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Biology LEVEL 2

SECOND EDITION

Teacher Guide

Blair H. Lee, MS

Pandia PRESS

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Included in this sample are seven chapters, one from each unit:

Unit I Organisms: Chapter 1 – All Living Things

Unit II Cells: Chapter 2 – Types

Unit III Genetics: Chapter 10 – Inheritance

Unit IV Anatomy and Physiology: Chapter 13 – Plant Reproduction

Unit V Evolution: Chapter 21 – How

Unit VI Ecology: Chapter 25 – Predator and Prey

Unit VII Classification: Chapter 31 – Kingdom Anamalia

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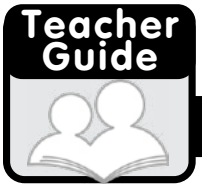


RSO Biology 2 Teacher Guide

Introduction

RSO Biology 2 is a complete, yearlong biology course. The student textbook, student Workbook, and the Teacher Guide contain all the information you need to teach biology this year. This course was written so that it could be taught by all educators, even if you do not have a science degree. It is my goal to make biology accessible to all, educators and students alike.

Structuring a good science course is like building a house. A well-built house starts with a strong foundation on which all other floors rest. RSO Biology 2 starts with the fundamentals, and fact by fact builds from there, creating a strong foundation for future science knowledge to rest on.

While learning the fundamentals of biology, students need to learn and practice the methods used by biologists to establish the scientific facts and theories that form the basis of those fundamentals. Understanding the scientific method and application of the processes used by biologists guides students to an understanding of the open-ended thinking that is a part of science. The labs are closely paired with the written material; that way students can see how the results of experiments have led to a better understanding of how the living world works. The experiments also demonstrate the application of science principles. All of this together gives you a complete science course that teaches the core principles of biology while teaching the processes used to develop these principles.

Course Structure

RSO Biology 2 consists of three books: the student textbook, the student Workbook, and the Teacher Guide. If working with a group, several students can share a textbook, but I recommend each student have a copy of the Workbook for written assignments, lab findings, and assessments. The course is comprised of 32 chapters designed as a 36-week course, assuming each chapter is completed within one week plus some extra time for review and testing.

The Course Is Divided Into Seven Units

I. Organisms
II. Cells
III. Genetics
IV. Anatomy and Physiology
V. Evolution
VI. Ecology
VII. Classification

Each Chapter Has Sections

In the student textbook:

- Lesson

In the student Workbook:

- General biology labs and activities
- Optional* microscope labs (in most chapters)
- Famous Science Series (research assignment)
- Show What You Know (short answer and multiple choice sections)
- Optional* unit exams (found in the appendix)

*Not optional for high school level

The Student Textbook

Students begin each chapter by reading a lesson in the textbook. Lessons are designed so that as students read, they are engaged through thought-provoking questions, and in many cases, by writing or coloring parts of diagrams found in the Workbook. This type of direct engagement when incorporated into learning material gives students ownership of the material.

The following are the sections of each chapter found in the textbook and in the Workbook. The sections are represented by the RSO acronym R.E.A.L.—Read, Explore, Absorb, and Learn. They are presented here in the order you will find them in both books. Although you can switch the order of the general labs, microscope labs, and the Famous Science Series within a chapter, you should not change the order of the chapters themselves. Each chapter builds upon the prior one.

READ: The Lesson

In the textbook lesson the fundamentals of biology are explained and built on. These lessons are designed to get students thinking about key concepts, asking questions, and applying what they are learning to things they observe in the world around them. The lesson is at a reading level so that most students can read it independently. Science vocabulary and terminology are introduced in context. They are written in ***bold italics***. Formal definitions can be found in the glossary of the textbook. Some lessons instruct students to color and label diagrams found in the Workbook.

The Student Workbook

After reading the chapter lesson in the textbook, students complete the labs, activities, research assignments, and assessments found in the Workbook for that chapter. Since students will be writing directly in the Workbook, it is recommended that each student has their own.

EXPLORE: General Labs

After reading the lesson, students turn to their Workbook to explore lesson concepts through experimentation. Students learn how scientists investigate and practice the scientific method in a meaningful way; gaining new insights into biology in the process. The general biology labs relate directly to the written lessons. The two are cohesive. Pairing lessons with labs that support the

material studied is living science and is important to the understanding of science. Some labs have a math section. All math concepts are clearly explained with examples. Science is a good place to begin applying the abstract math concepts students have been learning all these years. Note that several labs require adult supervision.

EXPLORE: Microscope Labs

The microscope labs are optional, but to truly get the most out of this biology course, a microscope is highly recommended. Students completing Biology 2 for high school credit should complete the microscope labs. All living things are made of cells, and cells are really small, so small the you need a microscope to see them. There is something really special about the first time you see a cell up close, chloroplasts, the wing of a fly, or bacteria move. See the note about purchasing a microscope on page 9.

Some labs are conducive for formal lab write-ups, and some are not. I indicate those that are recommended in the student text.

ABSORB: Famous Science Series (FSS)

The skill of researching a topic is essential to being proficient at science. As the famous scientist Isaac Newton once stated, “If I have been able to see farther than others, it was because I stood on the shoulders of giants.” By giants he means other great scientists. Scientists research what is known about a topic and build on that knowledge when making new discoveries.

The purpose of FSS is to sharpen the researching skills of students taking this course while they learn some interesting history relating to biology. Students are expected to research the questions in FSS on their own; the information is not found in the course material. How you have students conduct research is up to you. I feel that Internet research is adequate for FSS. But you might want to have your student do some library research as well.

There are 32 Famous Science Series topics in this course. The topics include famous scientists, famous pathogens, famous molecules, and famous scientific discoveries. Students will use FSS to learn topics more in depth as they relate to the lesson. If you want to reduce the amount of writing for students, you can have them orally report the results of their research to you.

LEARN: Show What You Know (SWYK)

Biology can be technical with a lot of new vocabulary words. I have tried to make the text as interesting as possible to keep students engaged in the material, but it is still important to have weekly assessments to ensure they have learned the key concepts. Show What You Know (SWYK) is the title of the question-and-answer section at the end of each chapter. I strongly recommend your students complete the SWYK assessments. They will help you assess whether your student understands the material being covered. If students do not do well in this section, you know they need to go back over the material before moving on to the next chapter. You can use this section like a written test, or you may choose to use SWYK as a format for open discussion. If students are taking the unit exams, this section will help immensely with their performance on the exams.

The Teacher's Guide

Your teacher guide is set up to resemble the student books. Each chapter section is reviewed in the teacher's guide with further explanation not found in the student text, as well as answers and suggestions. In addition, the teacher's guide contains the following:

Weekly Schedule

I have provided you with suggestions for scheduling each chapter based on teaching science two days, three days, and five days. The schedules will help ensure you complete the course in one school year.

Learning Goals

These are a list of all the important concepts in the chapter. Reviewing the learning goals can be particularly helpful when deciphering main ideas that shouldn't be missed from details that are nice, but not necessary.

Extracurricular Resources

This is a list of books and other resources that complement the material presented in the chapter. Links to website and online videos are provided at Pandia Weblinks (www.pandiapress.com/weblinks-biology2). Use these resources when your student's interest is sparked, or when you need further clarification on a concept.

Math this Week

The math concepts presented in a chapter are reviewed in the teacher guide. The math presented in a lab can be treated as optional, although I recommend that students at least attempt to complete it. Math is integral to a good science background. Math and science are intertwined in the same way spelling, punctuation, and grammar are to good writing.

Lesson Review

The lesson reviews included in this teacher guide are written as class notes. They can be used as notes or you can use them for question and discussion with your students. They are the main points from the lesson and are provided to assist you in teaching this course. When I taught as a community college professor, I would use a sheet of written notes, my lecture notes, as a guide to make sure I covered the important points and reviewed the material from previous lectures that related to the material being taught that day.

Unit Exam Answer Keys

The student Workbook contains the unit exams in its appendix. There are six of them. See page 12 of this teacher guide for information about administering and grading. The answer keys for the exams follow each unit in the teacher guide.

Grading

Grading is up to you, the instructor. Below are four possible grading schemes based on whether you are administering the unit exams and/or completing the microscope labs. There are grading scales provided for each unit exam, but you will have to determine the grade for each of the other parts of the course. The grading schemes below suggest how to weigh each part, if you choose to assign a grade. You, of course, are the teacher and will do what works best for you and your student.

1. Using all parts of the course
Unit exams = 40%
Microscope Labs = 15%
General Labs = 15%
FSS = 10%
SWYK = 20%

2. Not using unit exams
Microscope Labs = 20%
General Labs = 20%
FSS = 20%
SWYK = 40%

3. Not using microscope labs
Unit exams = 40%
General Labs = 20%
FSS = 15%
SWYK = 25%

4. Not using unit exams and microscope labs
General Labs = 30%
FSS = 30%
SWYK = 40%

Microscope

The microscope labs add a depth of understanding to any general biology course, but they can be left out in middle school. You could skip all the microscope labs and still have a high-quality middle-school-level biology course. Your students will need to use a microscope in high school, though, so you might want to think about that now. This way you will get a lot more use out of a microscope, and your student will be a microscope "expert" before high school.

If you are going to be purchasing a microscope, I suggest you invest in a nice one. This doesn't necessarily mean you have to spend your child's college fund, but you shouldn't waste your money on "toy" microscopes. For this course, and on into high school, you will need a compound light microscope. Compound microscopes have two lenses, the eyepiece and the objective lens, which work together to magnify the specimen. The type of compound light microscope used for these experiments is a bright field microscope. Bright field microscopes form a dark image against a more brightly lit background through the use of under lighting. Therefore you need a microscope that has an electric light. (I prefer direct current because it can be hard to tell when the battery is running down and this can affect the light coming from the base without you really noticing it.) Also, be sure to get one that has a fine focus knob.

You can use either a monocular microscope (one eyepiece) or a binocular microscope (two eyepieces). I give instructions for both types in the course. The advantage to the monocular scope is that it generally costs less, and it is easier to use for most, but not all, students. Some people have trouble focusing with both eyes open. The advantage of the binocular scope is that it magnifies up to 1000x with an oil immersion lens (the monocular scope magnifies up to 400x). There are a few labs where students get the opportunity to use the oil immersion lens if they have a binocular microscope. Either microscope is sufficient, however. The choice is entirely up to you.

Material List

Below is a list of items needed for the labs in each chapter. Refer to the student textbook for quantity and other details. The page # indicates the location of the lab in the student Workbook. The items marked with an asterisk * are those that are not readily available and need to be purchased through a science supply vendor. We recommend Home Science Tools (www.homesciencetools.com).

Chapter 1 Lab p. 5

- ☐ Tape measure
- ☐ Graph paper
- ☐ Notebook paper
- ☐ Clipboard
- ☐ Calculator
- ☐ Outdoor area
- ☐ Field guides
- ☐ Plot markers

Chapter 1 MSLabs (1 & 2) pp. 13 & 19

- ☐ Cutting mat or cardboard
- ☐ *Microscope
- ☐ White paper w/ black type
- ☐ Scissors
- ☐ X-Acto knife
- ☐ Tape
- ☐ *Microscope slide
- ☐ Catalogue with pictures

Chapter 2 Lab p. 26

- ☐ Canning jars
- ☐ Soap & water
- ☐ Apples
- ☐ Knife
- ☐ Sugar
- ☐ Apple peeler
- ☐ Cutting board
- ☐ Tall pot w/ lid
- ☐ Cooking pot
- ☐ Plastic container
- ☐ Cooking source
- ☐ Wooden spoon
- ☐ Food processor
- ☐ Potato masher
- ☐ Permanent marker
- ☐ Timer

Chapter 2 MSLab p. 29

- ☐ *Microscope
- ☐ *Slide w/ cover
- ☐ *Lens wipes
- ☐ Bottle cork
- ☐ X-Acto knife
- ☐ Cutting board
- ☐ Syringe
- ☐ Glass
- ☐ Water
- ☐ Tweezers

Chapter 3 Lab p. 37

- ☐ White glue
- ☐ Super glue
- ☐ Plastic wrap
- ☐ Knife
- ☐ Scissors
- ☐ Toothpick
- ☐ Ruler
- ☐ Tape
- ☐ Toothpicks
- ☐ Clay (Sculpey)
- ☐ Cookie sheet
- ☐ Oven
- ☐ Bowl
- ☐ Plaster of Paris
- ☐ Container for mixing
- ☐ Stirrer
- ☐ Measuring cup
- ☐ Water

Chapter 3 MSLab p. 43

- ☐ *Slides w/ covers
- ☐ *Methylene blue stain
- ☐ *Oil, for oil immersion
- ☐ Cleaner for oil
- ☐ Plastic spoon
- ☐ Yellow onion
- ☐ X-Acto knife
- ☐ Paper towel
- ☐ Syringe
- ☐ Water
- ☐ *Microscope

Chapter 4 Lab p. 53

- ☐ Worksheets from Web
- ☐ Internet access
- ☐ Food items
- ☐ Printer

Chapter 4 MSLab p. 61

- ☐ Labels from flour bags
- ☐ Whole-wheat flour
- ☐ White flour
- ☐ Teaspoon
- ☐ Butter knife
- ☐ Colored pencils
- ☐ *Slides w/ covers
- ☐ Syringe
- ☐ Water
- ☐ Toothpicks
- ☐ Glass bowls
- ☐ *Microscope
- ☐ Iodine

Chapter 5 Lab p. 71

- ☐ Measuring cup
- ☐ Tablespoon
- ☐ Teaspoon
- ☐ Cornstarch
- ☐ Iodine
- ☐ Water
- ☐ Zipper-lock plastic bag
- ☐ Wide glass
- ☐ Paper

Chapter 5 MSLab p. 75

- ☐ *Microscope
- ☐ Flashlight or desk lamp
- ☐ A helper
- ☐ Kernel corn
- ☐ Tweezers
- ☐ X-Acto knife
- ☐ Cutting board
- ☐ Water
- ☐ *Slide
- ☐ Iodine
- ☐ Small dish

Chapter 6 Lab p. 81

- ☐ Colored pencils
- ☐ Sunny day
- ☐ Fruit or vegetable snack
- ☐ Glue and construction paper (optional)

Chapter 6 MSLab p. 86

- ☐ One leaf from a thick plant
- ☐ X-Acto knife
- ☐ *Microscope
- ☐ *Slide w/ cover
- ☐ Water
- ☐ Syringe
- ☐ Green and gray pencil
- ☐ *Oil, for oil immersion
- ☐ Cleaner for oil

Chapter 7 Lab p. 95

- ☐ Mini marshmallows
- ☐ Beads
- ☐ Pipe cleaners
- ☐ Large marshmallows
- ☐ Skewer
- ☐ Toothpicks
- ☐ Scissors

Chapter 7 MSLab p. 99

- ☐ Sports drink
- ☐ Timer
- ☐ Rubbing alcohol
- ☐ Meat tenderizer
- ☐ Toothpick
- ☐ *Test tube
- ☐ *Pipette
- ☐ *Slide w/cover
- ☐ *Methylene blue stain
- ☐ Water
- ☐ *Microscope
- ☐ Dish soap
- ☐ Cup or glass

Chapter 8 Lab p. 107

- ☐ Poster board
- ☐ Pipe cleaners
- ☐ Mini marshmallows
- ☐ Markers
- ☐ Ruler
- ☐ Computer & printer
- ☐ CD
- ☐ Glue
- ☐ Can
- ☐ Cup
- ☐ Yarn
- ☐ Beads

Chapter 8 MSLab p. 112

- ☐ *Microscope
- ☐ *Prepared slide of an allium (onion) root tip

Chapter 9 Lab p. 119

- ☐ Colored pens or pencils
- ☐ Scissors
- ☐ Stapler

Chapter 9 MSLab p. 125

- ☐ *Microscope
- ☐ *Prepared slide of a *Lilium* (Lily), anther meiosis

Chapter 10 Lab & Act. pp. 132 & 142

- ☐ Family members
- ☐ Colored pencils or markers
- ☐ Scissors
- ☐ Coin

Chapter 10 MSLab p. 138

- ☐ Hair strands
- ☐ *Slides
- ☐ *Slide covers
- ☐ Scissors
- ☐ Tape
- ☐ Syringe
- ☐ Water
- ☐ *Microscope

Chapter 11 Dissection Lab p. 155

- ☐ *Preserved frog
- ☐ Safety goggles
- ☐ *Dissecting pins
- ☐ *Dissecting tray
- ☐ Paper towels
- ☐ Gloves
- ☐ *Forceps
- ☐ Tape measure
- ☐ Scissors
- ☐ *Slides
- ☐ *Slide covers
- ☐ Tweezers
- ☐ Medicine dropper
- ☐ Baggies
- ☐ X-Acto knife

Chapter 12 Dissection/MSLab p. 169

- ☐ Plant
- ☐ X-Acto knife
- ☐ Colored pencils
- ☐ *Microscope
- ☐ *Slides w/ covers
- ☐ Syringe
- ☐ *Methylene blue

Chapter 13 Dissection Lab p. 179

- ☐ Flower
- ☐ Lima bean
- ☐ X-Acto knife
- ☐ Scissors
- ☐ Tape
- ☐ Magnifying glass

Chapter 14 Labs 1 & 2 pp. 189 & 193

- ☐ Lemon
- ☐ Wire
- ☐ Nails or screws
- ☐ Pennies
- ☐ Calculator
- ☐ Salt
- ☐ Knife
- ☐ Paper towels
- ☐ Rubber band
- ☐ Stringed Instrument

Chapter 15 Lab 1 p. 202

- ☐ Corrugated cardboard
- ☐ Nail
- ☐ Blindfold

Chapter 15 MSLab p. 204

- ☐ *Microscope
- ☐ *Slide w/cover
- ☐ Water
- ☐ *Methylene blue
- ☐ Tissue
- ☐ Butter knife

Chapter 15 Lab 2 p. 206

- ☐ 2 liter bottle
- ☐ Sink
- ☐ Scissors
- ☐ Coffee filters
- ☐ Gravel
- ☐ Sand
- ☐ Cotton balls
- ☐ "Dirty" water
- ☐ Camera or colored pencils

Chapter 16 Labs 1 & 2 pp. 214 & 221

- ☐ Room w/ thermostat
- ☐ Flashlight
- ☐ Test subject
- ☐ Watch or timer
- ☐ Family member
- ☐ Paper & pen

Chapter 17 MSLab & Lab 1 pp. 228 & 229

- ☐ *Slide
- ☐ *Slide cover
- ☐ Needle or pin
- ☐ Rubbing alcohol
- ☐ Soap & water
- ☐ *Microscope
- ☐ Water bottles
- ☐ Scissors
- ☐ Duct tape
- ☐ Timer
- ☐ Vinyl tubing
- ☐ X-Acto knife

Chapter 17 Lab 2 p. 235

- ☐ Metric measuring stick or tape
- ☐ Balloon
- ☐ Calculator
- ☐ Another person

Chapter 18 Lab & Dissection/MSLab pp. 245 & 250

- ☐ House or car
- ☐ Book
- ☐ Chicken wing
- ☐ Paper towels
- ☐ *Microscope
- ☐ *Slide w/cover
- ☐ Syringe
- ☐ Methylene blue
- ☐ Gloves
- ☐ Scalpel or knife
- ☐ Scissors
- ☐ Cutting board
- ☐ Freezer
- ☐ Desk lamp

Chapter 19 Labs 1 & 2 pp. 264 & 272

- ☐ Paper
- ☐ Calculator
- ☐ Another person
- ☐ Outdoor area

Chapter 20 Lab p. 277

- ☐ Large work space
- ☐ Tape measure
- ☐ Marker
- ☐ Cardboard or card stock
- ☐ Poker chips or checkers
- ☐ Glue
- ☐ Scissors
- ☐ Colored pencils
- ☐ Roll of banner paper (optional)

Chapter 20 MSLab p. 287

- ☐ *Microscope
- ☐ *Slide
- ☐ Dead winged insect specimens
- ☐ Flashlight
- ☐ Scalpel or knife

Chapter 21 Lab p. 295

- ☐ Pompoms—brown, black, gray, and white
- ☐ Black magic marker
- ☐ Another person
- ☐ Timer
- ☐ Inside carpeted area

Chapter 21 MSLab p. 301

- ☐ Animal hair and fur samples
- ☐ *Microscope
- ☐ *Slides w/ covers
- ☐ Water
- ☐ Dropper

Chapter 22 Lab p. 309

- ☐ Pie or cake pan
- ☐ Clay
- ☐ Cooking spray
- ☐ Items for cast impressions—shells, bones, leaves, rocks, etc.
- ☐ Plaster of Paris
- ☐ Mixing container
- ☐ Measuring cup
- ☐ Water
- ☐ Towel
- ☐ Stir stick

Chapter 22 MSLab p. 312

- ☐ *Microscope
- ☐ Flashlight
- ☐ Sedimentary rock
- ☐ Paper
- ☐ Pencil w/eraser
- ☐ Magnifying glass (optional)

Chapter 23 Lab p. 319

- ☐ Scissors
- ☐ Glue
- ☐ Large sheet construction paper (optional)
- ☐ Internet connection

Chapter 23 MSLab p. 326

- ☐ *Microscope
- ☐ Magnifying glass
- ☐ Slice of wood
- ☐ Sandpaper
- ☐ Top lighting
- ☐ Paper

Chapter 24 Lab & Act. pp. 333 & 336

- ☐ Internet access
- ☐ World map
- ☐ Shoebox
- ☐ Drawing paper
- ☐ Art supplies, glue, scissors
- ☐ Nature magazines
- ☐ Various supplies to make biome diorama

Chapter 24 MSLab p. 341

- ☐ *Microscope
- ☐ Soil samples
- ☐ Top lighting
- ☐ *Slides
- ☐ Spatula

Chapter 25 Lab & MSLab pp. 347 & 350

- ☐ Colored pens or pencils
- ☐ Field guides (optional)
- ☐ *Microscope
- ☐ *Slides
- ☐ *Slide cover
- ☐ Freshly picked grass
- ☐ Pliers
- ☐ Water

Chapter 26 Lab p. 357

- ☐ Water
- ☐ Airtight container
- ☐ Pea gravel or pebbles
- ☐ Activated charcoal
- ☐ Spanish moss
- ☐ Soil
- ☐ Plants

Chapter 26 MSLab p. 360

- ☐ *Microscope
- ☐ *Slides
- ☐ *Slide covers
- ☐ Water
- ☐ *Legume inoculant (rhizobacteria)

Chapter 27 Lab p. 365

- ☐ Potted plants
- ☐ Dishes
- ☐ Jars w/ lids
- ☐ Tablespoon
- ☐ Marking pen
- ☐ Potting soil
- ☐ White vinegar
- ☐ Marking tags
- ☐ Distilled water
- ☐ Measuring cup
- ☐ Camera (optional)

Chapter 27 MSLab p. 370

- ☐ Nonmetallic bowls
- ☐ Distilled water
- ☐ White vinegar
- ☐ Leaves
- ☐ Measuring cup
- ☐ X-Acto knife
- ☐ *Slides
- ☐ *Microscope
- ☐ *Slide covers
- ☐ Water
- ☐ Syringe

Chapter 28 Lab & Research pp. 377 & 386

- ☐ Scissors
- ☐ Glue or tape
- ☐ Friends
- ☐ Magnifying glass
- ☐ Envelopes
- ☐ X-Acto knife
- ☐ Leaves
- ☐ Computer & printer
- ☐ Internet/ library access

Chapter 29 MSLab p. 395

- ☐ Yogurt
- ☐ Toothpick
- ☐ Water
- ☐ Dropper
- ☐ *Microscope
- ☐ *Slides
- ☐ *Slide covers
- ☐ *Methylene blue

Chapter 30 Lab & MSLab pp. 403 & 405

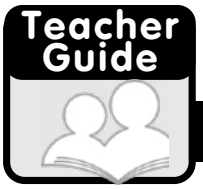
- ☐ Field guides (optional)
- ☐ Blade of grass
- ☐ Leaf
- ☐ Scalpel or paring knife
- ☐ *Slides
- ☐ *Slide covers
- ☐ Water
- ☐ Syringe
- ☐ *Microscope

Chapter 31 Lab/MSLab p. 411

- ☐ Magnifying glass
- ☐ Arachnid specimen
- ☐ Insect specimen
- ☐ *Microscope
- ☐ Liquid paper
- ☐ Scalpel
- ☐ *Slides
- ☐ *Slide covers
- ☐ Copy paper
- ☐ Syringe
- ☐ Water
- ☐ Tweezers
- ☐ Flashlight

Chapter 32 Lab & Dissection/MSLab pp. 421 & 425

- ☐ Banana
- ☐ Baggies
- ☐ Yeast
- ☐ String
- ☐ Ruler
- ☐ Mushroom
- ☐ Cutting board
- ☐ Flashlight
- ☐ Scalpel
- ☐ *Slides
- ☐ *Microscope
- ☐ *Methylene blue
- ☐ Syringe
- ☐ *Forceps



RSO Biology 2 Teacher Guide

Introduction to Student Unit Exams

There are six exams spanning seven units. The exams are found in the appendix of the student text. Answers to the exams are found in this teacher guide following each unit beginning with Unit 2. The exams have multiple-choice questions, vocabulary matching, true/false sections, and short written answers. There is no cumulative mid-term or final exam. One could be made by combining questions from the unit exams.

What Each Exam Covers

Exam 1: Units I Organisms and Unit II Cells, Chapters 1 – 6
Exam 2: Unit III Genetics, Chapters 7 – 10
Exam 3: Unit IV Anatomy and Physiology, Chapters 11 – 19
Exam 4: Unit V Evolution, Chapters 20 – 23
Exam 5: Unit VI Ecology, Chapters 24 -27
Exam 6: Unit VII Classification, Chapters 28 – 32

As the instructor, it is up to you how the exam is administered.

Possible Options

1. A closed-book exam with no notes
2. A closed-book exam with one sheet of notes (more pages of notes than this just get in the way)
3. An open-book exam
4. Don't use it as a exam at all; use it as a review

Structure of the Exams

- Multiple choice questions
- Vocabulary match
- Short answer questions
- The material from the Famous Science Series and the labs is not tested.
- Each exam is 100 points. Most of the exams have opportunities for extra credit.

Grading the Exams

- The questions that require written answers can make grading a little more difficult. Use my answers as a guide. Just remember, partial credit should be applied to these questions if students get most, but not all, of the answer correct.
- Students can get more than 100 percent on the exam if they get the extra credit points.

After the Exam

- Go over with your students any questions they missed. Use mistakes as an opportunity to learn.
- You can hand back the exam with incorrect answers marked and give half credit for any exam questions students correct. I like to do this because it keeps the focus on the primary reason for studying a course: to learn the material, NOT to get a grade.

TBYB Sample

Teacher Guide

Unit I: Organisms

Chapter 1: All Living Things

WEEKLY SCHEDULE

Two Days

Day 1
- ❑ Lesson
- ❑ Read Poem
- ❑ Lab

Day 2
- ❑ MSLabs
- ❑ FSS
- ❑ Lesson Review
- ❑ SWYK

Three Days

Day 1
- ❑ Lesson
- ❑ Read Poem

Day 2
- ❑ Lab

Day 3
- ❑ MSLabs
- ❑ FSS
- ❑ Lesson Review
- ❑ SWYK

Five Days

Day 1
- ❑ Lesson

Day 2
- ❑ Read Poem
- ❑ Lab

Day 3
- ❑ MSLabs

Day 4
- ❑ FSS

Day 5
- ❑ Lesson Review
- ❑ SWYK

FSS: Famous Science Series
MSLab: Microscope Lab
SWYK: Show What You Know

Introduction

Unit I is an introductory unit that is one chapter long. There are seven units in this book. Unit I is the only unit that does not have a separate exam available. Unit exam 1 covers elements from Units I and II.

Preparation for Lab 1: Locate an area for the plot study experiment.

Learning Goals

- Learn the nine characteristics that define organisms as living.
- Study about viruses and their big effect on all organisms.
- Understand how viruses reproduce.
- Learn the parts of a microscope.
- Learn how to focus a microscope.
- Investigate how plot studies are conducted.
- Find out about the numbers and species of wild plant and animal life near where you live.

Extracurricular Resources

Books

Five Kids & A Monkey Investigate a Vicious Virus, Blair, Beth L. and Riccio, Nina
Epidemic! The Battle against Polio, True Peters, Stephanie.
Jonas Salk, (Inventors and Creators Series), Durrett, Deanne
Jonas Salk and the Polio Vaccine, Krohn, Katherine. This book is written in graphic format.
Small Steps: The Year I Got Polio, Kehret, Peg
Jonas Salk: Conquering Polio (Lerner Biographies), Sammartino McPherson, Stephanie
Jonas Salk: Creator of the Polio Vaccine (Great Minds of Science), Tocci, Salvatore
Jonas Salk and the Polio Vaccine (Unlocking the Secrets of Science), Bankston, John
West Nile Virus (Diseases and Disorders), Abramovitz, Melissa
West Nile Virus: Epidemics Deadly Diseases Throughout History, Margulies, Phillip
Ebola Virus (Diseases and People), Willett, Edward
Understanding Viruses with Max Axiom, Biskup, Agniesezka
Killer Virus (Choose Your Own Adventure(R), Montgomery, R.A.
Franklin Delano Roosevelt: Champion of Freedom, Kudlinski, Kathleen

Online

Visit Pandia Weblinks for videos and websites recommended for this chapter:
www.pandiapress.com/weblinks-biology2

Lesson

What Is Living?

The lesson for this week explains the nine characteristics that define life. The poem reinforces these characteristics. Students at this level are competent at knowing when something is alive and when it is not. So competent, in fact, that they might gloss over this section. That is why I introduce the intriguing and thought-provoking example of viruses. The debate about viruses is a real-world application of the characteristics defining life. As students think through the debate about how viruses should be categorized, living or not, they will have to think through the characteristics used to define an organism as living. This will help reinforce these defining characteristics. Students are asked to come to their own conclusion about whether viruses should be reclassified as organisms. There is no right or wrong answer, in my opinion. I am a pragmatist, though. Viruses are what they are. The argument is really just a matter of definition, but definitions are very important when classifying organisms, so maybe the definition is not so trivial after all.

Students are asked to come to their own conclusion as to whether viruses should be reclassified as organisms. This can be done briefly on paper or orally. I would consider all well-thought out answers as correct. If you want a topic to debate over dinner, this would be a good one.

Lab

What's Out There? Plot Study

This is the type of lab I would expect to see at the start of any general biology class. Biology is the study of life. I think all biology students should start with a study of the organisms near where they live. A plot study is a great way to do that. An interesting addition to this lab would be to revisit the plot two or three times over the year and check out the seasonal changes at the plot.

You need to give some thought to the location of the plot. Choose somewhere that you can sit and observe for a while. Be prepared to help with the measuring of the plot lines, counting organisms, and drawing the plot. Do not let the calculations page seem overwhelming. There are a lot of words because I am trying to walk students through the process. Just worry about counting animals and filling in the data table when you are in the field.

If your plot size varies, the size of your rectangle will be different. For example, if your plot is 1m x 2m, then draw a block that is 10 squares by 20 squares on the graph paper. And for lab calculations, the area of this plot would be $2m^2$ (2m x 1m).

This is a good lab for writing a report lab. On the opposite page is an example of a completed lab report and data tables. Your students' reports will vary, and should include a drawing of the plot.

Math This Week

1. Measuring and marking the perimeter of the plot.
2. Mapping the area of the plot—this is a great activity to increase spatial awareness.
3. Drawing the mapped plot to scale.
4. Calculating the area of the plot.
5. Types of problem solving are: estimating, going from percent to decimal, multiplying, dividing, adding, and rounding.

Chapter 1: Lab Report

Name: _____ **Date:** _____

Title/Location: Plot Study From an Irrigation Ditch in the Eastern Sierras

Hypothesis

Using a small plot study of an irrigation ditch, I think I will get a good estimate of the plant and animal species for a larger area.

Procedure

I conducted a plot study on an irrigation ditch in the Eastern Sierras. I mapped the organisms on a 2m x 2m plot. I used the results from this study to estimate the number of different species and over-all number for each species that would be in 100m². I measured my plot along the bank of the creek. I began at one corner and methodically drew what was within the plot boundaries. I used the field guides to identify plants and animals. I recorded and counted the different animal and plant species I found onto my data tables. I used these numbers to calculate an estimate of the number and variety of plants and animals for a larger, 100 m², area.

Observations

- The flow of water is stronger in the middle of the ditch than on the sides. Most plants and animals prefer either the stronger flow or the weaker flow, but not both.
- The spider spun a web over the water. It hid on the side of the ditch until an insect landed on the web. Then it ran out to catch its dinner.
- In the past, I have seen an occasional fish in the ditch, but not today.
- Dragonflies flew over the ditch and landed on the grass out of the water but never in the water.
- Because it has been very cold this spring, I did not see any mosquito larvae.

Results and Calculations

I estimated the number for each species of animals and plants that I found (see attached Data Tables 1 and 2). On Table 3, I estimate there are nine animal species in 100m2 area of the ditch, and I estimate there are six plant species in 100 m2 area of the ditch. Notes: * I did not observe any fungi, so I did not include that in my Lab Report.
* Algae are plant-like protists, not plants, but I listed them under "Plants" in the table.
* For the Tables and Calculations, see attached

Conclusions

In conclusion, I think I got a good estimate of the number of plant and animal species in the irrigation ditch. I also think this was a good method for estimating the over-all number for each species.

Lab Calculations

Tables 1 and 2

How many of each type of organism is in a 100 square meter area, 100m²?

A. Calculate the area of my plot.

2m x 2m = 4m² plot

B. Calculate how many of these plots would fit into 100m2.

100m2 ÷ 4 =

25 of my plots would fit into 100m2

Table 3

I estimate that 10% were missed.

I turned 10% into a decimal: 10 ÷ 100 = .1

8 animal species x .1 = .8

.8 is rounded up to 1

How many animal species, would you expect to find in 100m²?

8 + 1 = 9

5 plant species x .1 = .5

.5 is rounded up to 1

How many animal species, would you expect to find in 100m²?

5 + 1 = 6

Chapter 1: Data Tables

Table 1

Animals (list each species)	# of species in my plot	# of my plots that fit into 100m²	Estimate # of species for 100m²
water strider	14	25	350
small snail	20	25	500
large snail	2	25	50
small crickets	5	25	125
little swimming black insects (probably larvae)	lots (more than 100)	25	2500+
white swimming insects	11	25	275
spider	1	25	25
sylphid beetle	1	25	25

Total animal species= 8

Table 2

Plants (list each species)	# of species in my plot	# of my plots that fit into 100m²	Estimate # of species for 100m²
algae, listed as plant	10 cm x 10 cm	25	2500 cm²
long grass growing in water at edge of ditch	10 clumps	25	250 clumps
tall grass with seeds in ditch	3 clumps	25	75 clumps
short green grass growing under water	17 clumps	25	425 clumps
plant w/ spiky leaves	1	25	25 clumps

Total plant species= 5

Table 3

	# Species found in my plot	Estimate # missed	Estimate # of species in 100m²
Animals	8	1	9
Plants	5	1	6

Microscope Labs 1 and 2

Your Microscope: Parts and Focus

This lab is a beginner microscope lab. Students will learn the names for the parts of the microscope as well as how to focus the microscope. If your students are experienced microscope users, you might find they do not need to do this lab. Through the remainder of this course, it will be assumed your student has performed this lab, and knows the terminology and how to use a microscope.

The instructions for the first few microscope labs are very long. They are written for those students who have never used a microscope and want to know it all. They are instruction manuals detailing proper technique, procedure, and terminology. Later in the text, the instructions for the microscope labs shorten considerably. Through continued use, students will become very good at using a microscope.

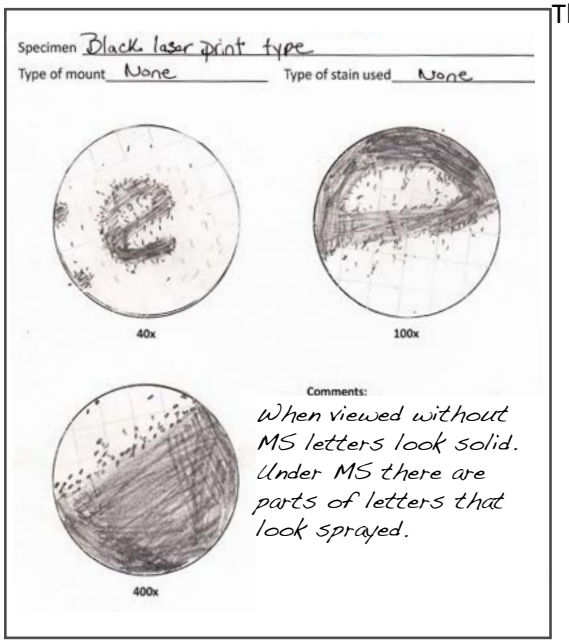
Part 1: Parts of the Microscope

The purpose of the first part of this lab is to teach students the names of all the relevant parts of the microscope. See the next page for correct labeling.

Students are not expected to memorize microscope terms. I expect they will learn the names of the parts of the microscope through continued use.

Part 2: How to Focus Your Microscope

This section instructs students on the correct procedure for focusing a microscope. Students are expected to draw three pictures, each is a microscopic view of the paper and ink at one of the three magnifications. The oil immersion lens will NOT be used with this lab. Next, students will look at a color picture from a catalogue. It is really interesting to see how all the colors in a catalogue are made by combining the same four colors of dots in different proportions.

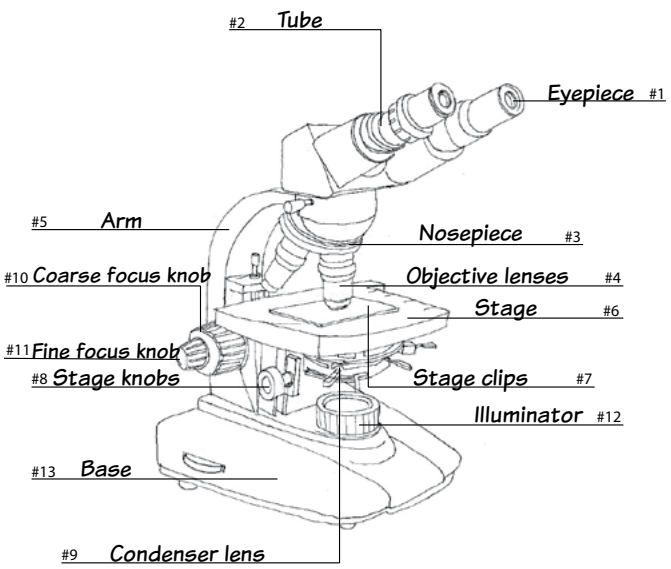


This is an example of a completed microscope view sheet. Throughout this guide you will find several such examples. These are for reference only. What your student views through the microscope could be vastly different than what is pictured in these examples.

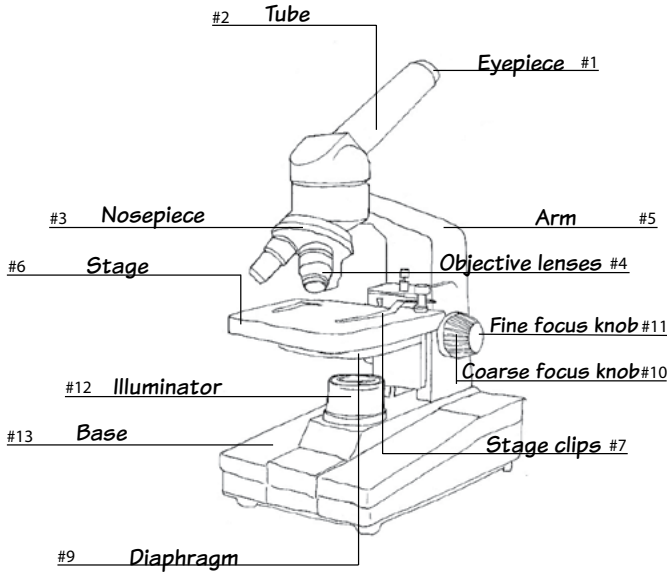
Lab sheet suggested answers:

"K" indicates black in the four-color print processing used for your catalogue picture (CMYK). But it doesn't stand for the word "black." Research what it does stand for and why. *K stands for the word "key." Way back when color printing started, the black plate was called the key plate because it contained the artistic detail or "key" information. Today we say that K means "black," so as not to confuse it with B (blue) in the RGB color model.*

#14 Binocular Compound Light Microscope



#14 Monocular Compound Light Microscope



Famous Science Series

Polio

Living or not, viruses have a big effect on organisms. Most children in this country are vaccinated against polio, so children today might not have heard of it. There was a time when people lived in fear of it. The vaccine for polio was invented by a true American hero, Jonas Salk. Salk spent his life trying to find cures for deadly diseases like AIDS and polio. When he did find a vaccine that worked, he refused to patent it. Vaccines that are not patented are cheaper and therefore available to more people.

The following example is very detailed. Students are not expected to answer with as much detail. It is simply for your and their information.

What is polio? How is it transmitted?

Poliomyelitis or polio is a virus that infects people. Polio is transmitted through polio-contaminated feces. The route of transmission is usually from a person's hands to their mouth. You can also get polio from sharing eating utensils with an infected person.

What does it do to a person who is infected with it? What is paralytic polio?

Ninety percent of the people who get polio recover from it with no ill effects. The other ten percent develop symptoms. One percent of these people develop paralytic polio. Paralytic polio causes paralysis. This in turn can lead to deformities of the hips, ankles, and/or feet. Polio can also cause breathing problems. People who suffered from these breathing problems sometimes had to use an iron lung to help them breathe in order to stay alive. In severe cases, people infected with polio died.

How long has polio been infecting people?
Polio has been infecting people for thousands of years. A stone carving from Egypt dated to about 1500 BCE shows a boy with shrunken legs caused by the virus. Tiny Tim in Charles Dickens's A Christmas Carol *was probably a victim of polio. Polio mainly infects children.*

Which U.S. president had polio? When did he serve as president? How old was he when he contracted polio?
Franklin Delano Roosevelt, FDR, was 39 years old when he contracted polio on August 10, 1921. He was the 32nd president. "Once you've spent two years trying to wiggle one toe, everything is in proportion," Franklin Delano Roosevelt said in 1945.

FDR had paralytic polio, which caused him to be paralyzed from the waist down. He was the only disabled president. He served as president from 1933 to 1945. He was the only U.S. president to serve three terms. He died less than three months after he was elected to his fourth term. The United States Constitution has since been changed, so that no one can be elected for more than two terms as president.

Who discovered the polio vaccine?
Polio used to be widespread until Dr. Jonas Salk, a true American hero, discovered the polio vaccine. The polio vaccine was made available to the public in 1955. He did not patent his polio vaccine discovery, because it would have drastically increased the medicine's price. He freely distributed the polio vaccine so every child could be saved from contracting this potentially crippling disease. In addition to polio, Dr. Salk dedicated his life to researching the causes, preventions, and cures of influenza, cancer, and AIDS.

Show What You Know

All Living Things

Answers:

This penguin is a living being. It is a(n) *organism*.

The penguin eats fish. This is how it takes in *energy*.

After it eats fish, it has to get rid of *waste*.

Laying eggs is part of how the penguin *reproduces*.

Penguins *move* when they swim through the water.

Penguins ruffle up their feathers, trapping warm air near their bodies to help them stay warm. This is one way penguins *respond to their environment*.

This penguin's blood carries food to its cells and waste away from its cells. That is because penguins have *circulation*.

This penguin is made from many more than one *cell*.

Penguins get energy from the food they eat. Penguins have *respiration*.

A baby penguin *grows* after it hatches from the egg on its way to becoming an adult.

Lesson Review

All Living Things

living beings = organisms

The nine characteristics that define ALL organisms:

1. All organisms are made of one or more cells.
2. All organisms take in energy.
3. All organisms get rid of waste.
4. All organisms move.
5. All organisms grow.
6. All organisms reproduce.
7. All organisms respond to their environment.
8. All organisms have some type of circulation.
9. All organisms have some type of respiration. *There are two types of respiration, aerobic (with oxygen) and anaerobic (without oxygen). The example used in this chapter is aerobic respiration. Both types of respiration will be covered in more detail in chapter 6.

If something does not have all nine of the characteristics, it is not defined as living. Viruses reproduce and possibly respond to their environment. Most scientists do not define viruses as organisms because they do not have the other seven characteristics needed to define life.

Viruses reproduce by attaching to a cell and injecting parts of itself into the cell. These parts turn the cell into a virus-making factory.

TBYB Sample

TBYB Sample

Teacher Guide

Unit II: Cells

Chapter 2: Types

WEEKLY SCHEDULE

Two Days

Day 1
- ❑ Lesson
- ❑ Lab
- ❑ FSS

Day 2
- ❑ MSLab
- ❑ Lesson Review
- ❑ SWYK

Three Days

Day 1
- ❑ Lesson
- ❑ Lab

Day 2
- ❑ MSLab

Day 3
- ❑ FSS
- ❑ Lesson Review
- ❑ SWYK

Five Days

Day 1
- ❑ Lesson

Day 2
- ❑ Lab

Day 3
- ❑ MSLab

Day 4
- ❑ FSS

Day 5
- ❑ Lesson Review
- ❑ SWYK

Introduction Unit II

Unit II consists of five chapters and it covers the topic of cell biology. All organisms are made from one or more cells. Therefore, an understanding of the structure and function of cells is fundamental to an understanding of biology. Cells and the molecules that build them cannot be seen individually without the help of an optical device, like a microscope. Three of the five microscope labs in Unit II examine cells and their parts. The other two microscope labs look at molecules that make cells. In Unit II, several of the labs, Famous Science Series topics, and activities are related to health issues. We are made of cells; how healthy we are is directly related to how well we take care of our cells.

Introduction Chapter 2

Chapter 2 explains the cell theory and the three things all cells share in common. It also classifies the two main groupings for cell types.

The history of science is filled with colorful characters and important discoveries. The reasons for, or methods used, when making discoveries are sometimes pretty strange. The two labs and one of the discoveries made by the scientist chosen for the Famous Science Series highlight this.

Preparation for microscope lab: The day before, put the cork in a glass of water. It will float, but it will absorb some of the water. Doing this makes it easier to get a thin slice of cork.

Learning Goals

- Memorize the three parts of the cell theory.
- Identify the three components all cells have.
- Understand the basic difference between eukaryotic and prokaryotic cells.
- Learn the technique for making wet mount slides.
- Learn about the history and process of canning and examine some basic food safety principles as they relate to canning.
- Perform the historic experiment when cells were discovered and named.
- Research the history of the first scientist to see living cells with a microscope.

FSS: Famous Science Series
MSLab: Microscope Lab
SWYK: Show What You Know

Extracurricular Resources

Books

The Basics of Cell Life with Max Axiom, Super Scientist, Keyser, Amber J.

Enjoy Your Cells, Balkwill, Fran

Germ Hunter: A Story About Louis Pasteur, Alphin, Elaine Marie

Louis Pasteur, Spengler, Kremena

Pasteur's Fight Against Microbes, Birch, Beverly

Louis Pasteur: Founder of Modern Medicine, Tiner, John Hudson

Robert Hooke: Natural Philosopher and Scientific, Burgan, Michael

Micrographia–Some Physiological Descriptions of Minute Bodies Made by Magnifying Glasses with Observations and Inquiries Thereupon, Hooke, Robert

Online

Visit Pandia Weblinks for videos and websites recommended for this chapter:

www.pandiapress.com/weblinks-biology2

Lesson

You Are a Eukaryote

The lesson for this week defines the cell and its role as the building block for all living organisms. The cell theory is explained. This theory is one of the central tenets of biology. There is an explanation of the three components shared by all cells.

The initial classification used for organisms is on the cellular level. It is based on where the genetic material is in the cell. The members of domain Bacteria and domain Archaea have prokaryotic cells without a nucleus. The members of domain Eukarya have eukaryotic cells with a nucleus. (The domain level has been added to the top of the classification system in taxonomy. For an explanation, please refer to chapter 28.)

Lab

Death to the Prokaryotes!

In this course I have, whenever possible, paired labs with theory. I feel strongly that a good science text has labs that directly relate to the theory sections. The theory sections are the written lessons. In addition, for this middle school text, I wanted some of the labs, activities, and Famous Science Series to focus on pertinent health concepts.

Math This Week

Food Canning

1. Measuring volume.
2. Diving into parts.

As I was developing a lab for this chapter, two food safety scares occurred in the same month. One was caused by unsanitary practices at a food manufacturing plant involving peanut butter, and the second was an E. coli scare affecting spinach. Both of these events resulted in illnesses caused by unicellular prokaryotic pathogens. It is important to include a food safety lab in this course, and apropos when teaching prokaryotes. I want students to understand the potential devastation something microscopic can cause if we aren't careful with the food we eat.

Most people take it for granted that the food we eat is safe. Canning is an important method of preserving food. In this lab, students will learn how food is canned and how harmful pathogens in food are killed. They will also learn the interesting history of canning. The process of canning food was invented so that Napoleon could better feed his troops during wartime.

Students will make applesauce in this lab. They will divide it into four parts, one part is to be eaten right away, but one part will be left sitting out. This part will go bad because it is not processed. It should NOT be eaten and will be thrown away. You will know when it has spoiled. The other two parts will be processed. One of these will be eaten in two weeks, the other in two months. The canned applesauce would be good for longer than that, but there needs to be an end date for this experiment.

Usually when a person cans food, they can a larger quantity than that canned for this experiment. The amount to be canned is kept small for those students and teachers who do not want to peel a bushel of apples. If you want to increase the amount, just be consistent with the amounts of the ingredients.

Lab Sheet Suggested Answers

If old rotting apples were used . . . *Rotting is caused by bacteria and other microorganisms. The more bacteria on the fruit, the harder it is to get rid of. The whole point is to eat non-rotten food.*

If bruises were not cut from the apples . . . *Bruised apples are damaged. Bruised sites can have small tears in them, which increases the threat that bacteria might have gotten inside.*

If the jars, rims, and lids were not clean . . . *You are cleaning away things that might spoil your food and make it unsafe to eat.*

If the seal between the jar and rim was not tight . . . *Microorganisms can get into the jars and spoil the food.*

If the applesauce was not cooked as long as it should have been . . . *You might not have killed all the microorganisms.*

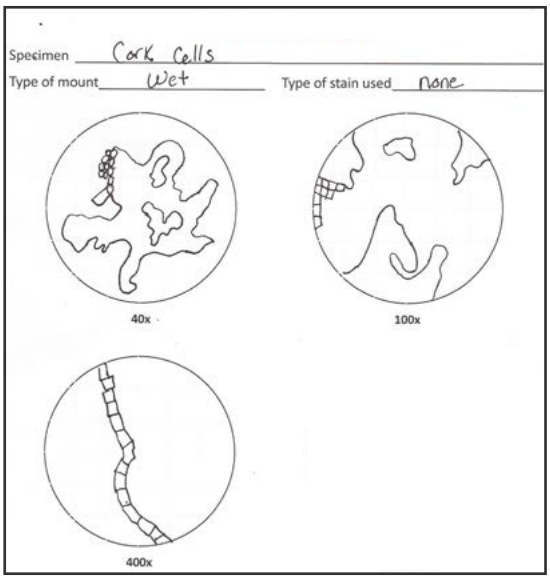
Microscope Lab

Discovering Cells

Yikes! Another microscope lab with lots of explanation and a long procedure section. These beginning microscope labs are written to give you, the teacher, more options. You can spend a lot or a little time on them. This lab gives step-by-step instructions in how to assemble and view a wet mount slide. The microscope labs become much shorter once the various parts and procedures we use in this book have been explained.

This lab recreates the historically important lab in which Robert Hooke documented the first microscopic view of a cell. The cells Hooke saw were cork cells. Cork is made from dead tree bark. Unlike cells that are alive, dead cells are "empty." Students will only see the cell walls of cork. During this lab, students will learn the important microscope technique of making wet mount slides.

Microscope Note: If the cork is sliced too thick, you will not have a clear view of each cell.



Famous Science Series

Antonie van Leeuwenhoek

Suggested Answers

Why is Antonie van Leeuwenhoek (LAYU-wen-hook) famous? What did he discover? What did he use to discover them? *Antonie van Leeuwenhoek has been called the father of microbiology. He is best known for his work to improve microscope technology. He became fascinated with how lenses magnify. He began grinding and polishing his own lenses. At the time, his lenses were some of the finest made.*

With his microscope, van Leeuwenhoek was the first person to see bacteria, unicellular eukaryotes, blood cells, and much more. It was not a compound microscope, though. It was more like a very strong magnifying glass. The bacteria that van Leeuwenhoek discovered came from scrapings from an old man's teeth. This man had never brushed his teeth in his life! EW! YUCH!

When and where was he born? *October 24, 1632, in Delft, Holland*

When did he die? *August 30, 1723*

He was inspired after reading a famous book written by Robert Hooke. What is the title? *Micrographia*

It has been speculated that the Dutch painter Johannes Vermeer used optical aids produced by van Leeuwenhoek. How would these have help Vermeer? *It might be that Vermeer used optical aids produced by van Leeuwenhoek to get a better feel for light and perspective in his paintings.*

How many microscopes did van Leeuwenhoek make? What happened to them? *van Leeuwenhoek made over 500 microscopes. Unfortunately, he made them out of silver and gold. When he died, his family sold them for the monetary value of the metal.*

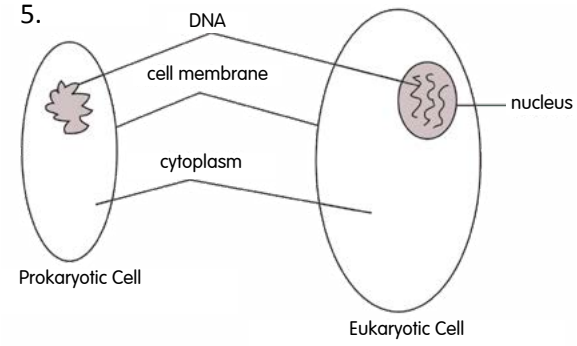
Show What You Know

Types

Multiple Choice

1. A shark is made from *eukaryotic cells*.
2. The bacteria that causes strep throat are made from *prokaryotic cells*.
3. The basic unit of structure and function of an organism is called *a cell*.
4. Unicellular organisms are *prokaryotes and eukaryotes*.

5.



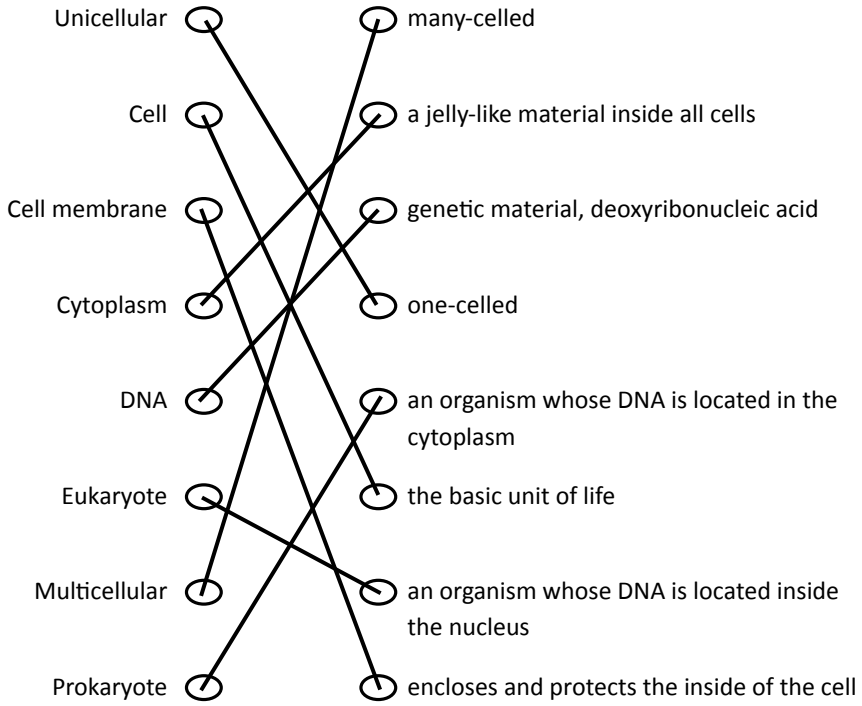
Fill In the Blanks

The <u>*cell*</u> theory states:

6. Every <u>*organism*</u> is made of one or more <u>*cells*</u>.
7. <u>*Cells*</u> come only from other living <u>*cells*</u>.
8. <u>*Cells*</u> are the basic unit of <u>*structure*</u> and <u>*function*</u> needed to support <u>*life*</u>.

9. **Question**:
What famous scientist coined the term *cell*? Why didn't he see a nucleus, cell membrane, cytoplasm, or genetic material?
Robert Hooke. He didn't see these things because the cells he saw with his microscope were "dead" cells. They were no longer part of a living organism. He saw the cell walls. The nucleus, cell membrane, cytoplasm, and genetic material had decomposed and disintegrated long before he looked at the cork with his microscope.

10. Match the word with the best definition.



Read

Lesson Review

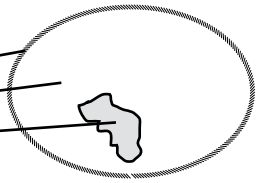
Cells: Types

Cell theory

- Every organism is made of one or more cells.
- Cells come only from other living cells.
- Cells are the basic unit of structure and function needed to support life.

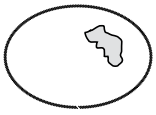
All cells have

- cell membrane
- cytoplasm
- DNA



Cells can be prokaryotic = NO nucleus = DNA floats in the cytoplasm

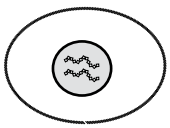
ALL prokaryotes are unicellular. Bacteria are prokaryotic.



"I'm free!! I'm free!!"

Cells can be eukaryotic = YOU! = DNA in a nucleus

ALL multicellular organisms are eukaryotes. Some unicellular organisms are eukaryotes, too.



"I'm protected!!"

TBYB Sample

Teacher Guide

Unit III: Genetics

Chapter 10: Inheritance

WEEKLY SCHEDULE

Two Days

Day 1
- ❑ Lesson & Activity
- ❑ Lab
- ❑ MSLab
- ❑ FSS

Day 2
- ❑ Activity
- ❑ Lesson Review
- ❑ SWYK
- ❑ Unit III Exam

Three Days

Day 1
- ❑ Lesson & Activity
- ❑ Lab

Day 2
- ❑ MSLab
- ❑ FSS
- ❑ Activity

Day 3
- ❑ Lesson Review
- ❑ SWYK
- ❑ Unit III Exam

Five Days

Day 1
- ❑ Lesson & Activity
- ❑ Lab

Day 2
- ❑ MSLab

Day 3
- ❑ FSS
- ❑ Activity

Day 4
- ❑ Lesson Review
- ❑ SWYK

Day 5
- ❑ Unit III Exam

Introduction

Chapter 10 is about inherited traits. This subject is a favorite for many students. The concepts of inheritance are fairly straightforward and provide an opportunity for students to apply what they have learned about genetics thus far. But this last chapter on genetics is filled with strange new terminology that might make this seem more confusing than it actually is. Don't shy away from the vocabulary. With continued use, students will pick it up fast.

This is the last chapter in Unit III. There is a Unit III exam that covers the material found in Chapters 7 through 10, in the appendix of the student Workbook. The answer key is found at the end of this chapter.

Preparation for microscope lab: Collect human hair strands in as many different colors as you can. Make sure all but one is untreated. Also, try to get hair samples from someone who is going gray; collect one gray hair and one non-gray hair.

Learning Goals

- Investigate how organisms of the same species come to have unique traits.
- Understand how genotype, phenotype, and traits relate.
- Understand the new terminology and concepts relating to alleles.
- Understand how to use a Punnett square and a probability table.
- Introduce the concept that genes, environment, and choices make you who you are.
- Learn the Law of Independent Assortment of Alleles.
- Learn the Law of Segregation.
- Learn about your family traits.

Extracurricular Resources

Books

Gregor Mendel: The Friar Who Grew Peas, Bardoe, Cheryl

Gregor Mendel: Genetics Pioneer: Life Science, Van Grop, Lynn

Gregor Mendel: And the Roots of Genetics, Edelson, Edward

Online

Visit Pandia Weblinks for videos and websites recommended for this chapter:

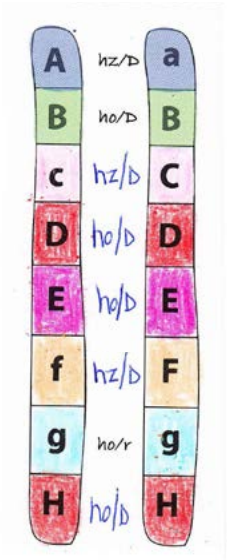
www.pandiapress.com/weblinks-biology2

Read

Lesson

What Makes You You?

Students are introduced to the new terms ***genotype*** and ***phenotype*** in this lesson. Your genes make up your genotype. Phenotype is the expression of your genes, your appearance. Genotype is the main factor affecting phenotype. In other words, the genes an organism has are the main factor affecting their appearance. There are different forms of each gene. Different forms of a gene code for making the same protein; they just make different versions of it. Blond hair versus brown hair, for example. You still have hair; it is just a different color. In this lesson students color alleles as they read.



To help demonstrate how different alleles affect phenotype, I came up with an imaginary creature, qwitekutesnutes [*quite-cute-snoots*]. I used an imaginary creature instead of a real-life organism for several reasons. The genetics I have presented so far in Unit III are straightforward, basic, and simplified. In reality, genetics is often much more complicated. Traits can be controlled by more than two alleles, there can be incomplete dominance, and genes controlling different traits can be very close to each other on a chromosome so that the assortment of the different genes is not entirely independent. Therefore, it would have been close to impossible to be absolutely certain I was getting the genetics completely correct for any living organism. With qwitekutesnutes I had total control of the genetics. I was able to keep it simple, straightforward, and at grade level, while still having an organism to use as an example. Plus qwitekutesnutes are, well . . . quite cute!

Explore

Lab

Family Traits

This lab is so much fun. Interview as many close relatives as possible. The answers for some of the traits, such as eye color, are subjective. Let the interviewer decide. If your student is adopted, I recommend you adapt this lab rather than skip it. An adopted child could choose a subject: someone who has access to and knowledge of many blood relatives. The student could gather data and complete the lab based on the subject. Actually, scientists are rarely the subject of their own experiments, so using a third party is a completely legitimate way to conduct this lab.

You may need to help students when they fill in the Family Traits Questionnaire. Answers will vary according to the subjects used. A few notes:

• If everyone interviewed has only the dominant trait, this does NOT mean they are all homozygous for the dominant allele.

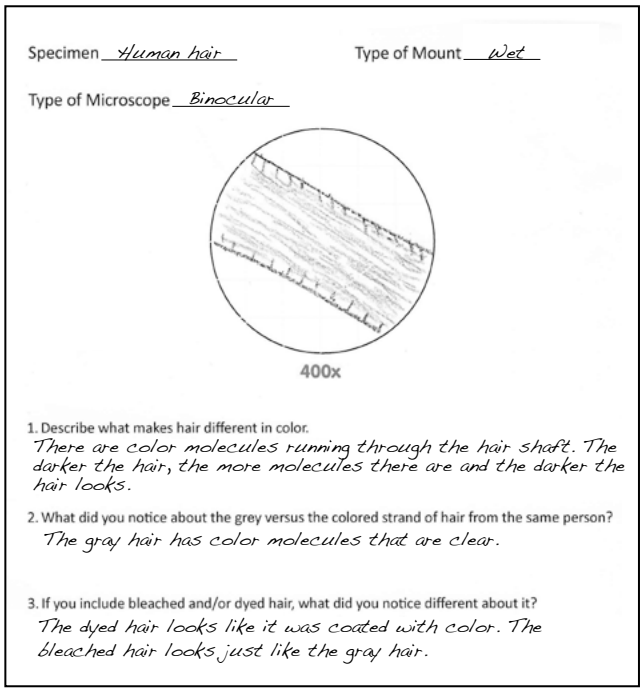
• When they occur, students can work back from a homozygous recessive phenotype to determine a heterozygous genotype.

• Blood type is a genetic trait that is not controlled by one dominant or recessive allele. Both alleles are expressed if two different alleles are present. The alleles are co-dominant.

Microscope Lab

Phenotype Under the Scope

This experiment surprised even me with its fun factor. You can see the color molecules along the hair shaft and the parts of the shaft that are unpigmented. Dyed hair looks different from undyed hair. Gray hair has color molecules but they no longer have color in them. Get as many different samples of naturally colored hair as you can. (I asked for samples at a dinner party.) You only need one sample of dyed hair, because they all look the same except coated with a different color.



Specimen *Human hair* Type of Mount *Wet*

Type of Microscope *Binocular*

400x

1. Describe what makes hair different in color.
There are color molecules running through the hair shaft. The darker the hair, the more molecules there are and the darker the hair looks.

2. What did you notice about the grey versus the colored strand of hair from the same person?
The gray hair has color molecules that are clear.

3. If you include bleached and/or dyed hair, what did you notice different about it?
The dyed hair looks like it was coated with color. The bleached hair looks just like the gray hair.

Famous Science Series

Gregor Mendel

There was a lot going on in the field of genetics in the mid to late 1800s. In 1859, Charles Darwin published his seminal work on evolution and natural selection, *The Origin of Species*. In 1866, Gregor Mendel published the results of seven years of research that examined how traits were passed from parents to their offspring. Unfortunately, Mendel published in an obscure Austrian periodical and Darwin never learned of Mendel's research. It was unfortunate because although Darwin was able to explain the "what" of evolution, he did not know the mechanism that explained the "how" of evolution. It was, at that time, a serious flaw to his theory. Evolution is covered in more detail in Unit 5.

If possible, do the Famous Science Series for chapter 10 and the "Make Your Own Qwitekutesnute" Activity together.

When and where was Gregor Mendel born? *Heinzendorf, Austria, on June 22, 1822. Heinzendorf, Austria, is now Hyncice, Czechoslovakia.*

What did Mendel do so that he could continue his education? *He joined the Augustinian Abbey of St. Thomas in what is now Brno, Czechoslovakia, in 1843.*

What is the blending theory of inheritance? *The blending theory states that the traits of an individual result from a blending of the traits of the parents. A tall parent and a short parent would have children of medium height.*

From 1856 to 1863, Mendel conducted an experiment with over 28,000 plants. What type of plant did he use? *Pea plants, common garden pea*

What seven traits did he study in these plants? *flower color, flower position, stem length, seed shape, seed color, pod shape, and pod color*

Did Mendel prove or disprove the blending theory of inheritance? *When Mendel crossed plants with specific traits, he got one of the two traits, not something in the middle. This disproved the blending theory of inheritance. From this he concluded that traits are passed on unchanged from parents to offspring by "units," now called genes.*

What two laws did Mendel discover? *Law of Independent Assortment of Alleles and the Law of Segregation*

When Mendel crossed true-breeding green peas and white peas, he got all green peas in the F1 generation. When he crossed two of the green peas from the F1 generation he got ¾ green peas and ¼ yellow peas in the F2 generation. Which is the dominant trait and which is the recessive trait? *Green is dominant, yellow is recessive.*

Was Mendel famous in his lifetime? *No, the scientific community took little notice of his work. It was not until 1900, sixteen years after his death, that three different scientists working to explain the laws of inheritance rediscovered Mendel's work.*

Activity

Make Your Own Qwitekutesnute

There is no answer key for this activity. Drawings will vary depending on the traits of the qwitekutesnute.

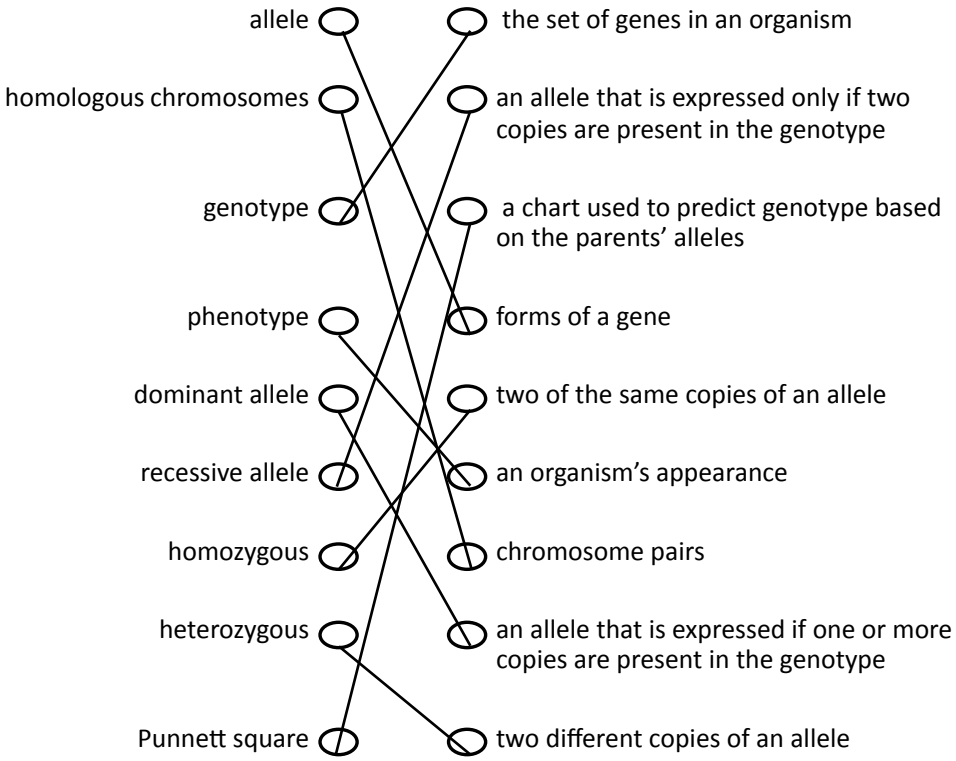
This activity is designed to be done directly following Famous Science Series. You might need to remind your student that the assortment of alleles is random. You do not always get what you want. This might seems like silly advice, but in my experience, students often want certain traits for their qwitekutesnute, which can affect the randomness of the traits the qwitekutesnute gets.

Learn

Show What You Know

Inheritance

1. Match the word with the best definition.



2.

	H	h
h	Hh	hh
h	Hh	hh

H = spiked hair h = ear tufts

Genotype	Genotype Probability	Genotype Fraction	Genotype Percentage	Phenotype	Phenotype Probability	Phenotype Fraction	Phenotype Percentage
Hh	2:4	2/4	50%	Spiked hair	2:4	2/4	50%
hh	2:4	2/4	50%	Ear Tufts	2:4	2/4	50%

What is the probability of a qwitekutesnute baby from this pair having ear tufts?
2:4 = 50%

If the qwitekutesnute parents have 12 babies, how many should have ear tufts? Will that many definitely have ear tufts? *Six. No, this is just the likelihood, the probability.*

If qwitekutesnute parents both have gray eyes (a dominant trait among qwitekutesnutes), could they have green-eyed offspring (a recessive trait)? Explain your answer. *Yes, if both parents are heterozygous, Ee, for eye color, they could have a baby that was homozygous recessive for eye color.*

If qwitekutesnute parents both have 4 whiskers, a recessive trait, could they have offspring with 7 whiskers? Explain your answer. *No, both the parents are homozygous recessive for the trait so neither parent has the dominant allele to pass on to their offspring.*

Multiple Choice

1. Law of Segregation states *allele pairs separate during meiosis*
2. Law of Independent Assortment states *allele pairs assort independently of one another*
3. The scar on your chin is an example of *phenotype*
4. The allele pair Ww is *heterozygous*
5. The allele pair BB is *homozygous dominant*
6. The allele pair ee is *homozygous recessive*
7. If two parents with brown hair have a baby with blond hair, the allele for blond hair must be *recessive*
8. Traits are *inherited and acquired*
9. Your genotype is *the set of genes in the somatic cells in your body*
10. Your traits are your *phenotype*

11. Extra Practice

HH x HH phenotype: 100% spiked hair

	H	**H**
H	**HH**	**HH**
H	**HH**	**HH**

HH x Hh phenotype: 100% spiked hair

	H	**H**
H	**HH**	**HH**
h	**Hh**	**Hh**

HH x hh phenotype: 100% spiked hair

	H	**H**
h	**Hh**	**Hh**
h	**Hh**	**Hh**

Hh x Hh phenotype: 75% spiked hair, 25% ear tufts

	H	**h**
H	**HH**	**Hh**
h	**Hh**	**hh**

Hh x hh phenotype: 50% spiked hair, 50% ear tufts

	H	**h**
h	**Hh**	**hh**
h	**Hh**	**hh**

hh x hh phenotype: 100% ear tufts

	h	**h**
h	**hh**	**hh**
h	**hh**	**hh**

Lesson Review

Inheritance

Traits = inherited and acquired characteristics
Inherited characteristics = traits determined by genes, e.g. eye color, heart murmur
Acquired characteristics = traits from life experiences, ex. scars

Meiosis separates alleles so there is one copy of an allele in a gamete.
Fertilization = 1 haploid set of mother's chromosomes + 1 haploid set of father's

Mitosis – This cell replicates to make more cells that are all genetically identical to the first cell, the zygote.

The chromosomes of diploid organisms come in pairs of homologous chromosomes.
One diploid set of offspring's chromosomes = offspring's genotype

Genotype determines phenotype.
Genotype = a set of genes in an organism
Phenotype = the appearance of the organism

Alleles are the forms a gene comes in.
Alleles can be dominant or recessive.
Allele vocabulary and rules:

- An uppercase letter = a dominant allele
- A lowercase letter = a recessive allele
- WW = homozygous dominant
- Ww = heterozygous
- ww = homozygous recessive

Your inherited traits are determined by the alleles you inherit.

Law of Segregation = allele pairs separate during meiosis
Law of Independent Assortment = allele pairs separate independently of each other

TBYB Sample

TBYB Sample

Teacher Guide

Unit IV: Anatomy and Physiology

Chapter 13: Plant Reproduction

WEEKLY SCHEDULE

Two Days

Day 1
- ❑ Lesson
- ❑ Dissection Lab

Day 2
- ❑ FSS
- ❑ Lesson Review
- ❑ SWYK

Three Days

Day 1
- ❑ Lesson
- ❑ Dissection Lab

Day 2
- ❑ FSS

Day 3
- ❑ Lesson Review
- ❑ SWYK

Five Days

Day 1
- ❑ Lesson

Day 2
- ❑ Dissection Lab

Day 3
- ❑ FSS

Day 4
- ❑ Lesson Review

Day 5
- ❑ SWYK

FSS: Famous Science Series
MSLab: Microscope Lab
SWYK: Show What You Know

Introduction

Chapter 13 looks at the parts of the flower. The flower is the reproductive organ of flowering plants called angiosperms. Angiosperms are the most common type of plant on Earth today. The reproductive strategies used by the other three main divisions of plants are discussed in less detail.

Learning Goals

- Learn the names and functions of the parts of a flower.
- Learn more about the process of fertilization.
- Learn the purpose and function of seeds and fruits.
- Learn how a plant goes from a zygote to a germinated plant.
- Learn about the reproductive structure and method of reproduction of gymnosperms.
- Learn about the reproductive structure and method of reproduction of ferns and mosses.

Extracurricular Resources

Book

Flowers (Plant Facts), McEvoy, Paul

Online

Visit Pandia Weblinks for videos and websites recommended for this chapter:

www.pandiapress.com/weblinks-biology2

Lesson

Making More Plants

The flower is the reproductive organ of angiosperms. For sexually reproducing organisms, fertilization occurs when sperm meets egg and a zygote forms. This is true for plants and for humans. The reproduction of humans is covered in Chapter 16. There are commonalities between the terms and processes for all sexually reproducing multicellular organisms.

This illustration of the flower and the illustration of the cherry tree show slightly different ovaries. Both types are common representations. *Carpel* is the British term for pistil.

Dissection Lab

Flower and Seed: Inside View

The general lab and microscope lab are again combined for this chapter. Students dissect a flower and a seed, taping parts to their lab sheet and labeling. Images of a flower and seed are already labeled on the lab sheet. A gentle touch, patience, and attention to detail are required to locate and dissect each part. Be careful with the ovary and ovules; they are particularly delicate.

There are two main classes of angiosperms: monocotyledons and dicotyledons. These two have different types of leaves and seeds. Monocotyledons have long, parallel veins. Lilies and grasses are monocotyledons. Dicotyledons have complex, net-veined leaves. Maples and most other angiosperms are dicotyledons. A lima bean is the seed of a dicotyledon. For more information on the differences between the two types of angiosperms, refer to Chapter 30.

Famous Science Series

Sunflower

Where did sunflowers originate? *Sunflowers are native to the Americas. Native Americans have used sunflowers for thousands of years.*

Sunflowers have been found at archaeological sites. How old are the remains? *The remains of sunflowers have been found at an archeological site in North America dating from 3000 BCE. There is evidence that Native Americans began cultivating sunflowers by at least 2300 BCE.*

Today, what country is the number one consumer of sunflowers? *Russia*

Sunflowers became important in this country because of two religious holidays. Name the country, the holidays, and why the sunflower is important to this country. *During Lent and Advent, the Russian Orthodox Church did not allow many foods that were rich in oil to be used. When sunflowers came to Russia, they could be used as an oil source during these holy days.*

The rulers of this country sent soldiers into battle with packages of sunflower seeds in what quantity? *The Russian Czars sent a two-pound pack of sunflower seeds with soldiers.*

In 1986, workers at the Chernobyl nuclear power plant caused an explosion that released massive amounts of radioactive material into the surrounding environment. How were sunflowers used to help clean up this problem? *Sunflowers absorb toxic waste from soil and water. Rafts of floating sunflowers were used to extract 95 percent of the radioactive material that was in water.*

Show What You Know

Plant Reproduction

1. Match the vocabulary word with its definition.

pistil–female reproductive structure of an angiosperm

seed–survival capsules, seed coat on outside and food inside

petals–the part of an angiosperm that attracts pollinators

stamen–male reproductive structure of an angiosperm

anther–where pollen is produced for an angiosperm

pollen–male gametes

ovules–female gametes

flower–reproductive organ of angiosperms

angiosperm–flowering plant

gymnosperm–seed-producing plants that do not produce fruit

cones–reproductive organs of gymnosperms

style–part of the pistil that joins the stigma and the ovary

fruit–protects seeds and aids in their dispersal

ovary–where the ovules are stored in an angiosperm

filament–the part of the stamen that supports the anther

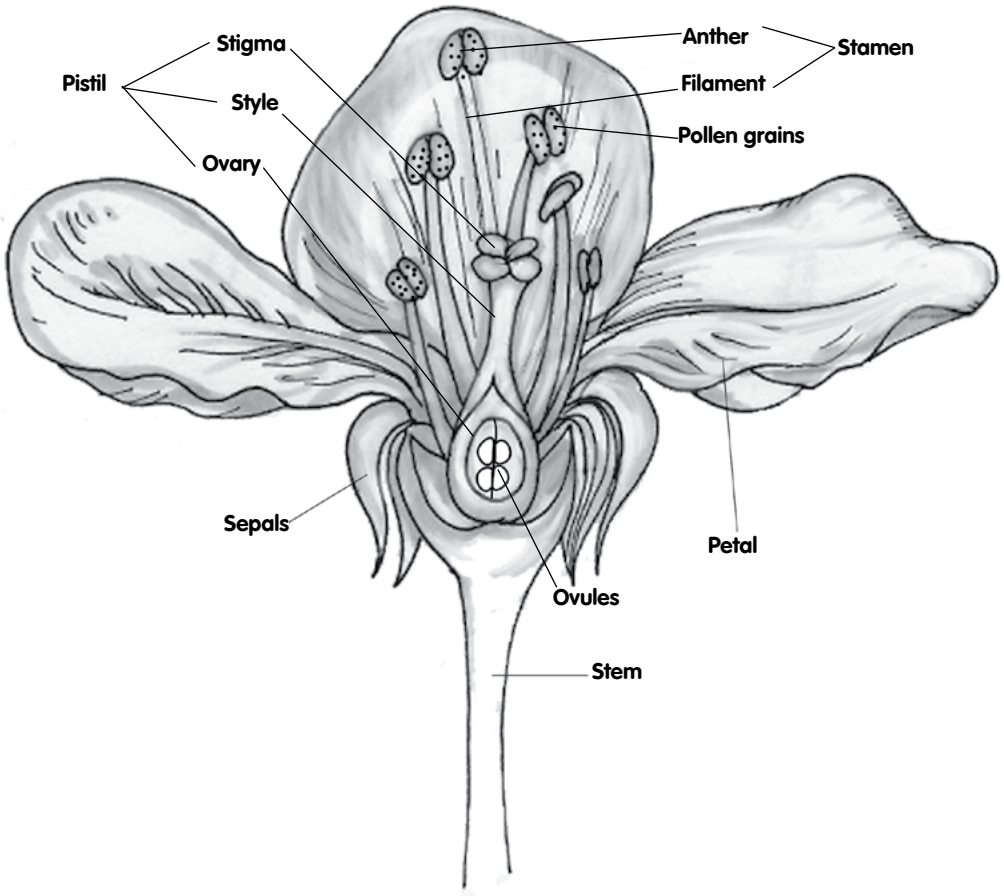
spore–used by mosses and ferns in reproduction

stigma–top part of the pistil where pollen is trapped

pollen tube–tube that grows through the stigma to the ovary

germination–when a seed first begins to grow

2. Label the flower.



Read

Lesson Review

Plant Reproduction

When you are going over the review, use the Socratic method and use this material to ask students questions. For example, when you get to the parts of a flower, you can ask what they are and what they do. Only give answers if students need help.

This is a good time to review meiosis:
Sexually reproducing organisms use the process of meiosis to make gametes.
Gametes have one set of chromosomes in them. They are haploid = n
Male gametes are called sperm in people. In most plants they are called pollen.
Female gametes are called eggs in people, and ovules in most plants.
When the gametes fuse during fertilization, they make a zygote, which has two sets of chromosomes. The zygote is diploid = 2n.
The zygote divides using mitosis. This is how the plant grows. The cells resulting from mitosis are genetically identical.

Angiosperms = flowering plants (even if there is not an obvious flower – such as with grasses)

Parts of a flower:
flower = reproductive organ of angiosperms
pistil = female reproductive organ of angiosperms = stigma, style, ovary
stigma = pollen sticks to stigma, then travels down through the style, creating a pollen tube
style = goes from the stigma to ovary
ovary = where the female gametes (ovules) are and where fertilization occurs in angiosperms
stamen = male reproductive organ of angiosperms
anther = where male gamete (pollen) is produced in angiosperms
filament = the stalk that supports the anther
sepals = protect buds as flower is growing
petals = attract pollinators
seed = where zygote develops into an embryo = a survival capsule that protects and nourishes the embryo
fruits = help with the dispersal of seeds
germinate = when the embryo breaks out of the seed coat and begins to grow

Review the circular process of reproduction using the cherry tree illustration in the student textbook.

Gymnosperms:
- plants that use cones to reproduce (they do NOT make flowers or fruit)
- cones = the reproductive organ of a gymnosperm
- have male cones that make pollen and female cones with female gametes where fertilization takes place
- reproduce sexually
- use wind to disperse pollen from male to female cones

Mosses and ferns are plants that use spores instead of seeds to reproduce.

TBYB Sample

TBYB Sample

Teacher Guide

Unit V: Evolution

Chapter 21: How

WEEKLY SCHEDULE

Two Days

Day 1
- ❑ Poetry
- ❑ Lesson
- ❑ Lab

Day 2
- ❑ MSLab
- ❑ FSS
- ❑ Lesson Review
- ❑ SWYK

Three Days

Day 1
- ❑ Poetry
- ❑ Lesson
- ❑ Lab

Day 2
- ❑ MSLab

Day 3
- ❑ FSS
- ❑ Lesson Review
- ❑ SWYK

Five Days

Day 1
- ❑ Poetry
- ❑ Lesson

Day 2
- ❑ Lab

Day 3
- ❑ MSLab

Day 4
- ❑ FSS

Day 5
- ❑ Lesson Review
- ❑ SWYK

FSS: Famous Science Series
MSLab: Microscope Lab
SWYK: Show What You Know

Introduction

The purpose of Chapter 21 is to explain how evolution happens.

Learning Goals

- Understand the scientific definition of "theory," and recognize that a scientific theory is a work in progress.
- Learn the steps in the process of evolution.
- Learn the causes of genetic variation.
- Learn how natural selection and genetic drift affect the prevalence of traits in populations.
- Learn how speciation occurs.

Extracurricular Resources

Books

Evolution Revolution, Winston, Robert
Evolution (DK Eyewitness Books), Gamlin, Linda
The Leakeys: Uncovering the Origins of Humankind, Poynter, Margaret
Evolution, Silverstein, Alvin
Mammals Who Morph, Morgan, Jennifer

Online

Visit Pandia Weblinks for videos and websites recommended for this chapter:
www.pandiapress.com/weblinks-biology1

Poetry

A Recipe for Making Something Different

This poem was first-place winner in the 2012 Lyric Division of Spellbinder Books' poetry contest. I wrote it to be used as a teaching poem, and recommend reciting it throughout the week. As this chapter demonstrates, the explanation isn't quite as simple as the poem's refrain indicates, but as a bare-bones answer the refrain is correct. The recipe for speciation is isolation, variation, and lots of time.

Lesson

How Evolution Happens

Over 1.75 million species of organisms have lived on Earth. Evolution is the process that has led to the great diversity of life. That is a fact; it is not a theory. What is a theory is exactly how the process of evolution happens. For example, is it a fact that the Endosymbiotic Theory is definitely how eukaryotic cells evolved? It is not a known fact. It is the best explanation for the data known at this time. That is what makes it a theory not a fact.

In this chapter when explaining overproduction I state that, "...some mice will have a higher survival rate than others will. It is part luck and part genetics." Remember, the combination of genes an organism gets from its parents is random. Which genes end up in which gamete during meiosis, and then end up in the sperm and egg that make the zygote, is a random process. If one sibling has a genetic makeup that increases its chances of survival over another sibling, this is just by random chance, also known as luck.

Genetic recombination, crossover, was first introduced in Chapter 8. It is not a type of mutation. The genes do not change their chemical composition, as happens in mutations. They shuffle and pair into different combinations.

Lab

Natural Selection

This lab asks the question: If I was a mouse, what color would I want to be? The answer is whatever color the ground is. This is a very good lab for demonstrating natural selection. Be careful that your students do not look at the pompoms while you are hiding them. Keep track on the lab sheet as you go along.

This lab is a nice one for a formal lab report. I have provided a sample.

Possible Answers

Your answers will vary from mine for these questions. The following answers are from a student who completed this experiment outside on sandy ground.

Hypothesis: *I think I will select the most black mice and the least gray mice.*

Round 1 – color of first mouse caught: *Brown*

Round 2 – color of first mouse caught: *White*

Round 3 – color of first mouse caught: *Black*

Math This Week

1. Pompoms are counted.
2. Students must keep track of the color of pompoms.

			black	brown	gray	spotted	white
Round 1		caught	*2*	*2*	*0*	*4*	*3*
		left	3	3	*5*	*1*	*2*
		added	3	3	*5*	*1*	*2*
	total mice in next round		*6*	*6*	*10*	*2*	*4*
Round 2		caught	*1*	*3*	*1*	*1*	*4*
		left	5	3	*9*	*1*	*0*
		added	5	3	*9*	*1*	*0*
	total mice in next round		*10*	*6*	*18*	*2*	*0*
Round 3		caught	*5*	*4*	*6*	*2*	*0*
		left	5	2	*12*	*0*	*0*

Did you catch the same color mouse first every time? What do you interpret from that? *No, the first mouse I caught was the most random because it was the one closest to me. In the next two rounds the first mouse I caught was the one that stood out the most because of its color.*

Which colored mouse was best adapted for the environment? Which colored mouse was the worst adapted for the environment? *The gray was the best adapted; the white was the worst adapted closely followed by the spotted*.

Based on the results from this experiment, why do you think the mice in the wild are brown or brownish-gray in color? Use the term *natural selection* in your answer. *There is natural selection for hair color. In nature (but not in my experiment for brown), mice that blend in best with their environment are less likely to get eaten. There is selection against fur colors that stand out, like white.*

In terms of evolution, fitness is defined as the ability to produce offspring. Which fur color results in the best fitness for the mice? *gray*

If there is continued selection for and against certain fur colors, what do you think will be the color of the mice in this population? *There will be more gray mice but maybe some black ones too.*

What happened to the mouse that had the best fur color once it became more numerous? *It started to get eaten more because there were fewer other color choices. But it still increased a lot in number. If the experiment were to go another round, there would be 24 gray mice in the next round. That is almost 5 times what I started with.*

Chapter 21: Lab Report

Name: *Oliver Smith* **Date:** *12/30/2012*

Title: *Natural Selection*

Hypothesis

I think I will select the most black mice and the least gray mice.

Procedure

I had my mom scatter 5 pompoms each of several different colors over a 2 to 3 square meter area at a local playground. I did not look while she was doing this. After she scattered the pompoms, she told me to open my eyes, then try to pick up as many pompoms as possible in 30 seconds. For each pompom I did not pick up, I added another one of that color to be hidden in the next round. I did this a total of three times.

Observations

Round 1 – the first pompom I picked was brown. I picked up the most spotted ones, 4, and no gray ones.

Round 2 – the first pompom I picked was white. I picked up the most white ones, 4, and only 1 gray one, 1 black one, and 1 spotted one. There were no more white pompoms for the next round, I picked them all up.

Round 3 – the first pompom I picked was black. I picked up the most gray ones, 6, and the least spotted ones, 2, but that was all of the spotted ones.

Results and Calculations

See data table from lab sheet for calculations
By the end of round three there were 12 gray pompoms, 5 black pompoms, 2 brown pompoms and no white or spotted pompoms.

The pompom color of the first pompom picked each round was only a good indicator of which color would be the one I caught most for round 2.
Round 1: brown picked 1st; I caught 4 spotted but only 2 brown total
Round 2: white picked 1st; I caught 4 white pompoms, all there were
Round 3: black caught 1st; I caught 6 gray and 5 black, but there were more gray pompoms

Conclusions

In conclusion, the gray did blend in the best as I thought in my hypothesis, but black blended in better than I thought it would. White and spotted pompoms showed up the best on the surface where they were scattered, and were the easiest to find when I was racing around trying to pick up as many pompoms as possible in 30 seconds. This experiment makes it easy to understand how there could be natural selection for fur color in nature. Animals that stand out are easier to quickly find the way a predator would need to do when catching its prey. That color would be selected against and would become less common and possibly nonexistent in nature.

Microscope Lab

Function and Form

Why are there so many different colors and forms of hair/fur? That is just the type of question Darwin and his peers were asking when they began to look for a scientific explanation for the many variations. Try to look at as many different types of fur as you can. You could add a slide of a feather to this lab too. Feathers in many ways function the same for birds as fur does for mammals.

Possible Answers

Your answers will vary from mine for these questions. The following answers are from a student who completed this experiment.

What two fur samples from different types of animals do you think will look the most alike with a microscope? Why? *Cat hair from a fuzzy cat and sheep hair because they have the most similar texture.*

What two fur samples from different types of animals do you think will look the most different with a microscope? Why? *Dog hair and guinea pig hair because they look and feel the most different from each other.*

Type of Fur	Appearance Description	Comments: Compare/Contrast
Dog, border collie	*coarse, thick black hair*	
Dog, white mix breed	*white hair on outside, black inside*	*texture was like people's hair*
Cat	*thin and fuzzy*	
Sheep	*super thin and fuzzy*	*looked almost identical to the cat hair*
Guinea pig #1	*straight, thick, white, and black*	*I could see a large cuticle*
Guinea pig #2	*straight red*	*thinner texture than guinea pig #1*
Person #1	*straight, brown, thin*	
Person #2	*curly, blond, thick*	*This was the thickest of all the fur samples*

What two fur types looked the most alike with a microscope? Why? *Cat and sheep; they were hard to tell apart they were so similar. They were the same thickness in diameter and both had similar-looking cuticles (the part around the outside of the hair).*

What two fur types looked the most different with a microscope? Why? *Guinea pig and sheep; the guinea pig hair was thick and coarse and the sheep hair was thin and fuzzy; the guinea pig hair had a thicker cuticle around it.*

Were you surprised by anything you saw? If so, what? *My white-haired dog; he looks totally white, but under the microscope his hair is black on the inside and white on the outside.*

Famous Science Series

Evolution Act 1: First Theories

My goal with this Famous Science Series is to set the stage to get students thinking about people's mindset and where the science was at just before the time Darwin proposed his theory of evolution.

In 1809, Jean-Baptiste Lamarck proposed a theory of evolution. What was his theory and was it correct? *Lamarck believed the traits an organism acquired during its lifetime were passed to the organism's offspring. He proposed that if a species used an organ more than they had in the past, that the size of the organ would*

increase, such as the neck of a giraffe. The longer the giraffe's neck was, the easier it would be to feed from leaves at the tops of trees. These longer-necked giraffes would give birth to even longer-necked giraffes. His theory was incorrect and had its problems. Chief among them was the lack of supporting data. Nevertheless, it was a start and it got people thinking.

In 1788, James Hutton, a Scottish farmer and geologist, put forth a theory called uniformitarianism. What was the theory and was it correct? *He proposed that:*

- *The earth was much older than the 10,000 years people at that time believed.*
- *The earth is constantly changing.*
- *The processes that cause change are slow, but many of them are observable:*
  - *o erosion caused by wind and water*
  - *o volcanic eruptions, bringing melted rock from the center of the earth, which then cools and builds up the earth's surface*
  - *o sediments deposited layer upon layer, becoming rock*
- *These processes have been constant over the life of the earth.*

James Hutton's theory of uniformitarianism is correct.

Show What You Know

Evolution: How

Multiple Choice

1. One bacterium splits into two, then two to four… Soon there are millions. The bacteria run out of food and begin to starve to death. This is an example of: *Overproduction*
2. The case of the peppered moths is a good example of how *natural selection* works.
3. What two mechanisms lead to genetic variation? *Genetic recombination and mutation*
4. Aquatic birds, like ducks, have webbed feet that help them paddle through water. This is an example of *an adaptation*.
5. Dogs and cats are not the same species because *they cannot breed with each other and have offspring*.
6. Which of the following statements are true? *All of the above*
7. This change to an all-green population on the new island is an example of *genetic drift*.
8. Arctic hares have fur that is brown in the summer and white in the winter. If the earth became warmer and all the snow melted in the Arctic, this would be an example of a *beneficial* trait that became a *harmful* trait.
9. Reproductive isolation is necessary for speciation because *gene flow must be stopped between populations for one to evolve into a new species*.
10. Mutations are *random*; selection for the traits they cause is not.

11. What is the name of the process that explains how all the species of organisms have come to be? *Evolution*
12. Overproduction should lead to there being many more organisms alive than the earth can support. What are the controls on overproduction? *All of the above*

Essay Answers

1. This essay takes some thought but it can be done. Here is an example:
Many years ago a terrible hurricane struck the Island of Mythical Creatures and a small group of sealocrabs became separated from the main population, when they were swept out to sea and marooned on a small island. The main island was too far for them to swim back to it. There was genetic variation in this small group, which led to the natural selection for certain adaptations that were favored in their new environment. The beneficial adaptations were selected for and increased in the group. Because the group was small, there was genetic drift for some traits. The group was reproductively isolated from its parent population for a long time. Because of genetic recombination and mutation, new traits evolved in the group. Eventually, there was speciation with the evolution of the sealocrab into the aquanotic.

2. *The cell theory was established in 1855.*
1665, Robert Hooke discovers squarish-looking structures in a specimen of cork with his microscope. He names these structures *cells*.

1674, Anton Van Leeuwenhoek is the first person to see a live cell with his microscope.

1831, Robert Brown discovers the cell nucleus.

1839, Thoeder Schwann and Matthias Schleiden propose a theory stating that all living things are made of one or more cells. Schwann and Schleiden perform many different experiments before proposing their theory. They conduct many experiments after their theory is proposed. *They called it a theory, but they are the only two researchers who have tested it, so it is not a theory yet.*

1855, Rudolf Virchow proposes that every cell comes from another cell. This is added as a part of the cell theory. He performed many different experiments before proposing this. He conducts many experiments after his theory is proposed. *This is the point where the cell theory becomes a legitimate scientific theory.*

1855 to present day, the cell theory has been tested many times by many different researchers. Their results have confirmed the cell theory.
The work Virchow is doing shows that different researchers are testing the findings of Schwann and Schleiden. Virchow adds to the theory, which is common in science. The continued research on working scientific theories leads to addendum and changes as scientists learn more through their research. The last entry is purposely worded to include the definition of a scientific theory in it.

Lesson Review

Evolution: How

A good review is to walk your timeline and discuss what things might have led to the evolution of types of organisms. For example, ask a question like: If birds evolved from dinosaurs, what kinds of mutations and selection would have led to the first birds?

To be of the same species, organisms must be able to . . .

1. Reproduce
2. Have healthy offspring that can also reproduce. For example, horses and donkeys are not the same species because: They can reproduce BUT their offspring, mules, cannot reproduce; they are sterile.

The Process of Evolution

Overproduction = more are born than can survive

Genetic variation = mutations and genetic recombination leads to different, new, and new combinations of traits

Natural selection = there is selection for and against traits

Genetic drift = in small populations, alleles can become fixed in a population where the allele is the only copy of that allele present in the population

Reproductive isolation = organisms are isolated from each other so they cannot reproduce with each other; gene flow is stopped between groups—this is a necessary condition for speciation

There must be genetic variation to have different traits.

Different traits allow for natural selection and genetic drift.

Natural selection and genetic drift change the traits in populations.

Organisms with different traits can evolve away from each other if there is reproductive isolation.

When enough new traits accumulate, speciation can happen.

TBYB Sample

Teacher Guide

Unit VI: Ecology

Chapter 25: Predator and Prey

WEEKLY SCHEDULE

Two Days

Day 1
- ❑ Lesson
- ❑ Lab
- ❑ MSLab

Day 2
- ❑ FSS
- ❑ Lesson Review
- ❑ SWYK

Three Days

Day 1
- ❑ Lesson
- ❑ Lab

Day 2
- ❑ MSLab
- ❑ FSS

Day 3
- ❑ Lesson Review
- ❑ SWYK

Five Days

Day 1
- ❑ Lesson

Day 2
- ❑ Lab

Day 3
- ❑ MSLAB

Day 4
- ❑ FSS

Day 5
- ❑ Lesson Review
- ❑ SWYK

FSS: Famous Science Series
MSLab: Microscope Lab
SWYK: Show What You Know

Introduction

The main topic of Chapter 24 was the abiotic, non-living, factors in the biosphere that affect organisms. The topic of Chapter 25 is the biotic, living, factors that affect organisms.

Learning Goals

- Learn about food webs.
- Understand how food energy is available in lesser amounts going from producers to consumers.
- Learn the main types of biotic interactions: predator/prey, competition, symbiosis
- Recognize the difference between interspecific interactions and intraspecific interactions.
- Learn how organisms adapt to survive.
- Understand why niches are important in minimizing competition.
- Learn the three types of symbiosis.
- Identify the wildlife that lives in your backyard.
- Learn how plant predation affects plants.

Extracurricular Resources

Books

Exploring Ecosystems with Max Axiom, Biskup, Agnieszka

A Journey into Adaptation with Max Axiom, Biskup, Agnieszka

The World of Food Chains with Max Axiom, O'Donnnell, Liam

Totally Amazing Rainforests, Golden Books

Fur, Feathers, and Flippers: How Animals Live Where They Do, Lauber, Patricia

Food Chains and Webs, Wallace, Holly

One of the many books written about or by Jane Goodall; one suggestion is: *My Life with the Chimpanzees*

Online

Visit Pandia Weblinks for videos and websites recommended for this chapter:

www.pandiapress.com/weblinks-biology2

Read

Lesson

No Fighting No Biting. Wanna Bet?

The lesson covers the biotic, living, factors that affect organisms. These interactions create natural selection for specific traits, adaptations. There is selection for morphological traits and of behavioral traits. Predator/prey relationships are a driving force for the selection for traits that help catch prey and elude predators. Competition also drives selection. The strongest competition is between members of the same species, intraspecific competition. Because these organisms have the same needs, they share the same niche. The more parameters of their niche that organisms share (and in the case of organisms of the same species, these parameters are identical), the stiffer the competition between those organisms.

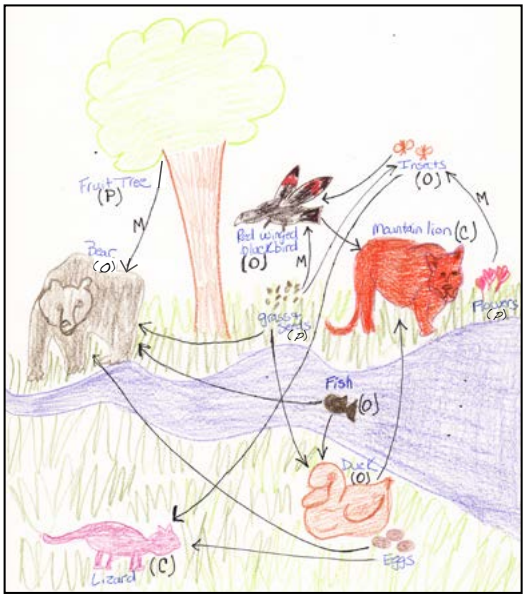
The terms interspecific and intraspecific might cause confusion for students. The prefix *inter* means "among or between." The word *interspecific* means "between species." The prefix *intra* means "within." The word *intraspecific* means "within the same species." These are useful prefixes to know for high school science.

Explore

Lab

Backyard Food Web

Set aside enough time so you can relax, enjoy, and spend as much time as possible getting to know all of the organisms in your backyard. It is helpful for students to be able to discuss what they are observing. The wildlife books are optional, but they are very helpful when determining what animals eat. If you know there are animals in your backyard that you do not observe, it is okay to include them. When filling in the lab sheet, make sure it is completed as a food web not as a food chain. Very few animals eat just one type of food.



Make sure students include plants and insects in their food web and help them look for evidence of symbiosis. If you have roses, you might be able to see ants and aphids in action. One type of symbiosis that is definitely going on in your backyard is parasitism. Wild animals have internal worms, fleas, and lice. You can talk about the impact of these parasites to the health of the host, what kind of niche a parasite has compared to other animals (at least they keep them alive as opposed to carnivores), and how and why we keep pets parasite-free.

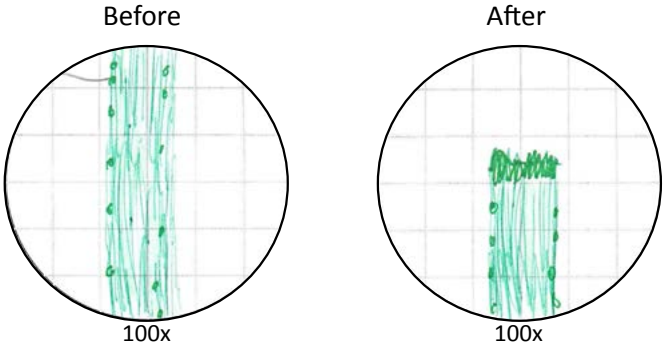
This is a good time to discuss why there are so many more plants in numbers and in mass than animals. It is because at each level up in the food web, there is less energy available to support the organisms at that level.

Explore

Microscope Lab

Plant Predation

Have you ever thought of plants as prey? Probably not, but they are.



Describe the differences between the two blades of grass.
At the place where the grass was torn, it was much darker than anywhere else that was not torn.

Why do you think grazing can be harmful to the organism to which it happens?
I think it damages the cells at the site where grazing occurs, killing those cells.

Sometimes when grass is cut, the tip turns brown. Use the differences you observed between the two blades to explain why this might occur.
At the tip where grass is torn, the cells die. These dead cells turn brown.

Absorb

Famous Science Series

Jane Goodall

When researching about Jane Goodall, the problem is the amount of information. Because of the sheer amount of material, it can be hard to sift through it all to answer the questions. She is a prolific author herself. In addition, many people have written about her. You might need to help with the research because of this.

A good title for Jane Goodall could be "Famous Observer of Biotic Interactions." What organisms did Ms. Goodall observe, and why is this a good title? *Goodall observed chimps; answers will vary*

What are the two main threats that chimps face today? *Poaching and loss of habitat*

It has been said that Jane Goodall, through her work, has changed the way we think about all animals. She once said, "Only if you understand, will you care. Animals have feelings too." What did she mean by this? *Answers will vary*

Many of the volunteer and outreach programs started by Goodall reach out to kids your age. How can people your age help save chimps? *Answers will vary*

A famous anthropologist gave Jane Goodall her start. What is his name and why is he famous? *Louis Leakey proved that people evolved in Africa. He also helped push back the date for when hominids evolved by thousands of years.*

The Gombe National Park is the location of the chimps Goodall studied. What country is Gombe National Park in? *Tanzania*

What lake does the park border? Find the lake and Olduvai Gorge, where Leakey made his discoveries, on a map of Africa. *Lake Tanganyika*

What famous explorer discovered the lake's only outlet? *Livingstone*

At Gombe National Park, humans need to keep 10 meters away from the chimps. Why? *Chimps and people can transmit diseases to one another.*

Show What You Know

Predator and Prey

1. If you have a pet, look at the list of ingredients on your pet's food. Based on the list, is your pet an omnivore, herbivore, or carnivore? If you do not have a pet, look at a bag of pet food the next time you are at the grocery store. *Answers will vary*

2. Draw a food web using the organisms below. You do not have to use all of them. Draw the arrow going away from an organism to what it might be eaten by. Mark a P on organisms that make their own food.

   Spider ←bee, fly
   Eagle ←snake, cardinal, mouse, trout, chicken (occasionally)
   Lion ←deer, mouse, raccoon, chicken, eagle (if it can catch it)
   Snake ←mouse, cardinal, fish
   Cardinal ←apple tree (P), mushrooms
   Deer ←grass (P), tree (P), mushrooms
   Mouse ← grass (P), tree (P), flower, mushrooms
   Fly ←any of these animals if they are dead (or poop), apple
   Raccoon ←apples from tree, mouse, cardinal, fish, snake, mushroom
   Trout ←fly, bee, spider
   Chicken ←fly, bee, spider, apples from tree
   Person ←deer, chicken, trout, apple from tree, mushroom
   Mushroom ←rotting log, rotting apples

3. List three adaptations predators have for catching prey. *Claws, fangs, poison*

4. List three adaptations prey animals have for avoiding being caught. Explain the benefits of each adaptation.
   - *Camouflage–helps to hide*
   - *Mimicry–look like a bad-tasting or poisonous species so you are not eaten*
   - *Aposematic coloring–says leave me alone, I am poisonous or taste bad*
   - *Bioluminescence helps organisms find food and escape predators*
   - *Plants make bad-tasting or poisonous chemicals, have thorns and stickers, and protect seeds*

5. **Multiple choice**

Cleaning fish will go into the mouth of a barracuda and clean its teeth, eating any parasites they find. This is an example of *All of the above*

Going from producer to herbivore to carnivore: *there is less energy*

When two species have a similar niche, they use *resource partitioning* to reduce competition.

Coral snakes have yellow, red, and black stripes. This is an example of *aposematic coloration.*

Commensalism is a symbiotic relationship where *one species benefits and it doesn't affect the other species.*

The most intense competition is *intraspecific competition.*

Plants defend themselves against predators using *All of the above*

An example of intraspecific competition is *a dog marking its territory.*

The predator/prey relationship is beneficial to a community because *they increase the diversity in the community.*

A population's niche is its *job in the community.*

Questions

6. Plants are called producers because they produce their own food. What is the name of the process they use to do this? In what organelle does this process occur? Write the chemical reaction and state the name of the food made in this process. (10 points if you do not have to peek, 5 if you do)

Photosynthesis occurs in chloroplasts
$6CO_2 + 6H_2O$ + energy from the sun → $C_6H_{12}O_6 + 6O_2$
carbon dioxide + water + sunlight → glucose + oxygen

7. All organisms need energy. What is the name of the process used to make energy? In what organelle does this process occur? Write the chemical reaction for this process. (10 points if you do not have to peek, 5 if you do)

Cellular respiration occurs in mitochondria
$C_6H_{12}O_6 + 6O_2$ → $6CO_2 + 6H_2O$ + energy organisms can use
glucose + oxygen → carbon dioxide + water + energy organisms can use

Lesson Review

Predator and Prey

biotic = living parts of the environment
producers = autotrophs = organisms that produce their own food
consumers = heterotrophs = organisms that consume others for food
Types of consumers:

- **carnivores** = eat meat
- **herbivores** = eat plants
- **omnivores** = eat plants and meat

- **decomposers** = use chemicals to break plants and animals into molecules and absorb the molecules

Food web = a diagram showing what organisms eat

Going from producers → herbivores and decomposers → omnivores → carnivores, there is less food energy for each level. Less available food energy leads to smaller population sizes as you go up the energy pyramid.

Natural selection is the process where organisms have a better or a worse chance of survival because of their traits.

Biotic interactions are the interactions between organisms. Biotic interactions lead to natural selection for traits. Selection for traits leads to adaptations that help an organism survive in its environment.

Interspecific interactions = interactions between <u>different</u> species

Intraspecific interactions = interactions between organisms of the <u>same</u> species

Examples of interspecific interactions:

- **Predator/prey relationship**
  - » Predation benefits populations by increasing diversity
  - » There are adaptations to help predators catch prey and to help prey escape predators:
    - Sharp claws and teeth
    - Produce poisonous or bad-tasting chemicals
    - **Camouflage**. Types of camouflage:
      - * Disruptive coloration
      - * Light bellies for fish and some amphibians
    - Aposematic coloration = warning coloration
    - Mimicry = looks like poisonous or bad-tasting species
    - Bioluminescence = organisms create their own light
    - Stickers or thorns, plants
    - Protective shell
- **Competition**
  - » **Niche** = job an organism has in its environment, such as what it eats and where it lives. Niches reduce interspecific competition.
  - » Intraspecific competition is more intense than interspecific competition, because members of the same population occupy the same niche.
  - » **Resource portioning** = different species of organisms with similar niches use resources slightly differently; this reduces interspecific competition
- **Symbiosis** = interspecific relationship
  - » **Mutualism** = both species benefit from relationship
  - » **Parasitism** = one species benefits from relationship, one species is harmed by relationship
  - » **Commensalism** = one species benefits from relationship, one species is unaffected

TBYB Sample

Teacher Guide

Unit VII: Classification

Chapter 31: Kingdom Animalia

WEEKLY SCHEDULE

Two Days

Day 1
- ❑ Lesson
- ❑ Lab/MSLab

Day 2
- ❑ FSS
- ❑ Lesson Review
- ❑ SWYK

Three Days

Day 1
- ❑ Lesson part 1
- ❑ Lab/MSLab–begin

Day 2
- ❑ Lesson part 2
- ❑ Lab/MSLab–complete

Day 3
- ❑ FSS
- ❑ Lesson Review
- ❑ SWYK

Five Days

Day 1
- ❑ Lesson part 1
- ❑ Lab/MSLab–begin

Day 2
- ❑ Lesson part 2
- ❑ Lab/MSLab–complete

Day 3
- ❑ FSS

Day 4
- ❑ Lesson Review

Day 5
- ❑ SWYK

Introduction

Note: Lab 32, in the next chapter, takes 5 to 10 days to see observable results. You might want to start it on Friday of the week you complete Chapter 31, or on Monday of the week you start Chapter 32.

Most of the species of organisms in domain Eukarya are in kingdom Animalia, the subject of Chapter 31. That makes for a long lesson listing traits. If you are using the two-days-a-week schedule, make sure your student stays focused for the entire lesson. The three- and five-day schedule split the lesson up over two days, studying invertebrates the first day and vertebrates the second.

The lab in this chapter, Arthropod Arrangement, has students comparing and discovering insects and arachnids. This is a general lab and a microscope lab combined. If you are not using a microscope for this course, this lab could be completed using only a magnifying glass (hand lens), but obviously students won't see as much detail for comparison.

Learning Goals

- Learn the traits all animals share.
- Learn the names of the nine major animal phyla.
- Learn shared derived traits that warrants an organism's placement in a phylum.
- Learn the difference between invertebrate and vertebrate animals.
- Learn the terms *ectotherm* and *endotherm*.
- Learn about the three types of mammals.

Extracurricular Resources

Books

You can find many books about animals at your local library. Some that I like are:

Animal Grossology, The Science of Creatures Gross and Disgusting, Branzei, Sylvia

Intelligence in Animals, Reader's Digest, long but very interesting

Time-Life Student Library Mammals

Wolf Pack: Tracking Wolves in the Wild, Johnson, Sylvia A. and Aamodt, Alice

Online

Visit Pandia Weblinks for videos and websites recommended for this chapter:

www.pandiapress.com/weblinks-biology2

Lesson

Lords of Their Domain

You might have noticed that the lists of traits for each phylum only include those that are observable. There is no discussion about genetics, biochemistry, or biochemical pathways. There are differences in genetics and biochemistry between different organisms in the different phyla; I just do not discuss them. In fact, there must be genetic differences for groups with different traits—that is a given. There are certain genetic markers and biochemistry unique to each grouping. A discussion of the differences in chemistry and genetics is more appropriate for a high school or college-level course. That makes the written approach in Chapters 30, 31, and 32 more "old fashioned." As the genotypes of more and more organisms are known, there have been and will continue to be organisms that are reclassified based on the results of the analyses.

Lab and Microscope Lab

Arthropod Arrangement

When I wrote this lab I could just imagine being a scientist one hundred years ago, performing an experiment like this, just me and my microscope figuring out the difference between arachnids and hexapods. You need relatively fresh specimens. Insects that have been dead a long time tend to get crumbly. If you collect and kill live specimens, do not damage them. If you use bug spray on them be very careful. Bug spray is toxic to humans. You could collect them and put them in the freezer until they die. It all seems very unkind, doesn't it? I started looking for them for about two weeks leading up to the experiment; I found more than enough good specimens of fresh but dead insects. Spiders were harder to find, but I managed to find one too.

Possible Answers

This information is for a fly and a spider.

My Insect, Class Hexapod. My Observations:

Exoskeleton: *Hair and pores all over. I could see through the exoskeleton into the internal cavities.*

Body parts: *3 segments. I could see where the body parts are connected at joints, these occur at tapered sites where the joints connect them.*

Joints and legs: *6 legs. It is easy to find the points where the exoskeleton has its joints. Some joints look similar to how our joints would look if the skin were removed. Other joints look just like the joints I have seen on the exoskeleton of crab legs. It looks like the smaller of the two parts that connect the joint fits inside of the larger part.*

Other observations: *The fly had white lines across its abdomen that looked like segments in the exoskeleton. These were not joints, though. I wonder if the fly's*

exoskeleton grows in segments. Maybe every time the fly molts, its exoskeleton grows back with another segment. The fly looked like it had eggs in its abdomen. It was filled with little circles.

My Arachnid, Class Arachnida. My Observations:

Exoskeleton: *Hair and pores all over. I could see through the exoskeleton into the internal cavities.*

Body parts: *2 segments. I could see where the body parts are connected at joints, these occur at tapered sites where the joints connect them.*

Joints and legs: *8 legs. It is easy to find the points where the exoskeleton has its joints. Some joints look similar to how our joints would look if the skin were removed. Other joints look just like the joints I have seen on the exoskeleton of crab legs. It looks like the smaller of the two parts that connect by joint fits inside of the larger part. Looks like claws at the end of the legs.*

Other observations: *Some spiders, like the one I looked at, spin webs and have a little place at their bottom where the web-building material or silk comes from, called spinners. Insects do not have this. The spider has fangs, which look quite gruesome under the microscope. On either side of the fangs is what looks like teeth. These are not fangs or teeth such as mammals have. The spider's fangs and "teeth" look like they are a part of the exoskeleton.*

Similarities and Differences of Hexapods and Arachnids

Similarities:

An exoskeleton–The exoskeleton of both have hair and pores all over them. I could see through the exoskeleton on both into their internal cavities.

Jointed legs–It is easy to find the points where the exoskeleton has its joints. Both have claws at the ends of their legs.

Multiple body parts–You can see where the body parts are connected at joints, these occur at tapered sites where the joints connect them.

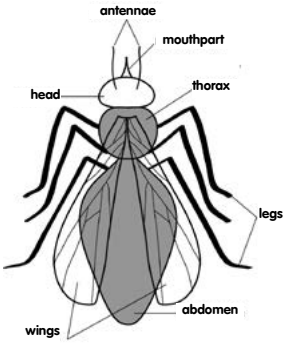
Differences:

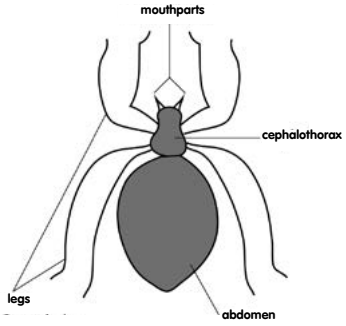
Insects have 3 segments and 6 legs

Spiders have 2 segments and 8 legs

Some insects, like the one I looked at, have wings. Spiders do not have wings.

Spiders may have spinners or fangs. Insects do not.





Famous Science Series

John James Audubon

John James Audubon is a famous naturalist and frontiersman. His story is interesting and unique. One reason I chose him was to give insight into how the methods of learning about animals has changed since his time.

John James Audubon painted hundreds of birds. Where was he born? When was he born? In what country did he study birds? Why did he go to that country? *He was born in 1785 in Haiti. He studied birds in the United States. He came to the U.S. to avoid being conscripted into Napoleon's army.*

What was the name of the book Audubon wrote about birds? *The Birds of America or Ornithological Biographies*

What society is named after him? What is its purpose? *The National Audubon Society. Its purpose is to save and restore ecosystems with special emphasis on the birds and wildlife found in those ecosystems.*

When Audubon discovered a bird he had not seen before, he shot it to study it more closely. Then he painted it. Do you think members of the National Audubon Society still shoot birds to study them? *Only with a camera!*

Show What You Know

Kingdom Animalia

1. This is the classification for the Southern Hairy-Nosed Wombat. Wombats are marsupials native to Australia and the island of Tasmania.

Domain	Eukarya
Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Diprotodontia
Family	Vombatidae
Genus	*Lasiorhinus*
Species	*latifrons*

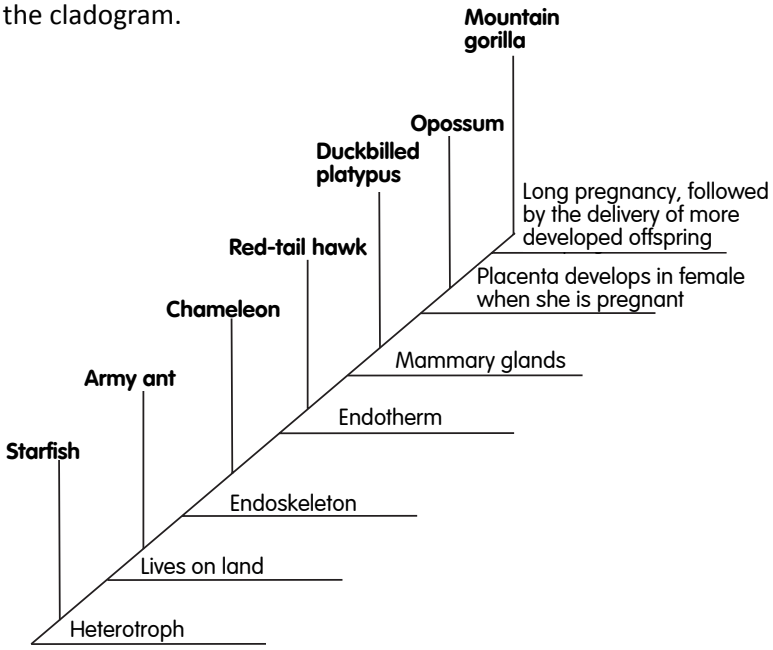
What is the scientific name for the Southern Hairy-Nosed Wombat? *Lasiorhinus latifrons*

2. Fix each statement to make it true. All animals...
   - are ~~unicellular~~ *multicellular*
   - are ~~immobile~~ *mobile*
   - have ~~prokaryotic~~ cells *eukaryotic*
   - ~~have~~ cell walls *do not have*
   - ~~are autotrophs, which means they make their own food using photosynthesis~~ *are heterotrophs, which eat other organisms for food*

3. Match each group with the best description for it.

Crustacea	long bodies, lots of segments, 1 to 2 feet coming from each segment
Myriapoda	2 body segments, 8 legs
Hexapoda	3 body segments, 6 legs, 2 antennae
Arachnida	10 to 40 legs, 4 antennae, gills

4. Fill in the cladogram.



Multiple Choice

1. A squid is an invertebrate animal, meaning *it does not have a backbone.*
2. An animal that has one muscular foot and a soft body is a(n) *mollusk.*
3. An animal that is aquatic, does not have tissue but does have specialized cells, has a hollow body with pores in it, and has a big hole on top where waste flows out, is a(n) *porifera.*
4. An animal with jointed legs, a segmented body, and an exoskeleton is a(n) *arthropod.*
5. An aquatic animal with a radial body plan, a sac-like body with one opening, and stinging tentacles it uses to immobilize it prey is a(n) *cnidaria.*
6. An aquatic animal with a radial body plan, a tough spiny skin, and tube feet it uses to move is a(n) *echinoderm.*
7. An animal with a backbone, a head, and a sophisticated body plan is a(n) *chordate.*
8. Segmented worms *have both male and female parts.*
9. Nematodes are roundworms that *have a long, threadlike body.*
10. Platyheminthes are worms that *have a flat body with a mouth at one end.*
11. This animal gets food when it moves food and water through pores in its body. It is a *sponge.*

12. The term *radial body plan* means an organism *has a central point that the rest of their body is arranged around.*
13. A vertebrate has *an internal skeleton.*
14. Endoskeletons are made from *bone and cartilage.*
15. An ectotherm *regulates its body temperature by exchanging heat with the environment.*
16. An endotherm *regulates its own body temperature internally.*
17. This vertebrate animal goes through a metamorphosis, where it starts out as one form and grows to look differently as an adult, is an ectotherm, and lays eggs in water. It is a(n) *amphibian.*
18. This vertebrate animal lives in water, has fins, breathes through gills, lays eggs, and is an ectotherm. It is a(n) *fish.*
19. This vertebrate animal has feathers and wings, a beak, lays eggs, and is an endotherm. It is a(n) *bird.*
20. This vertebrate animal has dry scaly skin, lays eggs, and is an ectotherm. It is a(n) *reptile.*
21. This vertebrate animal has mammary glands, hair or fur, and is an endotherm. It is a(n) *mammal.*
22. The purpose of mammary glands is to *make milk.*
23. A mammal that lays eggs is a *monotreme.*
24. Organisms with gills *transfer oxygen and carbon dioxide across them.*

Lesson Review

Kingdom Animalia

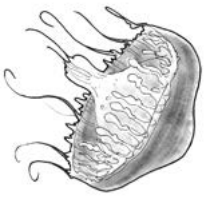
Try using the Socratic approach and see how well students remember the traits with or without a little prompting.

All animals
- Are multicellular
- Are mobile
- Have eukaryotic cells
- Do not have cell walls
- Are heterotrophs

Invertebrate = no backbone
Vertebrate = has a backbone

Eight of the nine major animal phyla are invertebrates:

1. **Porifera = sponges**
   - Aquatic
   - Do not have tissues or organs
   - Do have specialized cells
   - Hollow body
   - Food and water move into the sponge's body through openings called pores
   - Waste moves out of the sponge's body through a hole in its top
   - Hard spine that gives them support and shape



2. Cnidaria = jellyfish, sea anemones

- Aquatic
- Radial body plan
- Sac-like body with one opening, their mouth
- Tentacles with stinging cells surrounding their mouth

3. Platyhelminthes = flat worm

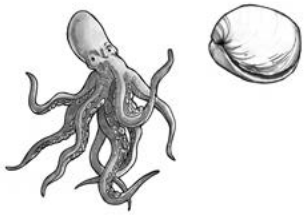
- Flat body
- Mouth at one end
- Parasites

4. Nematoda = roundworm

- Long, threadlike bodies
- Parasites

5. Annelida = earthworm

- Tube-shaped bodies made from segments
- Both male and female parts on same animal



6. Mollusca = shelled animals

- Live in water, except snails, slugs
- Shell, except squids, octopuses, some species of slugs
- Muscular foot that they use so they can move and burrow
- Soft bodies with a layer of folded skin that protects their internal organs

7. Arthropoda = insects, spiders

- Jointed legs
- Bodies are divided into segments
- Exoskeleton
- Antennae, except arachnids
- Four main classes = **Crustacea**, **Myriapoda**, **Hexapoda**, **Arachnida**

8. Echinoderms = starfish, sand dollars

- Live in the marine biome
- Tough, spiny skin
- Radial body plan arranged in five parts
- Move on tube feet by creating and releasing suction

One animal phylum contains all vertebrates:

9. Chordata = animals with backbones

- Endoskeleton with backbone
- Head
- Sophisticated body system

Classes of Chordates:

Fish

- Live in water
- Bullet, streamlined shape
- Fins for swimming
- Breathe through gills
- Most ectotherms
- Most lay eggs

Amphibians

- Lay eggs in water
- Go through metamorphosis
- Smooth moist skin they exchange oxygen across
- Ectotherms

Reptiles

- Dry, scaly skin
- Breathe through lungs
- Lay eggs that have a leathery shell
- When they hatch from their egg they look like miniature adults
- Ectotherms

Birds

- Feathers and wings
- Two legs covered in scaly skin
- Beak with no teeth
- Breathe through lungs
- Lay eggs in hard shells
- Endotherms
- Most can fly

Mammals

- Hair or fur
- Breathe through lungs
- Mammary glands
- Endotherms

Three groups of mammals with three different birth strategies:

1. Placental mammals, e.g. wildebeest
   - The embryo attached to a placenta
   - Nutrients and waste are transferred across the placenta between mother and embryo
   - Fetus born well-developed

2. Marsupial mammals, e.g. kangaroo
   - The embryo attached to a placenta
   - Nutrients and waste are transferred across the placenta between mother and embryo
   - Fetus born less developed

3. Monotreme mammals, e.g. duckbilled platypus
   - Lay eggs
   - Embryo develops in egg
   - No placenta