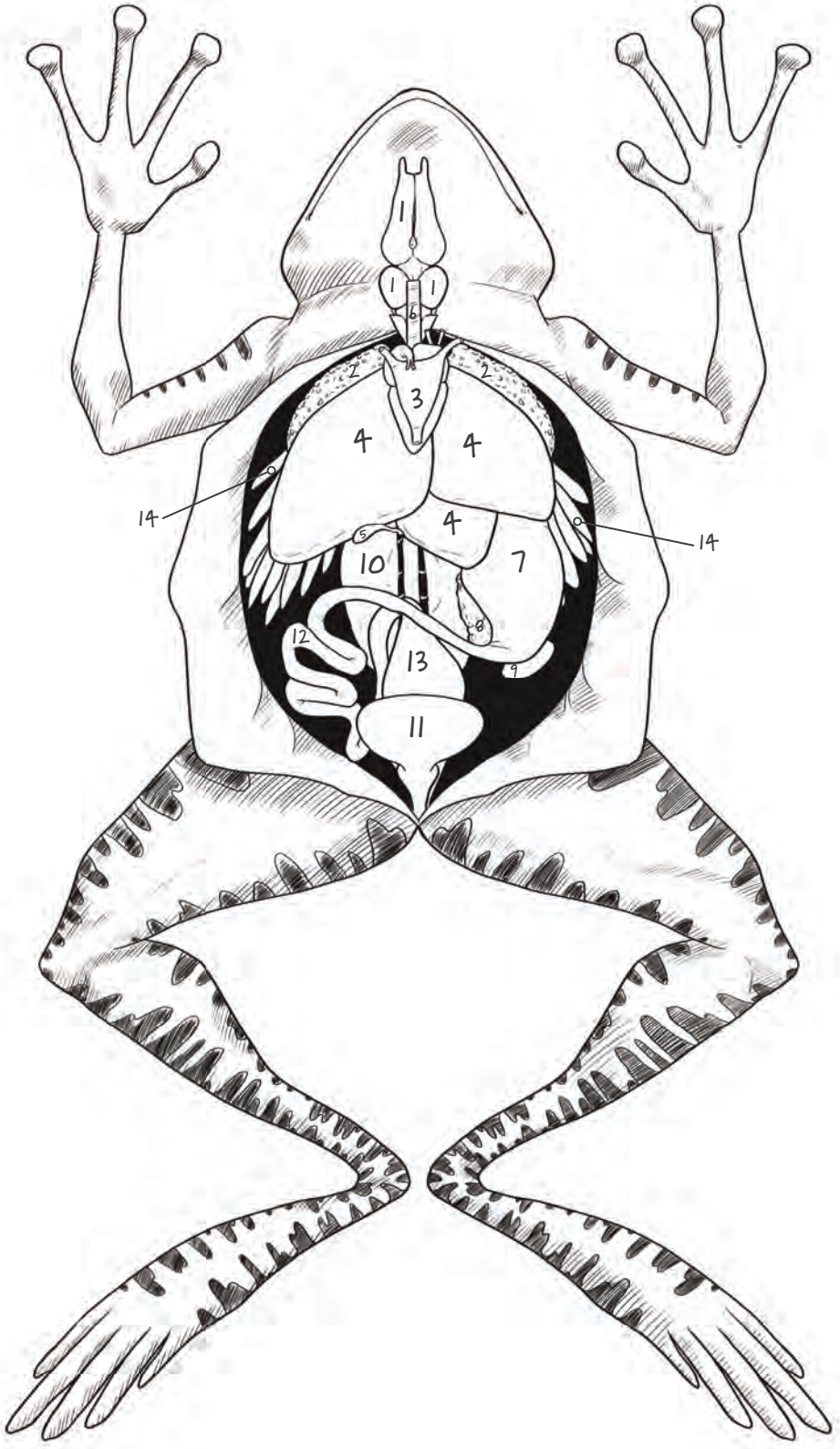
Color the liver brown.

The liver is the largest organ in the frog's abdomen. It produces bile to help the frog digest fats, and it also filters toxins from the blood. A frog's liver has three lobes, or sections.

☐ #5 – GALLBLADDER

Color the gallbladder gray.

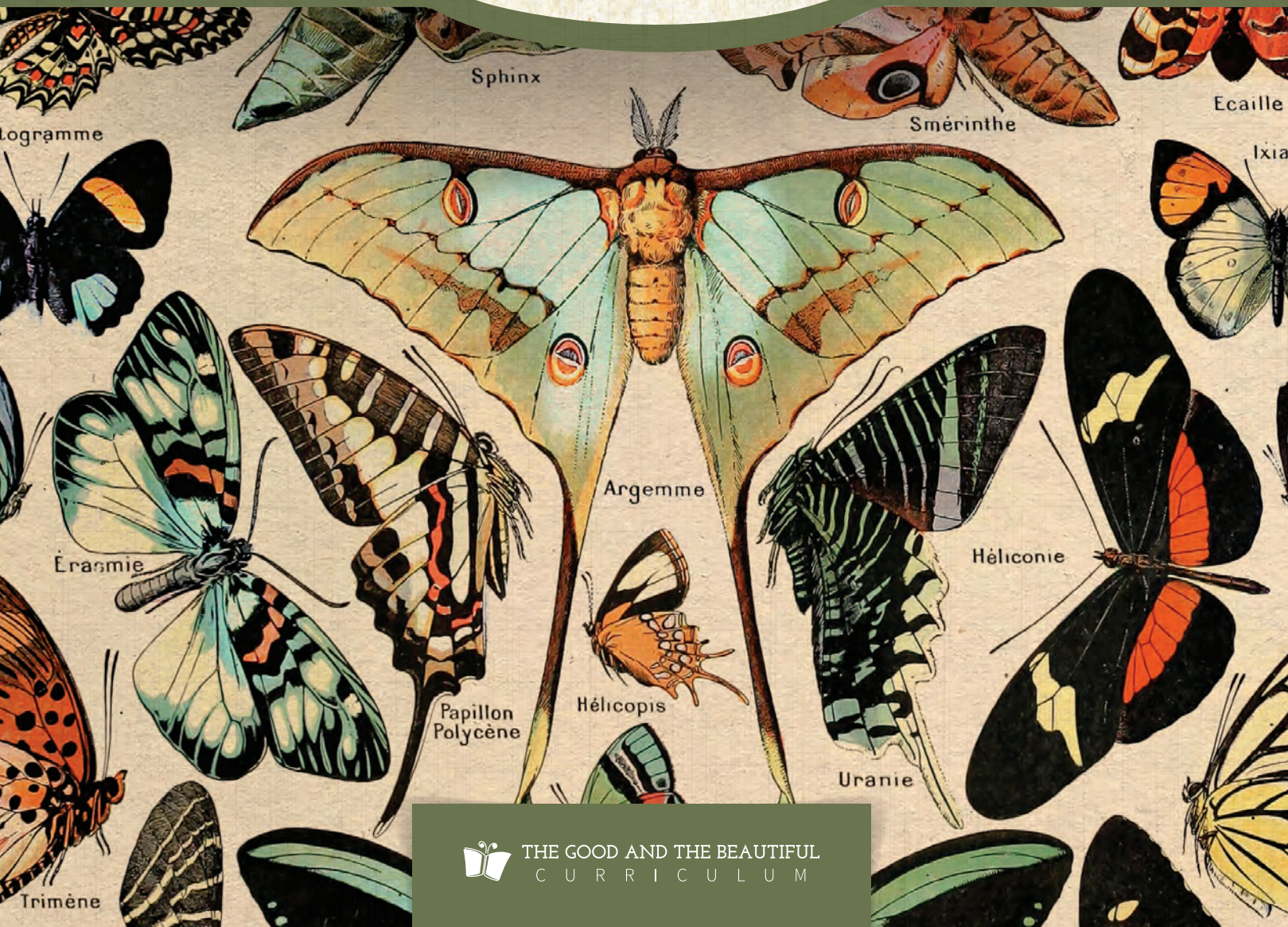
The gallbladder stores the bile produced by the liver until it is needed.


1
1
1
6
2
2
3
4
4
14
14
4
5
10
7
8
12
13
9
11

UNIT 5

HIGH SCHOOL BIOLOGY

Workbook



THE GOOD AND THE BEAUTIFUL
CURRICULUM

WORKBOOK

UNIT 5

Wonders of the Animal Kingdom

PART 2

Table of CONTENTS

Lesson 72: Introduction to Birds 1
Lesson 73: Fitted for Flight 3
Lesson 74: Feeding Strategies 5
Lesson 75: Nests and Eggs 7
Lesson 76: Bird Vocalization 9
Lesson 77: Bird Migration 11
Lesson 78: Bird Behaviors 13
Lesson 79: Bird Conservation 15
Lesson 80: Introduction to Mammals 16
Lesson 81: Reproductive Strategies of Mammals 17
Lesson 82: Bats, Echolocation, and Flight 19
Lesson 83: Rodents, Rabbits, and Endothermy 22
Lesson 84: Insectivores 24
Lesson 85: Hoofed Mammals 26
Lesson 86: Elephants, Manatees, and Other Near Ungulates 28
Lesson 87: Carnivores 31
Lesson 88: Aquatic Mammal Characteristics 33
Lesson 89: The Mammal Neocortex 35
Lesson 90: Conservation 37
Lesson 91: Ecology 39
Lesson 92: Trophic Energy Pyramid Activity 42
Lesson 93: Theories of Origins and Adaptations 47
Lesson 94: Unit 5 Review and Test 49

Bird VOCALIZATION

1

Read Lesson 76: Bird Vocalization in *The Wonders of the Animal Kingdom, Part 2* in the app (computer version). Complete the notes below.

- List four practical reasons why birds utilize vocalization.

1.
2.
3.
4.

- The two terms used to describe the sounds made by birds are _____ and _____.





Briefly explain the difference between a bird call and a bird song.

- Briefly explain why a male bird's song is so important to a female bird.

- Why is it important for male birds to establish a specific territory?

- _____ communicate the _____ of the sender, and a bird can immediately tell if the sounds are coming from one of its own kind or not.

- The _____ is the organ responsible for producing bird vocalizations. Located within the body cavity of the bird, it is divided into two chambers. Each half produces sound independently of the other, which means a bird can simultaneously produce two different _____.

© Good and Beautiful

BIRD VOCALIZATION NOTES

Lesson 76 in *The Wonders of the Animal Kingdom, Part 2*



2

To learn about another fascinating aspect of birds, watch the video "Bird Coloration" in the app (computer version).

VIDEO: Bird Coloration

Before you watch the video, answer Question 1, then fill in Question 2 as you watch. Complete the activity below after the video.

1. How do you think feather coloration helps a bird to survive?

2. Write one example from the video of how pigments help a bird survive or thrive.



Create your own color combination on the bird provided. In the boxes below, record the colors you chose and write which pigment could be responsible for that color. Use and identify at least three colors. If the color is visible due to nanostructures, write "nanostructure" in the right column.

Color	Pigment or Nanostructure

Introduction to MAMMALS

1 QUIZ

Review your notes for Lessons 72–79, then ask your parent or teacher for the mid-unit quiz. When finished, return it to your parent or teacher for grading and for your score to be added to the Grading Sheet found in the *High School Biology Tests and Quizzes* booklet.

2

Read Lesson 80: Introduction to Mammals in *The Wonders of the Animal Kingdom, Part 2* in the app (computer version). Answer the questions below.

- Mammals belong to kingdom _____, phylum _____, and class _____.



- List the eight main characteristics of mammals.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

- The tiniest mammal by size is a _____, while the largest is the mighty _____.



- What is a follicle?

- Explain why animals such as elephants, whales, and dolphins do not appear furry or hairy, yet still classify as mammals.

- The layer under the skin that keeps the animals' body heat from escaping: _____ _____.

- The color, or _____, of animal fur varies and can be eye-catching or provide regulation of _____.

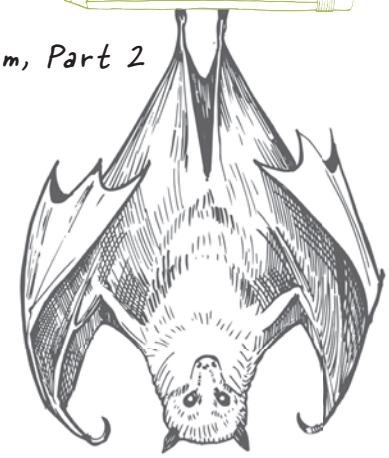
List the two types of fur coats and their functions.

1.

2.

BATS, ECHOLOCATION, AND FLIGHT NOTES

Lesson 82 in *The Wonders of the Animal Kingdom, Part 2*



- Bats have a wide range of diets. List at least three sources of food for bats.

  1.

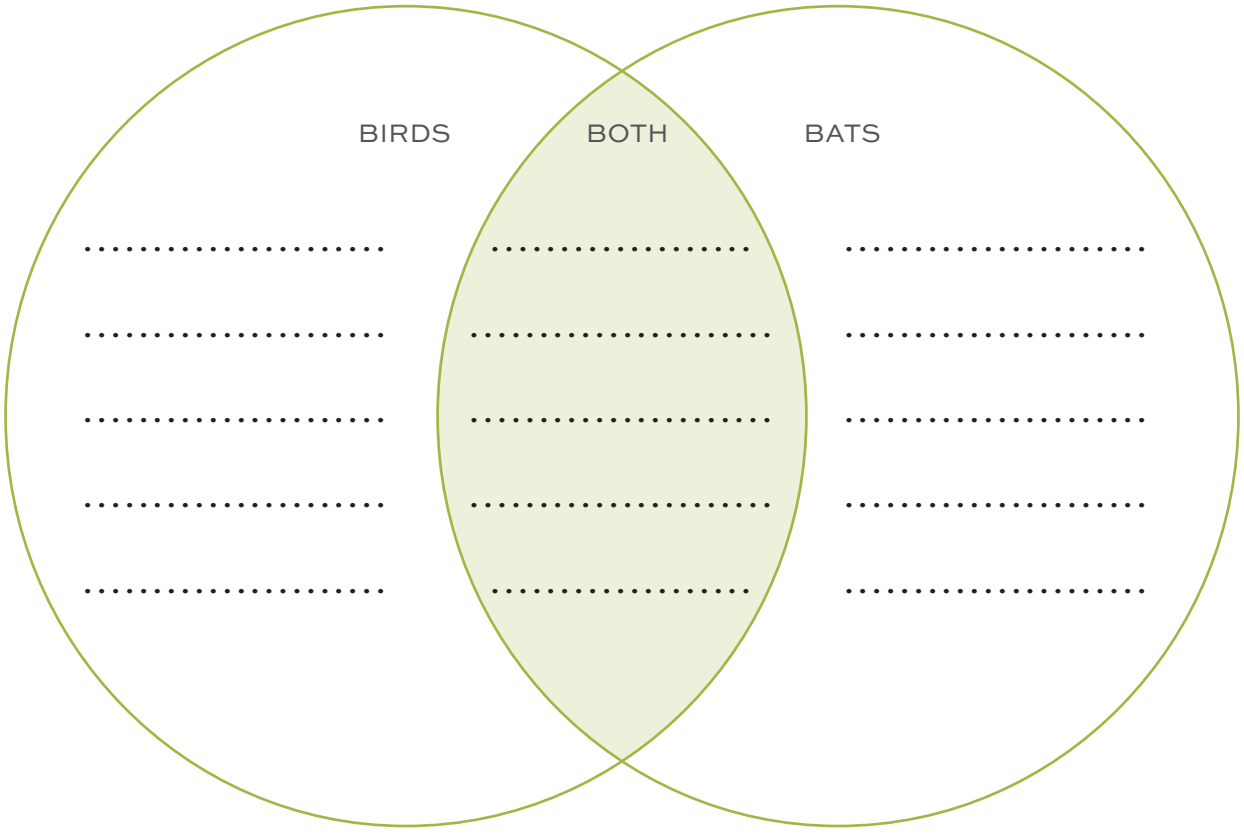
  2.

  3.

- Bat wings are modified _____ with four long _____ supporting the wing membranes.

- Complete the Venn diagram comparing birds and bats using the provided characteristics.

  - More maneuverability
  - Wings with feathers
  - Body mass at center of body
  - Light wings
  - True flight (flapping)
  - Endothermic
  - Soaring flight
  - Wings of skin
  - Slower flight
  - Higher flight speeds
  - Wings used for catching insects or for warmth



INSECTIVORES NOTES

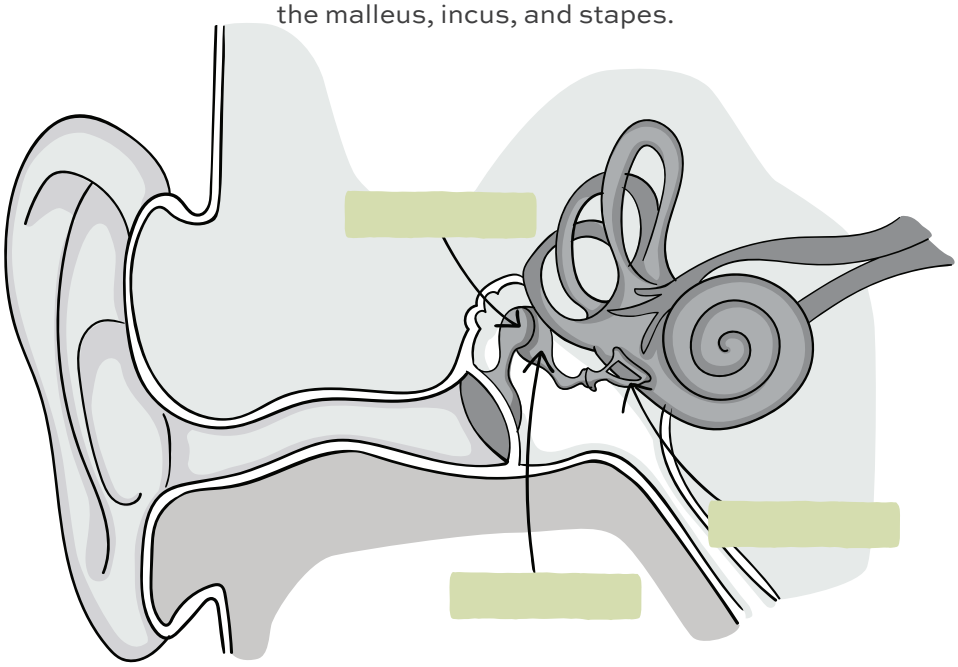
Lesson 84 in *The Wonders of the Animal Kingdom, Part 2*

- Which type of body protection does each animal have? Draw a line to the correct answer.

Aardvark	Scales
Anteater	Thick skin
Hedgehog	Spines
Pangolin	Thick, dense fur



Label the three inner ear bones described in the text: the malleus, incus, and stapes.



- What are two advantages of mammals having three ear bones?

- Briefly explain why shrews need to consume their entire body weight in food every day.

- Aardvarks spend most of their lives underground but do not stay in one burrow for long. How does this habit make them a keystone species in their ecosystem?

© Good and Beautiful

NEAR UNGULATES NOTES

Lesson 86 in *The Wonders of the Animal Kingdom, Part 2*

Write a **T** next to the facts that are TRUE about lactation.

Write an **F** next to the statements that are FALSE.

___ Only mammals produce milk secreted from mammary glands.

___ The birth process and the sucking of the infant stimulate milk production.

___ Most infant mammals do not need milk to survive, although it provides many health benefits.

___ All mammals produce milk that is identical in composition.

___ Milk contains antibodies and other substances that help protect the infant from viruses and bacteria.

___ Elephant babies nurse for only a few months.

- Hyraxes have which of the following characteristics? (Select all that apply.)

  - ○ Elastic foot pads
  - ○ Prehensile tails
  - ○ Grooming claw
  - ○ Chisel-like incisors



- Write what you learned about these features of hyraxes:

Climbing ability: _____

Feet: _____

Teeth: _____

Hyraxes are poor thermoregulators.
List two ways they maintain their body temperature.

- What is unusual about the way hyraxes care for their young?

- Why don't manatees tolerate cold water?

CARNIVORES

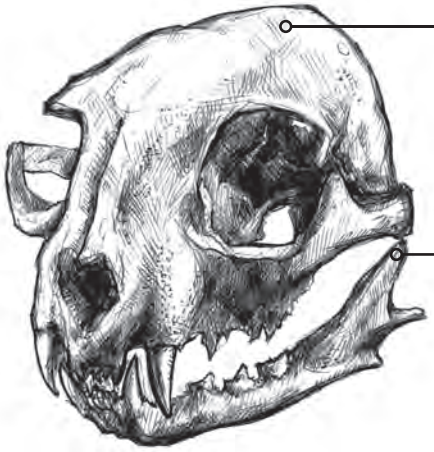
1

Read Lesson 87: Carnivores in *The Wonders of the Animal Kingdom, Part 2* in the app (computer version) and take notes on this and the next page.

- Which of the following are part of the carnivore family? Select all that apply.

- ○ Grizzly bears
- ○ Mongooses
- ○ Virginia opossums
- ○ River otters
- ○ Brown rats
- ○ Hyenas
- ○ Walruses
- ○ Gazelles
- ○ Genets
- ○ Domestic cats
- ○ Aardvarks
- ○ Skunks
- ○ Raccoons
- ○ Poodles

- Label the image below with the two features of a carnivore's skull and explain how each feature is ideally suited for a carnivorous diet.



Match each type of teeth to its description.

Canines	Specialized premolars and molars that work together like two knives
Molars	Sharp front teeth used to hold prey
Premolars	Prominent teeth used to stab, cut, and tear
Incisors	Serrated teeth to shear and cut
Carnassial teeth	Back teeth used to crush

© Good and Beautiful

CARNIVORES NOTES

Lesson 87 in *The Wonders of the Animal Kingdom, Part 2*



- _____ use their highly specialized abilities to _____ and kill prey, while _____ will feast on animals that have died of natural causes, leftover animal carcasses from other carnivores, or even roadkill.

- Carnivores have _____ _____, meaning their eyes are _____ _____ and each eye's field of vision _____ with the other.

- List five purposes of a carnivore's claws.

1. _____
2. _____
3. _____
4. _____
5. _____

- Which of the following are features of a carnivore's digestive system? Select all that apply.

- ○ Single-chambered stomach
- ○ Four stomach chambers
- ○ Long digestive tract
- ○ Short digestive tract
- ○ Highly acidic
- ○ Kills bacteria and parasites in their food

- Carnivores have proportionately _____ _____ than the size of their body. Compared with the mammal population as a whole, carnivores have an _____-_____ _____.

Draw lines to put each animal in the correct category and match it with the corresponding definition.

Diet consists of less than 30% meat	Hypocarnivore	Tiger
Diet consists of 50–70% meat	Hypercarnivore	Fox
Diet consists of more than 70% meat	Mesocarnivore	Black bear



Briefly explain how a carnivore limiting populations of omnivores and herbivores helps an ecosystem.

- All carnivores are animals.

- ○ True
- ○ False

ECOLOGY NOTES

Lesson 91 in *The Wonders of the Animal Kingdom, Part 2*



Circle the biotic factors and draw a rectangle around the abiotic factors.

Ferns	Landforms	Temperature
Fire	Minerals	Amoebas
Zebras	Mushrooms	Rain

Match each word to its definition.

Ecosystem	A large area characterized by its climate and the plants and animals that live there
Biome	A community of interacting organisms and their physical environment

- List the five major biomes. 1. _____ 2. _____ 3. _____ 4. _____ 5. _____

- List three tropical places in the world that have high biodiversity.



- Explain what biodiversity hotspots are and why they are vulnerable.

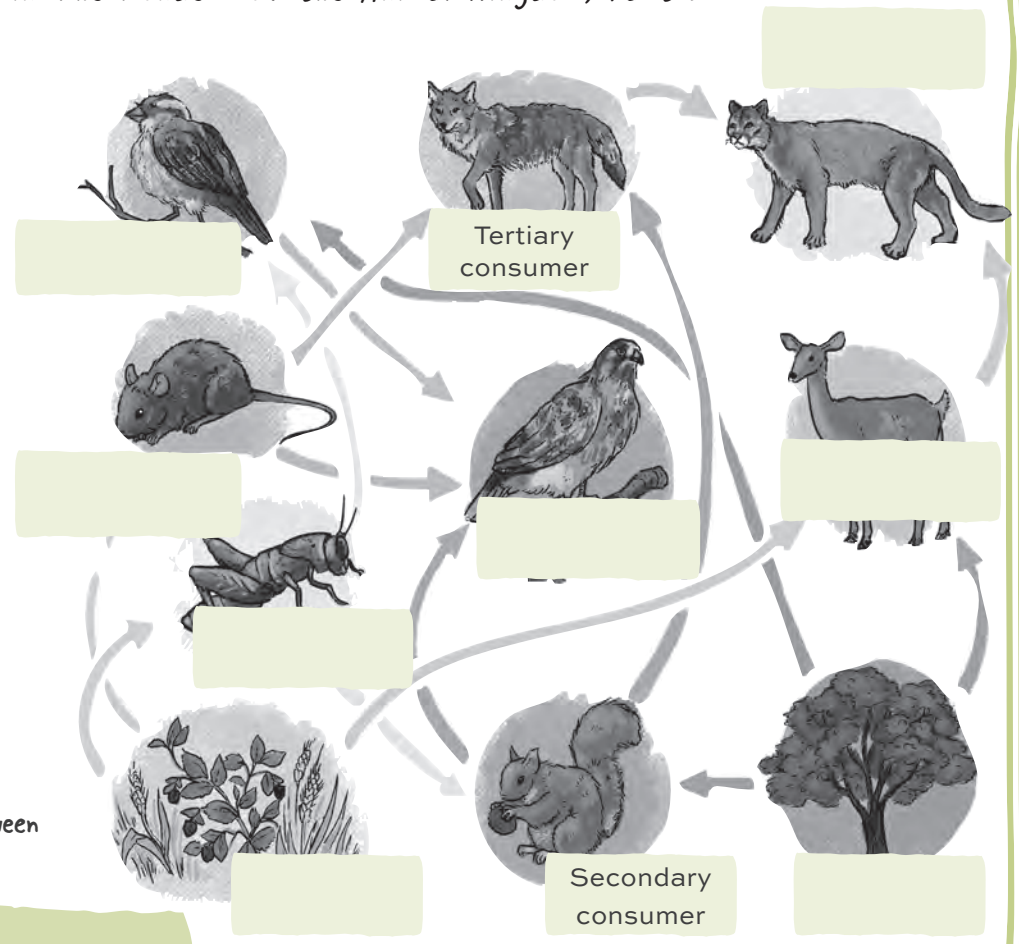
- What is an endemic species?

ECOLOGY NOTES

Lesson 91 in *The Wonders of the Animal Kingdom, Part 2*

Label the food web diagram using the words provided. (The number listed indicates how many times the word should appear at right. One animal will have two labels.)

- Producer (2)
- Primary consumer (3)
- Secondary consumer (3)
- Tertiary consumer (1)
- Apex predator (2)



- Explain the difference between scavengers and decomposers.

- A _____ _____ is a necessary resource that keeps a population from growing too large for the environment. The _____ _____ is the largest population that an environment can support.

- What is the term used to describe when two or more organisms require the same resource?

  - O Parasitism
  - O Competition
  - O Communalism
  - O Biodiversity





- Give an example of organisms showing competition.

© Good and Beautiful

Trophic ENERGY PYRAMID Activity

Lesson 92 is an activity only; there is no reading assignment.

This activity explores how much food is consumed at each trophic level of an ecosystem, demonstrating the energy loss that happens through a trophic level pyramid. This activity focuses on an ocean ecosystem.

SUPPLIES

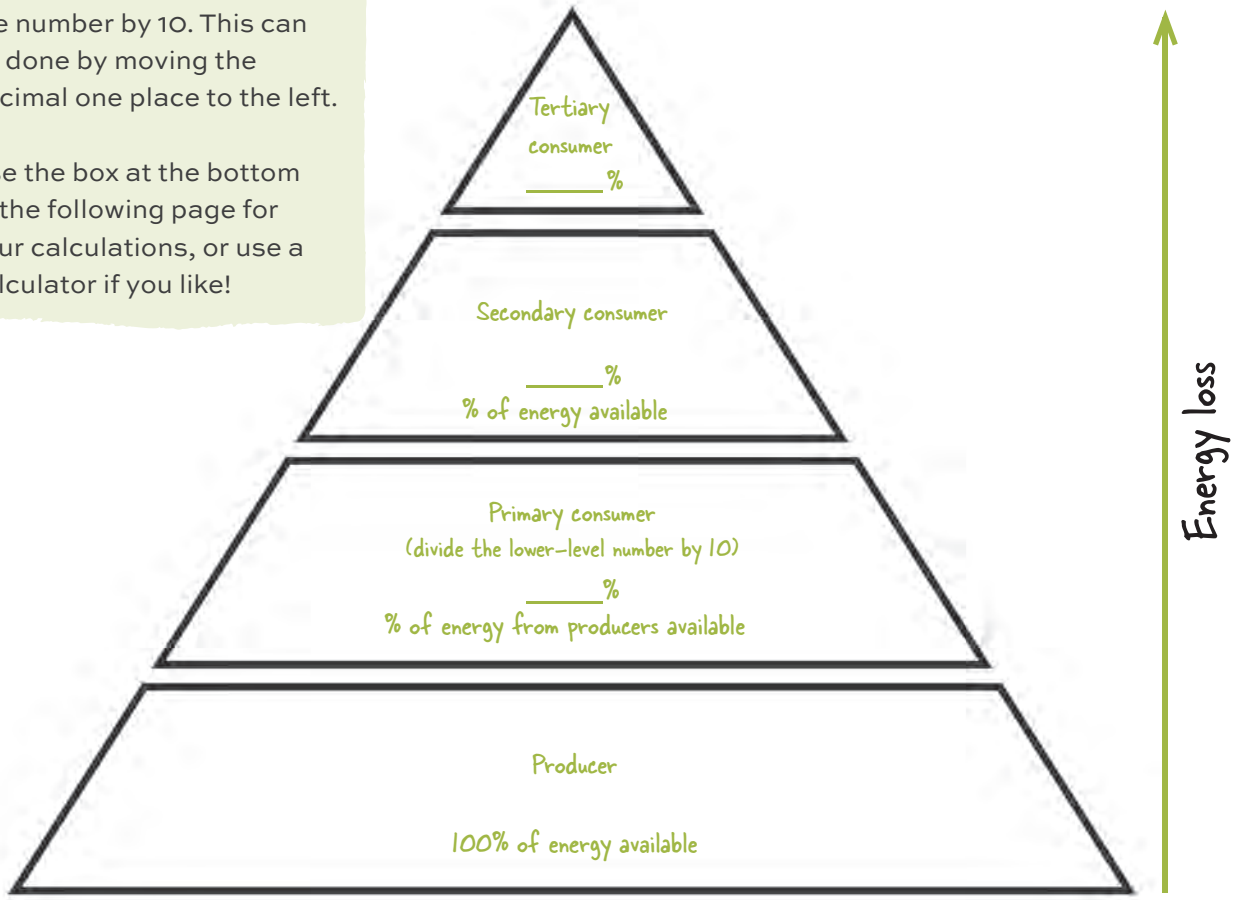
- Calculator (optional)

#1 When organisms in one trophic level consume the organisms in the level below them, only about 10% of the energy from this food is gained by the consumer. The remaining energy is lost through heat, digestion, breathing, waste, and other processes. Use this information to fill in the percent of the energy that is passed on at each level in the trophic pyramid below. Start at the bottom.

HINT

To find 10% of a value, divide the number by 10. This can be done by moving the decimal one place to the left.

Use the box at the bottom of the following page for your calculations, or use a calculator if you like!

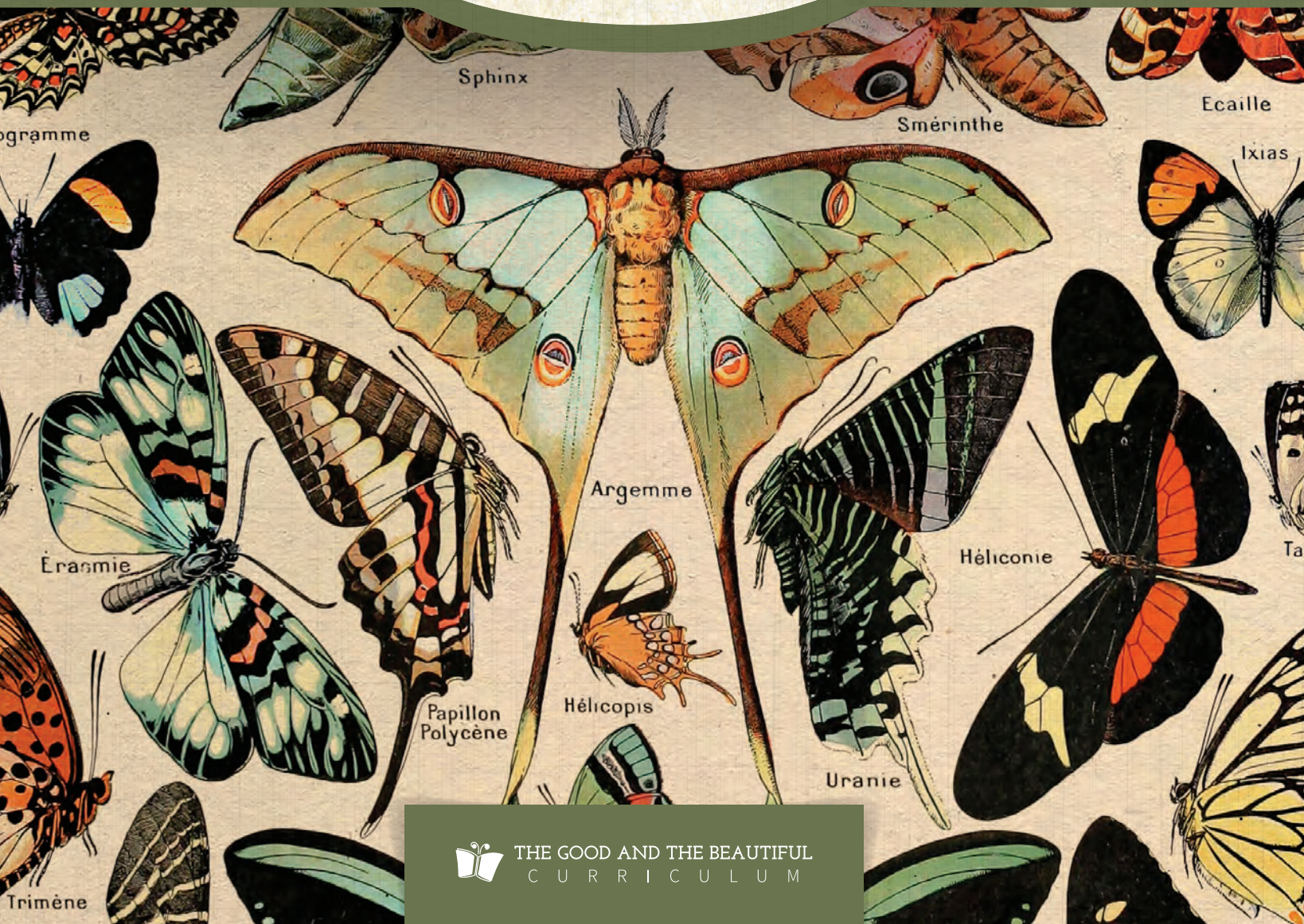


Trophic pyramid

UNIT 6

HIGH SCHOOL BIOLOGY

Workbook



THE GOOD AND THE BEAUTIFUL
CURRICULUM

WORKBOOK

UNIT 6

Wonders of the Human Body

Table of CONTENTS

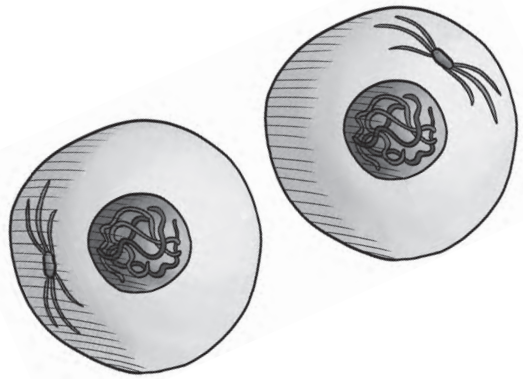
Lesson 95: Introduction to the Human Body 1
Lesson 96: Cells, Tissues, and Organs 3
Lesson 97: Asexual Reproduction Through Mitosis 5
Lesson 98: Sexual Reproduction and Meiosis 11
Lesson 99: Skeletal System 13
Lesson 100: Muscular System 15
Lesson 101: Central Nervous System 17
Lesson 102: Peripheral Nervous System 20
Lesson 103: Nervous System Activity 22
Lesson 104: Circulatory System 26
Lesson 105: Respiratory System 28
Lesson 106: Digestive System 30
Lesson 107: Renal System 32
Lesson 108: Integumentary System 34
Lesson 109: Immune System 37
Lesson 110: Endocrine System 39
Lesson 111: Reproductive System 41
Lesson 112: Sensory Systems 44
Lesson 113: Introduction to Genetics 46
Lesson 114: Heredity and DNA 48
Lesson 115: Strawberry DNA Extraction Lab 50
Lesson 116: How DNA Replicates 54
Lesson 117: Protein Synthesis 56
Lesson 118: Health and Wellness 58
Lesson 119: Unit 6 Review and Test 60
Lesson 120: Final Exam 63

Asexual Reproduction Through MITOSIS

1

Read Lesson 97: Asexual Reproduction Through Mitosis in *The Wonders of the Human Body* in the app (computer version) as you complete the notes on this page and the next.

- What is mitosis?



- In asexual reproduction we call the original cell the _____ cell and the two resulting cells _____ cells.

- Which of the following is the longest part of the cell cycle and occurs when the cell is performing its regular functions?

  - O Interphase
  - O Anaphase
  - O Prophase
  - O Metaphase

- Briefly explain how cells prevent damaged or deformed cells from replicating.

- Why do brain and spinal cord injuries sometimes result in permanent disability?

© Good and Beautiful

ASEXUAL REPRODUCTION THROUGH MITOSIS NOTES

Lesson 97 in *The Wonders of the Human Body*

- What is a chromosome? _____

Sketch each of the four stages of mitosis below.
Label the centromeres, mitotic spindles, centriole, and sister chromatids.

Prophase	Metaphase	Anaphase	Telophase

- What is cytokinesis?

_____

_____

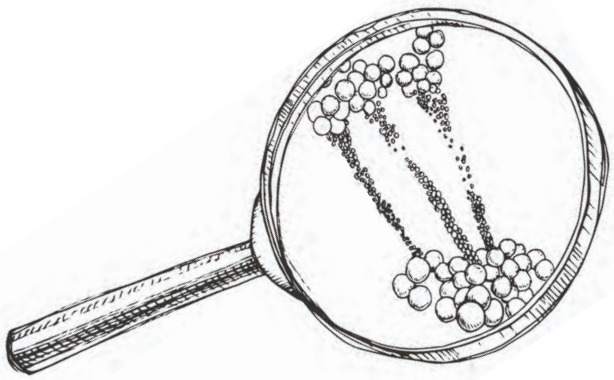
_____

- Mitosis occurs in multicellular organisms for growth and repair.

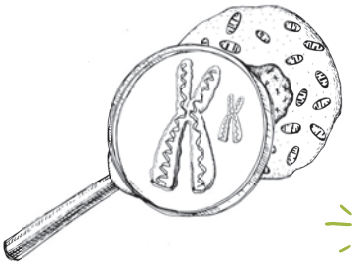
  ○ True ○ False

- Mitosis is a form of sexual reproduction.

  ○ True ○ False







PHASES OF MITOSIS IN ONION CELLS LAB

Ask your parent if you should do the lab hands-on or if you should watch the lab through the video on the app. Optionally, you may choose to do both.

INTRODUCTION

You may have suspected that in order to grow from a baby to an adult, a child's body must grow new cells. But did you realize that even a full-grown adult's body constantly produces new cells to maintain itself? Biologists estimate that a human replaces around 330 billion cells every day!

Some cells get replaced quickly (red blood cells are replaced about every 120 days) and some more slowly (by about 10 years, the skeleton cells are all replaced). Take a look at your hand. The cells you see are only 2–4 weeks old! We have learned about the structure of cells and the composition of cells; in this lesson we will get an inside look at cell reproduction through mitosis.



Cell division through mitosis doesn't only occur in humans, of course. All eukaryotes undergo mitosis—some in fascinating ways. Because of mitosis a sea star can regrow rays if they are cut off, and an acorn worm can regenerate any part of its body! Today, we will view onion cells, which offer a rare glimpse into the microscopic world and, upon careful examination, will show us two, three, or four different stages of mitosis. A single onion cell takes just 2–4 hours to complete all stages of mitosis.

Parent or teacher supervision is required for this lab because you will use a powerful acid and a stain.

SUPPLIES

- Fresh onion
- Glass or jar
- Muriatic acid, also called hydrochloric acid (a few drops, available from pool or hardware stores)
- 3 disposable cups
- 3 pipettes
- Distilled water
- Methylene blue (available online as lab stain or medicine or in pet stores as fish treatment)
- Scissors
- Paper towels
- Tweezers
- Pencil with eraser end
- Microscope
- 2 glass slides
- Cover slip
- Goggles, gloves, and apron
- Newspapers, disposable tablecloth, or foam tray
- Timer

WARNING: **Hydrochloric acid can cause severe skin burns and eye damage. Prevent contact with skin and eyes, and do not inhale or ingest. If there is skin or eye contact, flush with water.**

CAUTION: **Do not ingest methylene blue chloride. It can stain skin and clothing.**

© Good and Beautiful

CENTRAL NERVOUS SYSTEM NOTES

Lesson 101 in *The Wonders of the Human Body*

- Write at least two functions of each brain area.

Brain stem: _____

_____

Cerebellum: _____

_____

Diencephalon: _____

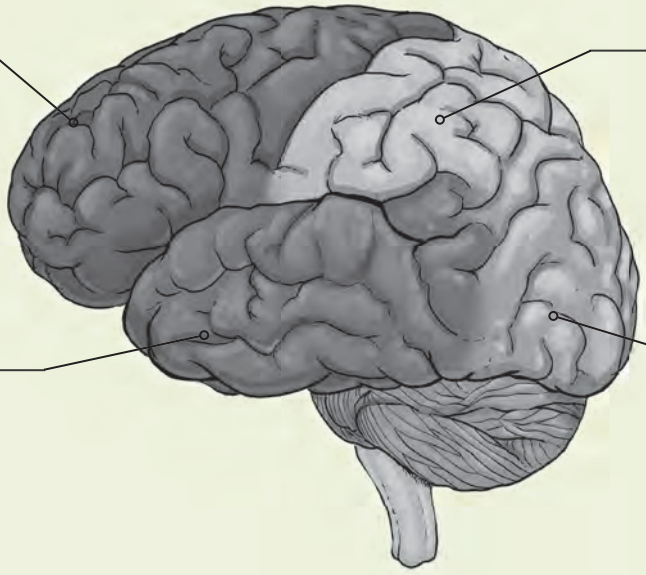
_____

Cerebrum: _____

_____

Label the lobes on the diagram of the brain, then list two functions of each.

Frontal lobe Parietal lobe Temporal lobe Occipital lobe



1. _____
2. _____

1. _____
2. _____

1. _____
2. _____

1. _____
2. _____

- What connects the left and right hemispheres of the cerebrum?

  - ○ A series of ligaments that allow flexibility
  - ○ A muscle that allows movement
  - ○ Nothing; they are completely separate
  - ○ A thick bundle of nerve fibers that provides communication between hemispheres

_____:

When connections within the brain are damaged or destroyed, the brain can reroute or rewire itself and form new connections to aid recovery.

© Good and Beautiful

NERVOUS SYSTEM
Activity

Lesson 103 is an activity only; there is no reading assignment or video. This activity requires you to find a willing parent, sibling, or friend to be your test subject.

All day long your somatic nervous system gathers information from environmental stimuli and relays it rapidly to your brain. When you touch a steaming cup of hot cocoa, nociceptors (pain receptors) in your hand fire off signals to your brain and back to your hand, causing you to put the mug down before you even have the conscious thought, "Ouch! That's hot!" When you step outside in a T-shirt on a snowy, blustery day, thermoreceptors (temperature-sensing receptors) signal the chill to your brain, which signals a small band of smooth muscles to contract, pulling your hair follicles upright and giving you goosebumps. When your mom envelops you in a bear hug, a variety of mechanoreceptors sense the pressure and stretching of your skin while you feel the love. Proprioceptors in muscles, tendons, and joints keep track of your feet and maintain balance as you seamlessly fly down the stairs for breakfast, your eyes locked in a book you can't seem to put down. Receptors riddle your body, constantly receiving, translating, and relaying signals.

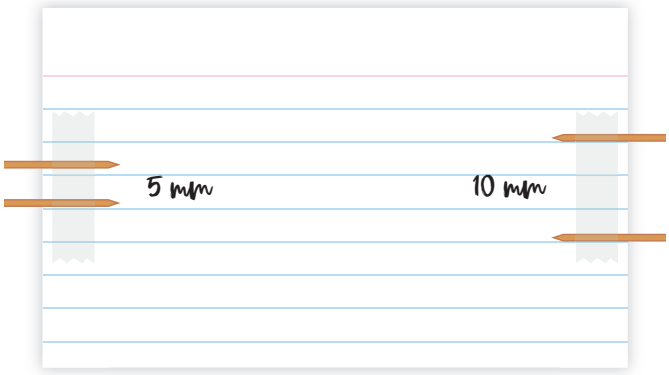
However, sensory receptors are not distributed equally. The somatic nervous system concentrates certain receptors in areas responsible for doing much of the sensory heavy lifting, like the ***glabrous*** [GLAY–bris] ***skin*** (smooth and hairless skin) on your fingertips, palms, lips, and the soles of your feet. What you step on, touch, and eat are vital to your well-being, so having concentrated sensory receptors in these areas makes sense. Glabrous skin contains a higher density of sensory receptors that each have a smaller receptive field, or area for which they take in stimuli. Hairy skin has fewer receptors that each have a larger receptive field.

Today, we are going to explore this unequal distribution of sensory receptors in your body using the ***two-point discrimination test***. Basically, you will construct a series of probes using toothpicks, index cards, and tape that you will use to determine the relative distribution of tactile receptors in different parts of the body. In areas of fewer receptors that have larger receptive fields, being touched by two points will be signaled as being touched by one. We will test different areas of the body with the probes to determine which have a higher relative density of sensory receptors.

SUPPLIES

- A willing volunteer
- 9 toothpicks
- Tape
- Ruler with millimeters
- 2 index cards
- Paper towel or hand towel
- Pencil
- Ice (keep frozen until Step 5)

☐ **Step 1 –** To prepare the probes, you will tape the toothpicks to the index cards in a specific way. Please read the full procedure and look at the diagram provided before proceeding.



First, take two toothpicks and lay them on one end of the first index card. They should extend off the edge of the card by about 1 inch. The toothpicks should be parallel to each other, 5 mm apart. Use your ruler to verify the distance. Tape the toothpicks in place, making sure they cannot move. Write "5 mm" on the card near these toothpicks. On the opposite end of the card, repeat the procedure, but place the toothpicks 10 mm apart and label the distance. The card should resemble the image.

☐ **Step 2 –** On the other index card, repeat the same procedure with one set of toothpicks 15 mm apart and the other set 20 mm apart. You should now have two index cards with four different toothpick probes each and a single toothpick that is not attached to a card.

☐ **Step 3 –** Introduce the experiment to your test subject. If you like, use the script below to explain the experiment:

"Welcome to The Good and the Beautiful Nervous System Lab. Today, I will be conducting a two-point discrimination test on you designed to explore the distribution of sensory receptors in different parts of your body. With your eyes closed, I will gently touch you with toothpicks set at different distances, and your job is to let me know if you feel contact with one or two toothpicks. This is not an intelligence test! I don't want you to tell me what you *think* I might be touching you with. Simply close your eyes, and every time I touch you with the toothpicks, tell me if you feel one or two. I will be testing your palm, index finger, elbow, calf, heel, big toe, and the back of your neck. After testing your palm, I am going to repeat the test after applying ice to your palm for 10 seconds."

☐ **Step 4 –** Before you begin, remember that the toothpicks must touch the skin at the exact same moment, so pick relatively flat areas of skin to test. Also, don't poke your test subject too hard because you don't want to activate pain receptors. Test the different toothpick spacings randomly.

Remind your test subject to keep their eyes closed, and then start with the palm of their hand, lightly touching the hand with each of the toothpicks in succession, using the single toothpick now and again to keep the progression random. To record your data, simply put a check mark in the appropriate box on the chart on the next page if your subject correctly identifies the number of touch points.

© Good and Beautiful

CIRCULATORY System

1

Read Lesson 104: Circulatory System in *The Wonders of the Human Body* in the app (computer version) as you complete the notes on this page and the next.

List the six things that blood carries throughout the body.

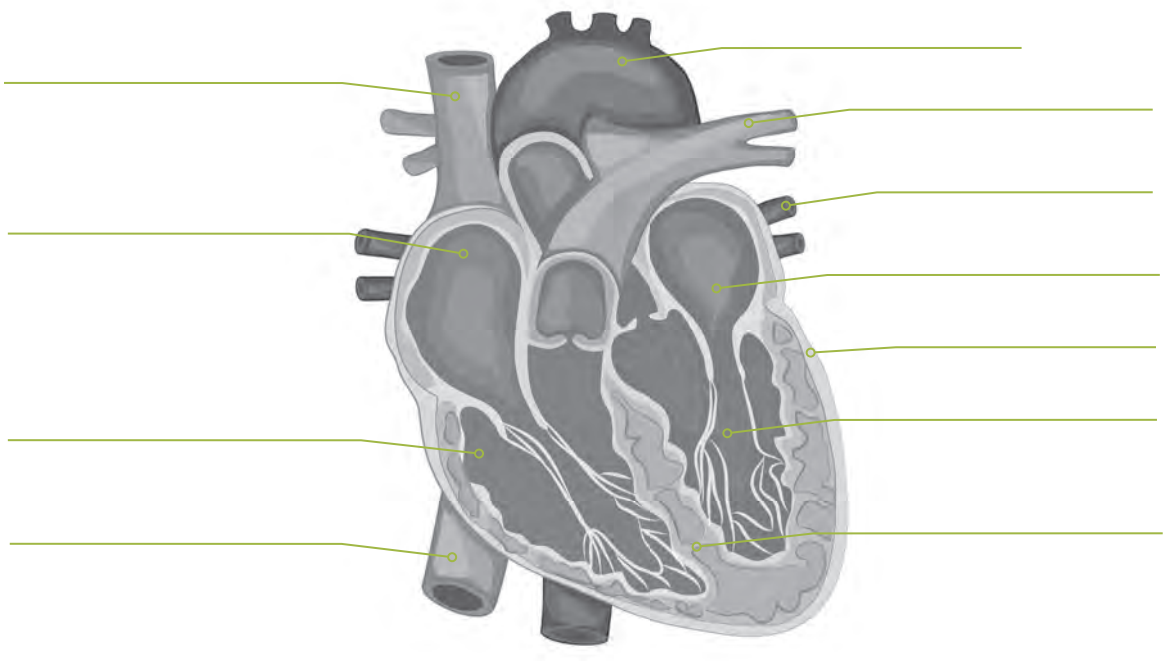
1.	2.	3.
4.	5.	6.

- What is the function of the pericardium?

WORD BANK

- RIGHT ATRIUM
- LEFT ATRIUM
- RIGHT VENTRICLE
- LEFT VENTRICLE
- SEPTUM
- PERICARDIUM
- AORTA
- SUPERIOR VENA CAVA
- INFERIOR VENA CAVA
- PULMONARY ARTERY
- PULMONARY VEIN

- Using the diagrams in the *Wonders* text and the word bank, label the heart below.



- What separates the chambers of the heart and ensures that blood flows in only one direction?
  - O Valves
  - O Ventricles
  - O Septums
  - O Arteries

HEREDITY and DNA

1

Read Lesson 114: Heredity and DNA in *The Wonders of the Human Body* in the app (computer version) as you complete the notes on the following page.

2

Go to the app (computer version) to watch the video "DNA and Twins."

Take notes below.



VIDEO: DNA and Twins

PONDER	NOTICE	WONDER
<u>Before</u> you watch the video, think about what questions you have about twins. Note two questions below.	<u>During</u> the video, record interesting facts you learn about twins.	<u>After</u> watching the video, write down what questions you still have.

STRAWBERRY DNA EXTRACTION LAB

This lesson is a lab only; there is no reading assignment. Ask your parent or teacher if you should do the lab hands-on or if you should watch the lab through the video on the app (computer version only). Optionally, you may choose to do both. **Before you begin, you should have already placed the rubbing alcohol in the refrigerator, but if not, place the bottle in the freezer now. Label it clearly and ask your parents if you should put it in a special place or tape it shut so no one accidentally ingests it.**

You know that deoxyribonucleic acid, or DNA, is the molecule containing the genetic information that determines the function and development of a cell. You've seen magnified images of DNA's double helix structure, the two strands that twist to resemble a ladder. But have you seen what DNA looks like to the naked eye? In this lab we will use common household items to break the cell membranes of a strawberry apart from its nuclei in order to isolate the DNA.

SUPPLIES

- 2 strawberries (fresh)
- 2 plastic zipper freezer bags
- Cup
- Spoon
- ½ c water (warm)
- 2 tsp dish soap
- 1 tsp salt
- Coffee filter or cheesecloth
- Pint or half-pint glass jar with ring
- 2 Tbsp rubbing alcohol (cold)
- Toothpick or coffee stirrer
- Teaspoon and tablespoon measuring spoons
- Timer

CAUTION: Use caution with rubbing (isopropyl) alcohol. Prevent contact with eyes and skin, and do not ingest or inhale. If alcohol gets on skin, wash with soap and water. Flammable; keep away from flames.

PROCEDURE

☐ **Step 1 –** Leave the rubbing alcohol in the refrigerator or freezer until instructed to get it out.

In a cup stir together the water, dish soap, and salt. Mix well until the salt is dissolved. This is an ***extraction buffer***, a solution that breaks open cells. Set aside.

LESSON 115

LAB REPORT

STRAWBERRY DNA EXTRACTION

1. As the strawberry liquid and alcohol layers sit, sketch what you observe and make notes about your observation.

2. Describe what the strawberry DNA in the bag looks like. _____

3. In what part of the cell is most of the DNA contained? _____

4. Think about the structure of a cell. What was the reason for mashing the strawberries well in this lab?

5. What was the reason for adding soap to the buffer solution? The salt?

6. Explain why strawberries are an ideal fruit to use for DNA extraction.

7. You have discovered where DNA is found within the strawberry. Describe specifically where DNA is found within the human body. _____

© Good and Beautiful

Final EXAM

1 Review some of the information you learned in each unit below and on the next few pages in preparation for the final exam. The final exam is closed book, so be sure you have studied and are ready for it before you begin.

Unit 1: The Wonders of Life



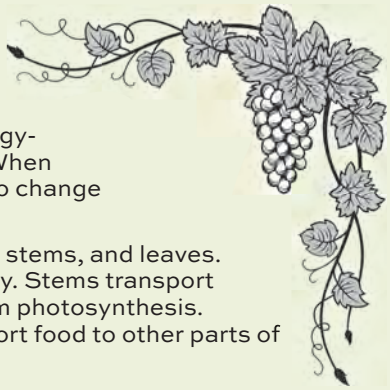
Every living thing on this planet senses and responds to its environment, grows and develops, consumes energy, reproduces, carries DNA and RNA, and contains certain vital elements, including hydrogen, oxygen, nitrogen, sulfur, phosphorus, and carbon, which form biomolecules. Living things are also composed of cells: the basic building blocks of life. Prokaryotic cells do not contain a true nucleus but instead have DNA floating freely within the cell. Eukaryotic cells have DNA contained in a true nucleus as well as membrane-bound organelles.

Swedish biologist Carl Linnaeus used morphology, or the structure and form of organisms, to organize life into five taxonomic levels. Today, scientists recognize eight taxonomic levels: domain, kingdom, phylum, class, order, family, genus, species. Using binomial nomenclature, each species has a unique scientific name composed of the genus and species. Using the scientific method, scientists reach conclusions based on measurable evidence and observation.



Domains Archaea and Bacteria are prokaryotic and are home to the most numerous organisms on Earth. Diverse kingdom Protista has no unifying characteristics and includes animallike protozoa, plantlike algae, and fungus-like molds, all of which can be either unicellular or multicellular. Kingdom Fungi boasts more than 5 million members. The majority of kingdom Fungi are saprotrophs, or organisms that decompose and recycle dead materials externally.

Unit 2: The Wonders of Botany



More than 300,000 autotrophic (self-nourishing) plants form kingdom Plantae. Plants get energy from photosynthesis by using sunlight to convert carbon dioxide and water into simple sugars and releasing oxygen. Uniquely, plant cells have rigid cell walls composed of cellulose, contain chloroplasts that harbor energy-capturing chlorophyll, and have a large central vacuole that regulates pressure. When there is less sunlight in the autumn, chlorophyll breaks down and causes leaves to change color.

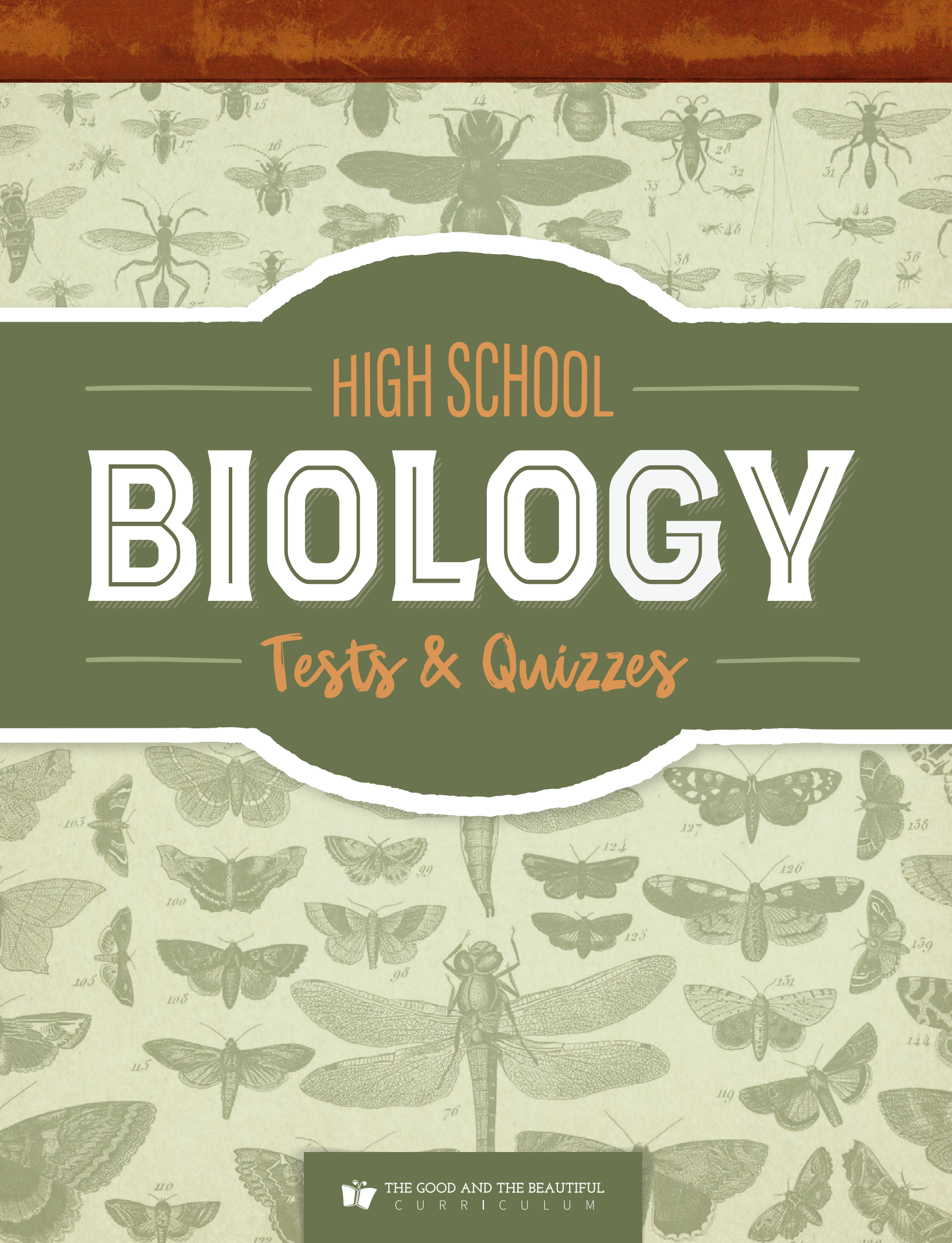
Plants have vegetative and reproductive tissue. Vegetative tissue includes roots, stems, and leaves. Roots anchor the plant, absorb water and nutrients from the soil, and store energy. Stems transport nutrients and water through the plant, provide support for the leaves, and perform photosynthesis. Leaves capture sunlight for photosynthesis, and stems transport food to other parts of the plant through xylem and phloem.



Reproductive plant tissue includes flowers, fruit, and seeds. Plants reproduce in myriad ways, including sexual reproduction and many forms of asexual reproduction, like budding and fragmentation, where offspring are genetically identical to the parent plant.

Scientists categorize plants as vascular or nonvascular. Vascular plants have xylem and phloem to transport water and nutrients, and nonvascular plants lack this tissue. The vascular plants are grouped into three categories based on seed structure: spore-bearing, cone-bearing (gymnosperms), and fruit-bearing (angiosperms).

© Good and Beautiful



HIGH SCHOOL BIOLOGY

Tests & Quizzes

THE GOOD AND THE BEAUTIFUL
CURRICULUM

HIGH SCHOOL BIOLOGY

Tests & Quizzes

Table of CONTENTS

Grading Tracker.....IV

Unit 1: Mid-Unit Quiz.....1

Unit 1: Unit Test.....3

Unit 2: Mid-Unit Quiz.....7

Unit 2: Unit Test.....9

Unit 3: Mid-Unit Quiz.....15

Unit 3: Unit Test.....17

Unit 4: Mid-Unit Quiz.....23

Unit 4: Unit Test.....25

Unit 5: Mid-Unit Quiz.....31

Unit 5: Unit Test.....33

Unit 6: Mid-Unit Quiz.....39

Unit 6: Unit Test.....41

Final Exam.....49

Grading Tracker
Workbook Note-Taking Guides

Suggested scoring: Scores based on completeness and neatness; one point each.

	Unit 1										
	1	2	3	4	5	6	7	8	9	10	11
Lesson Complete											
Neatness											
Unit 1 Total: ____/22											

Unit 2																			
13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Unit 2 Total: ____/42																				

Unit 3																		
35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
Unit 3 Total: ____/38																		

Unit 4															
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70
Unit 4 Total: ____/32															

Unit 5																				
72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93
Unit 5 Total: ____/44																					

Unit 6																							
95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119
Unit 6 Total: ____/50																								

Notes Total Score: _____ / 228 points

Grading Tracker
Tests & Quizzes

Suggested scoring: Quizzes are designed to have one point per answer. Tests are multiple choice, and each question is worth one point. The suggested total for each quiz and test is included below.

Unit 1: *The Wonders of Life*	
Quiz	Test
_____/6	_____/18
Unit 1 Total: _____/24	

Unit 2: *The Wonders of Botany*	
Quiz	Test
_____/15	_____/38
Unit 2 Total: _____/53	

Unit 3: *The Wonders of Marine Biology*	
Quiz	Test
_____/18	_____/36
Unit 3 Total: _____/54	

Unit 4: *The Wonders of the Animal Kingdom, Part 1*	
Quiz	Test
_____/14	_____/30
Unit 4 Total: _____/44	

Unit 5: *The Wonders of the Animal Kingdom, Part 2*	
Quiz	Test
_____/11	_____/42
Unit 5 Total: _____/53	

Unit 6: *The Wonders of the Human Body*	
Quiz	Test
_____/26	_____/44
Unit 6 Total: _____/70	

Quizzes and Tests Total: _____ / 298 points (47.3%)

Final Exam: _____ / 104 points (16.5%)

Notes Total: _____ / 228 points (36.2%)

Course Total: _____ /630 points Percentage: _____ %

Mid-Unit QUIZ

For this quiz, refer to your Unit 1 workbook as needed, but do not use the *Wonders* book. Answer the questions below, and then have your parent or teacher check the answers and record your score on the Grading Tracker. Save the corrected quiz to help you study for your test at the end of the unit.

1 All living things share six characteristics. Fill in the missing characteristic in the list below.

1. All living things are able to sense and respond to their environments.
2. All living things consume energy.
3. All living things have the ability to reproduce.
4. All living things contain DNA and RNA.
5. All living things contain certain elements.
6. All living things _____.

2 When conclusions are formed using the scientific method, what are they based on?

_____

3 Label the cells shown below as either prokaryotic or eukaryotic:



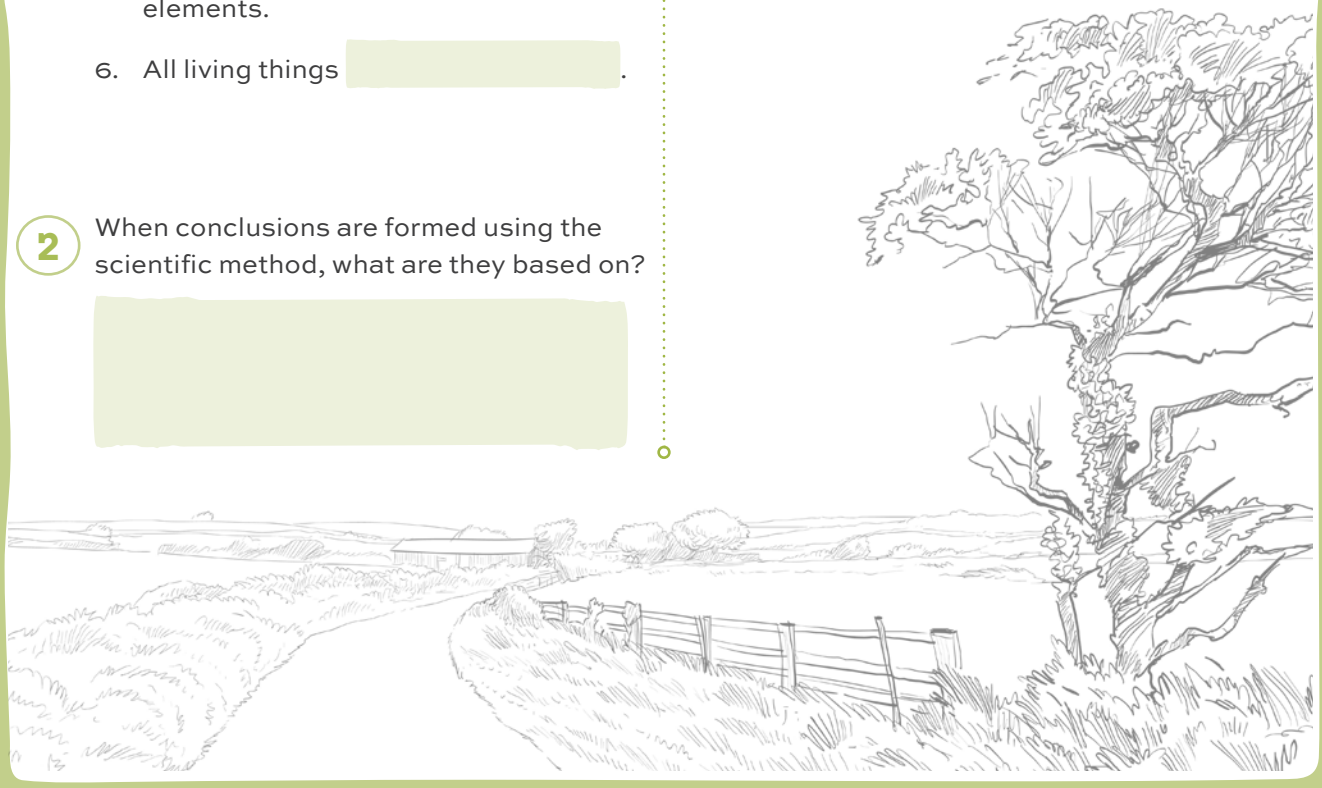
_____



_____

4 **Binomial nomenclature:**

A name consisting of two words indicating the _____ and the _____ of an organism



Unit 1 TEST

For this open-note test, refer to your Unit 1 workbook and mid-unit quiz as needed, but do not use the *Wonders* book. Answer the questions below, and then have your parent or teacher check the answers and record your score on the Grading Tracker. Make any necessary corrections, and then save the corrected test to study for the closed-note final exam at the end of the course.

1 Which of the following is NOT a characteristic of ALL living things?

- O Living things respond to their environment.
- O Living things reproduce through asexual reproduction.
- O Living things grow and develop.
- O Living things consume energy.

2 Which form of reproduction results in offspring that is identical to the parent organism?

- O Asexual
- O Sexual
- O Both asexual and sexual
- O Neither asexual nor sexual

3 Which of these provides a consistent and logical process to investigate a question?

- O A scientific law
- O A hypothesis
- O The scientific method
- O Peer review



4 Why is it important to limit bias when conducting scientific research and experiments?

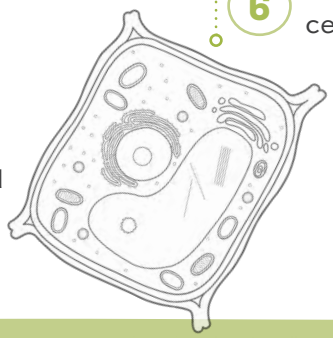
- O Bias will make the experiment fail.
- O Bias has already been proven and doesn't require further research.
- O Bias makes it impossible to gather data.
- O Bias will influence your interpretation of what you observe.

5 Which of these is a difference between prokaryotic and eukaryotic cells?

- O Prokaryotic cells do not have a true nucleus, but eukaryotic cells do.
- O Prokaryotic cells do not have a cell membrane, but eukaryotic cells do.
- O Eukaryotic cells do not have vacuoles, but prokaryotic cells do.
- O Eukaryotic cells do not have cytoplasm, but prokaryotic cells do.

6 What provides the structure to a plant cell?

- O Cytoplasm
- O Cellulose cell wall
- O Large central vacuole
- O Rigid cell membrane



© Good and Beautiful

7 The structure and form of an organism is referred to as its _____.

- O Morphology
- O Classification
- O Taxonomy
- O Nomenclature



8 How does the scientific community consistently and universally identify species?

- O Translating names into every language
- O Using the scientific name
- O Using the common English name
- O Listing all taxonomy levels when a species is mentioned

9 Which of these things distinguishes domains Bacteria and Archaea from other groups of organisms?

- O They are the most numerous on Earth.
- O They are the only domains that have all species named.
- O They only exist within organisms from other kingdoms.
- O These domains are made up of the largest organisms on Earth.

10 Organisms belonging to which kingdom can produce their own food?

- O Kingdom Animalia because they are heterotrophic
- O Kingdom Fungi because of their ability to decompose waste
- O Kingdom Plantae because the process of photosynthesis makes them autotrophic
- O Kingdom Protista because protists are foundational to the oceanic food web

11 Which of these is NOT one of the main parts of an atom?

- O Neutron
- O Electron
- O Carbon
- O Proton

12 What do enzymes do?

- O Build proteins
- O Break down biomolecules
- O Mix easily with water
- O Store genetic information

Mid-Unit QUIZ

For this quiz, refer to your Unit 4 workbook as needed, but do not use the *Wonders* book. Answer the questions below, and then have your parent or teacher check the answers and record your score on the Grading Tracker. Save the corrected quiz to help you study for your test at the end of the unit.

1 What is the name of a fluid-filled skeletal structure?

2 Animals in the class Porifera are _____, meaning that one organism possesses both male and female genetic material.

3 All cnidarians are characterized by their tentacles, which are equipped with sharp, coiled barbs called _____.

4 Match the species with the mollusk class it belongs to.

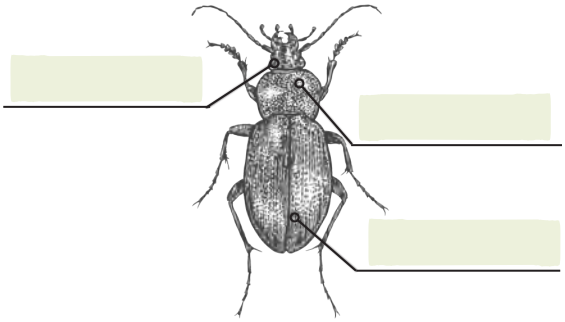
1. Cephalopod
2. Gastropod
3. Bivalve

- ☐ Octopus
- ☐ Nudibranch
- ☐ Oyster
- ☐ Crown conch
- ☐ Nautilus
- ☐ Mussel



5 Annelids have _____ in the skin, which are tiny holes that act like kidneys, getting rid of additional waste in the system.

6 Label the image below with the head, thorax, and abdomen of the arthropod.



7 Which part of an echinoderm is made up of ossicles?



© Good and Beautiful

Unit 5 TEST

For this open-note test, refer to your Unit 5 workbook and mid-unit quiz as needed, but do not use the *Wonders* book. Answer the questions below, and then have your parent or teacher check the answers and record your score on the Grading Tracker. Make any necessary corrections, and then save the corrected test to study for the closed-note final exam at the end of the course.

1 What is the name for animals that convert energy from food to maintain their body temperatures?

- O Ectotherm
- O Endotherm
- O Exotherm

2 Which biomes do birds inhabit?

- O Polar areas
- O Deserts
- O Ocean environments
- O Tropical regions
- O All of the above

3 Preening helps birds rid themselves of bacteria and mites.

- O True
- O False



4 Which type of feather provides insulation close to the bird's skin, conserving energy needed for flying?

- O Wing flight feathers
- O Tail flight feathers
- O Contour feathers
- O Down feathers

5 Which of these is the name of an extended section of the esophagus that is used to soften and temporarily store food before digestion?

- O Crop
- O Gizzard
- O Papillae
- O None of the above

6 What is the purpose of the gizzard?

- O To pulverize food into a mushy consistency
- O To soften and temporarily store food before digestion
- O To grasp and push food back toward the esophagus
- O To remove old feathers and make space for new replacements

© Good and Beautiful

36 A primate group where the size and composition of males and females in the group changes throughout the year is called what?

- O Monogamous
- O Fission-fusion
- O Matriarchal
- O Polyandrous

37 Which of these is a consequence of habitat fragmentation?

- O A reduction in species population
- O More biodiversity in a habitat
- O Mutations leading to new species
- O Increased opportunity for reproduction

38 The effort to use Earth's resources in a way so they are not depleted or destroyed is called what?

- O Task-switching
- O Ecology
- O Biodiversity
- O Sustainability

39 What is the study of the interrelationships that exist among organisms and between those organisms and their environment?

- O Biology
- O Ecology
- O Topography
- O Geography

40 What is an endemic species?

- O A non-native organism that outcompetes those native to an area
- O A species that exists in only one place
- O A species that is essential to its ecosystem
- O A species in danger of dying out throughout all its range

41 Which theory suggests that animals with traits that are most "fit" in the environment would be most successful in passing those features to the next generation?

- O Competitive advantage
- O Immutability of species
- O Speciation
- O Natural selection



42 Which idea shares the belief that the earth and all that is in it was created in 6 (24-hour) days, dating the earth to approximately 6,000 years old?

- O Young-Earth creationism
- O Old-Earth creationism
- O Evolutionary creationism
- O Gap creationism

FINAL EXAM

BIOLOGY
Final Exam

This is a closed-book, closed-note exam covering the full High School Biology course. Before you begin, review the quizzes and tests from each unit. Answer the questions below, and then have your parent or teacher check the answers and record your score on the Grading Tracker.

UNIT 1

1. All living things are able to sense and respond to their environments, grow and develop, have the ability to reproduce, contain DNA and RNA, and contain certain elements. What is the final characteristic of all living things?

- O Perform photosynthesis
- O Consume energy
- O Reproduce asexually
- O Breathe oxygen

2. Most fungi feed off dead materials, recycling them back into their environment, so they are known as what?

- O Autotrophs
- O Parasites
- O Mycelium
- O Saprotrophs

3. Which type of cell includes DNA contained inside a true nucleus?

- O Eukaryotic
- O Bacteria
- O Prokaryotic
- O Archaea

4. Conclusions based on measurable evidence and observation are reached through what method?

- O The empirical method
- O The taxonomical method
- O The fragmentation method
- O The scientific method

5. Which of the following groups is made up of prokaryotic organisms?

- O Kingdom Animalia
- O Phyla Chordata and Porifera
- O Kingdom Plantae
- O Domains Archaea and Bacteria

6. When Carl Linnaeus began classifying organisms, he based the organization on morphology. What is morphology?

- O An organism's genetic makeup
- O An organism's appearance
- O An organism's movement
- O An organism's structure and form

© Good and Beautiful

98 What is a peptide?

- O Messenger RNA
- O Group of three nucleotides
- O Pathogen
- O Chain of amino acids

99 The sensory systems include the tactile system, auditory system, olfactory system, gustatory system, and what?

- O Endocrine system
- O Digestive system
- O Visual system
- O Renal system

100 The DNA sequences that code for specific traits and make up a chromosome are called what?

- O Somatic cells
- O Phenotypes
- O Genes
- O Nucleotides

101 Lungs take in oxygen from outside the body and remove carbon dioxide from the body. Which part of the respiratory system exchanges these gases?

- O Pharynx
- O Trachea
- O Bronchial tubes
- O Alveoli



102 When DNA replication is described as semi-conservative, what does this mean?

- O Half the original strand is kept as part of each new strand.
- O The replicated strand contains none of the original strand.
- O The original strand of DNA is broken into four parts, which combine to form two new strands.
- O Half the original strand is destroyed during the replication process.

103 What is the purpose of mitosis?

- O Sexual reproduction
- O Growth and repair
- O Protein synthesis
- O Asexual reproduction

104 What does the brain create and store during REM sleep?

- O Hormones
- O Memories
- O Protein
- O Flexibility

© Good and Beautiful