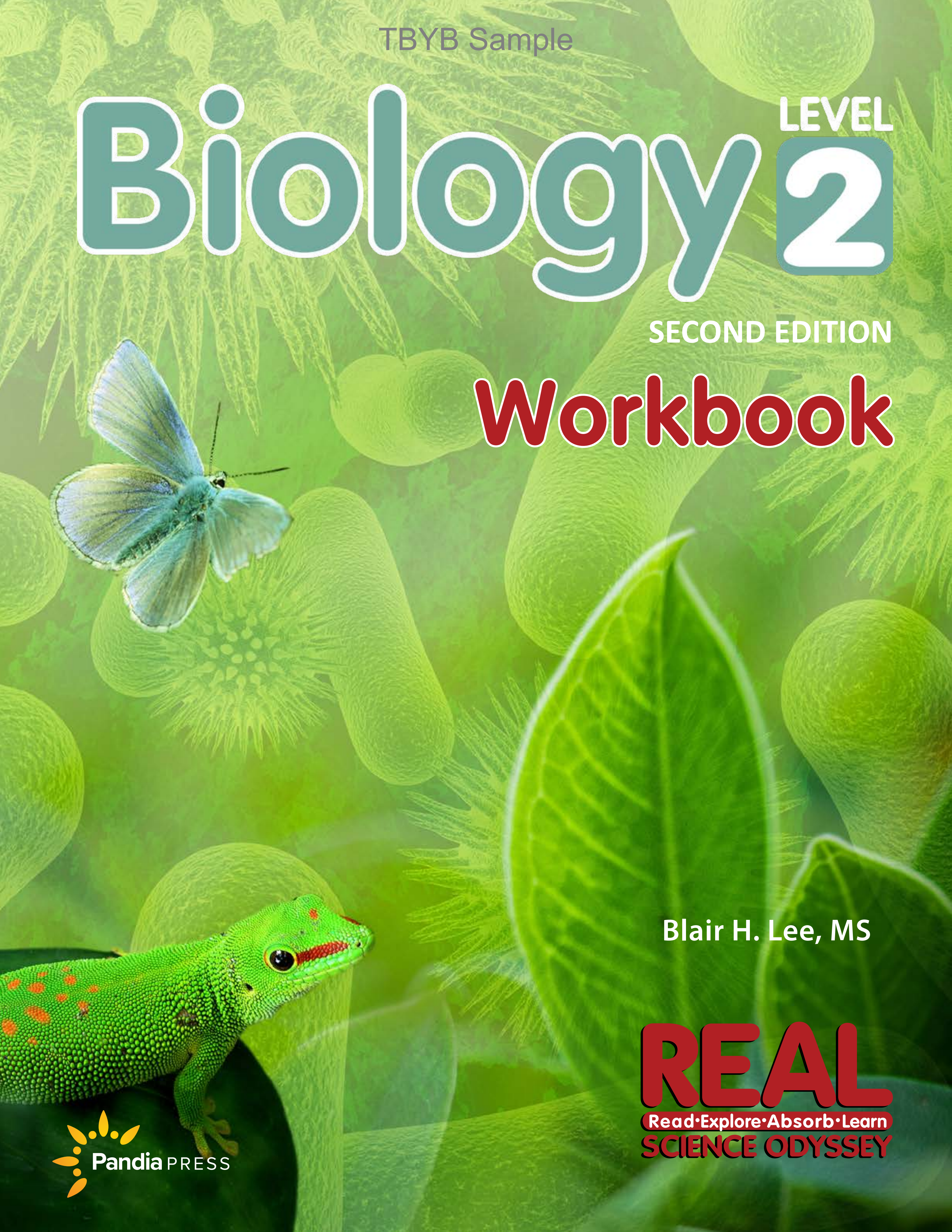
Biology LEVEL 2

SECOND EDITION

Workbook



Blair H. Lee, MS

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This file contains a preview of ***RSO Biology 2 Workbook***.
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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Pandia PRESS

ISBN: 978-0-9798496-8-8

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www.pandiapress.com

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Table of Contents

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Chapter 1: All Living Things

Explore

What's Out There? Plot Study

Chapter 1: Lab

Plot studies help scientists monitor fluctuations of species in a specific area.

In 1980, two biologists, Robin Foster and Stephen Hubbell, began a ***plot study*** in the rain forest on Barro Colorado Island, located in Gatun Lake in Panama. One purpose of this experiment has been to monitor changes to the numbers and ***species*** (types) of trees in the area. The size of the plot they are studying is 50 hectares, or about 124 acres.

To begin their plot study they chose an area that represented the overall tree population on the island. After choosing the location, they measured the perimeter of the plot. Next, the scientists carefully walked through the area and plotted (mapped) the different tree species. They counted the numbers of each species. They found about 300 different species of trees in the 300,000 they counted! Since then, scientists regularly revisit the plot to monitor any changes. There are now over 18 of these types of plots and plot studies worldwide, monitoring about 6,000 tree species. The plots are called "earth observatories." They are in Asia, Africa, and Latin America.

Plot study experiments are one method of determining what's out there. Researchers map an area or plot. They use the data collected from the plot to estimate what is in a larger area. These 18 plots have taught scientists a lot about what's out there and what's happening in rain forests worldwide.

Today you are going to conduct your own plot study. You are not going to count 300,000 trees or walk over 124 acres, but you are going to do what Drs. Foster and Hubbell did. You are going to go to an area and find a small plot within that area to conduct a study. You will mark off the boundaries of that area and study what is living in it. Be sure to check in trees and under rocks. While you are at it, check to see if anything is growing on that rock. Check the plants in your plot for insects; maybe you will find caterpillar eggs or a cocoon. Take the time to look for both the small and the tall in the area you choose to study.

Chapter 1: Lab *(continued)*

Materials

- Tape measure
- Graph paper
- Notebook paper
- Data tables
- Clipboard
- Calculator
- Outdoor area to conduct plot study
- Field guide(s): be prepared to identify insects, plants, birds, reptiles, mammals, and if you choose a water area—fish
- 4 markers for the corners of your plot

Procedure

1. Write your hypothesis for this experiment on the Lab Report before performing it. For this lab, and a few other labs in the course, you will be writing a formal lab report. The following explains how to write a lab report:

> The scientific method is based on experimentation, observation, and deductive reasoning. Lab reports about the experiments use the scientific method. Before you write anything down about an experiment, you need to understand what you are testing. Ask yourself, "What question is this experiment asking?" When you can answer that, you are ready to make your **Hypothesis** (an educated guess) about the outcome of the experiment. The next section is the **Procedure**. In this section you will briefly rewrite the steps used to conduct the experiment. The **Observations** section is where you keep track of what happened during the experiment. The **Results and Calculations** section is where your data, calculations, and tables go. In the **Conclusions** section, take the information from the observations and results and calculations sections and use deductive reasoning to determine an answer to the question the experiment asks. If there are any weaknesses to the experiment, this is the place to state them.

2. Decide on the location of the plot. Are you going to map a forested area, desert area, your lawn, a slow-moving creek, or a playground? When you decide on an area, try to choose a plot that is a good representative of the area as a whole.
3. Use your tape measure or meter stick and measure a 2 meter by 2 meter (2m x 2m) square plot on the ground. Mark the boundaries of the plot with a marker at each corner.
4. In the center of a piece of graph paper, draw an outline of a large block that is 20 squares by 20 squares. This will be used to draw a representation of your plot. Your drawing of the plot will be ***scaled***. Each square on the graph paper accounts for 10 centimeters (1⁄10 of a meter) of the plot. Therefore, the scale

Chapter 1: Lab *(continued)*

when drawing the plot is 10:1. This means that every 10 centimeters of the plot will be drawn into one square of graph paper. 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.

5. Draw the plot on your graph paper. Try to include a sketch of everything. Do your best to count the total number of each species of animal and plant. If there are rocks or other non-living objects that can be lifted, lift them very carefully, and on a separate sheet make notes about and drawings of what is underneath. When you are done, carefully replace the objects, so all the little animals still have a home.

6. Using your field guide, do your best to identify the plants and animals in the plot. If you can find the name, write it down.

7. You can fill in your data tables in the field or after you get home.

8. Note that some species of plants and animals might look different when they are really the same organism, depending on:
    - Their life stage. Caterpillars become butterflies and tadpoles become frogs in a process called ***metamorphosis***. Animals that go through metamorphosis look different as adults from when they are babies.
    - Plants can look different depending on their life stage. Males and females of the same species of animal can look very different from one another. This is called ***sexual dimorphism***. Take, for example, mallard ducks. The female is a drab brown all over and the male has a colorful green head with a white ring around its neck.

9. In addition to plants and animals, look for fungi (fungi is the plural form of fungus).
    - Mushrooms are fungi.
    - The orange/yellow/red growths on rocks are living fungi or lichens (fungi and algae).

When you have finished drawing the plot, on a sheet of notebook paper:

10. Describe the plot, in words.

11. Describe the entire area the plot represents. Some questions you might address:
    - Did you observe any wildlife nearby that was not included in your plot?
    - Did you include the one and only one tree in the area in your plot? In other words, if you did not choose a representative sample of the area for your plot, this is the place to note that.
    - Did you expect to find a species of wildlife that you didn't see?

12. Write your report using the following Lab Report forms. Refer to Lab Calculations as needed for assistance in writing your report.

What's Out There? Plot Study

Chapter 1: Lab Report

Name_______________________________ Date______________

Title/Location____

Hypothesis

Procedure

Observations

Results and Calculations

Conclusions

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Chapter 1: Lab Report–Data Tables

Table 1 (refer to Lab Calculations to complete this table)

Animals (list each species)	# of species in my plot	# of my plots that fit into $100m^2$	Estimate # of species for $100m^2$

Total animal species =

Notes:

Chapter 1: Lab Report–Data Tables *continued*

Table 2 **(refer to Lab Calculations to complete this table)**

Plants (list each species)	# of species in my plot	# of my plots that fit into $100m^2$	Estimate # of species for $100m^2$

Total plant species =

Table 3 **(refer to Lab Calculations to complete this table)**

	# Species found in your plot	Estimate # missed	Estimate # of species in $100m^2$
Animals			
Plants			
Fungi			

Chapter 1: Lab *continued*

Lab Calculations

Use the following lab calculations to assist you in completing Lab Report–Data Tables. (It looks like there are a lot of steps for the math part. That is because I spend a lot of time explaining it.)

You measured and described a small part of a larger area. Using math, you are going to estimate how many organisms are in a bigger area and how many species you might have missed.

Tables 1 and 2

How many of each type of organism is in a 100-square-meter area, $100m^2$?

A. Calculate the area of your plot.

Area = length x width

2m x 2m = ____m^2

B. Calculate how many of these plots would fit into $100m^2$.

$100m^2$ ÷ the answer from **A** = number of plots that would fit in $100m^2$.

$100m^2$ ÷ _____ = _____

This number is used to estimate how many of each type of organism is in the larger area.

Example: If you observed 5 beetles in your 2m x 2m plot, you would multiply the answer from **B** by 5, the number of beetles you saw. That is your estimate of the total number of beetles in $100m^2$.

Animals (list each species)	# of species in my plot	# of my plots that fit into $100m^2$	Estimate # of species for $100m^2$
Beetle	5	25	125

Now it's your turn. Fill in Tables 1 and 2 with your calculated estimates for the numbers of plant and animal species in a $100m^2$ area.

Table 3

Do you think every plant and animal in a $100m^2$ area was included in the 2m x 2m plot? Most likely not; some error is introduced into a study like this because we are looking at a small area. You are going to calculate an estimate of error, also known as a fudge factor, to correct for this.

Chapter 1: Lab *continued*

Let's assume the 2m x 2m plot you chose did not include 10 percent of the plant and animal species found in the $100m^2$ area. Because percent means "out of a hundred," this means ten out of every hundred plant and animal species in an area of $100m^2$ were missed.

If 10 percent is converted to a decimal, you can use the decimal to find an estimate for the number of species missed.

$$10\% \div 100 = .1$$

Example: For every ten species of organisms included in your plot, how many were missing from the larger area? 10 x .1 = 1. There was one species in $100m^2$ that was not in the 2m x 2m plot.

So let's say you found 17 animal species in your plot. To use this estimate to find the total number of animal species you would expect to find in the larger area:

17 x .1 = 1.7 (There cannot be .7 of a species, so you need to round to the nearest whole number.) 1.7 is rounded up to 2.

> A note about rounding numbers: If the decimal is .1 to .4, round down to the nearest whole number. If the decimal is .5 to .9, round up to the nearest whole number. For example: 1.1, 1.2, 1.3, and 1.4 are all rounded DOWN to 1. While 1.5, 1.6, 1.7, 1.8, and 1.9 are all rounded UP to 2.

You would estimate that two species of animals would be found in the larger area, $100m^2$, that were not seen in the 2m x 2m plot.

How many animal species would you expect to find in $100m^2$?

Number in plot + number missed = total number.

17 + 2 = 19, this is your estimate for the total number of animal species in $100m^2$, based on the results of your 2m x 2m plot study.

	# Species found in your plot	Estimate # missed	Estimate # of species in $100m^2$
Animals	17	2	19

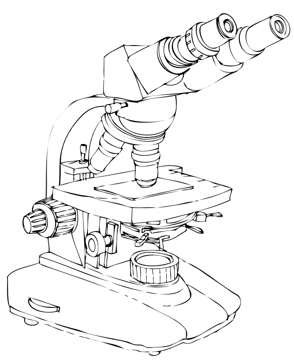
Now it's your turn. Count all the different species of plants, animals, and fungi (if you found any) from your data tables. (If you saw 10 of the same species of spider, that would be 1, not 10.) Complete Table 3 by estimating the number of species you would find in a larger area.

Explore

Your Microscope: Parts

Chapter 1: Microscope Lab 1

The instructions for the microscope labs are long in the first few chapters. They are written for students who have never used a microscope. Even for those of you who have used a microscope before, there is a lot of information in these beginning labs. Using a microscope is a lot of fun. At the end of this course you will be good at it.

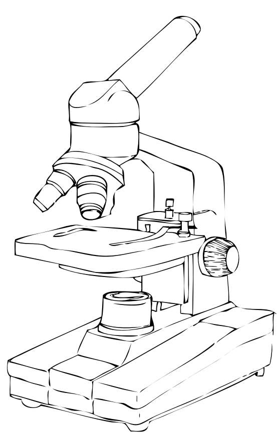


Binocular Microscope

Materials

- Microscope Lab sheet
  (choose the lab sheet for the type of microscope you have)
- Microscope (monocular or binocular)

Procedure



Monocular Microscope

As you read the explanation of what the parts of the microscope are and what each part does, fill in the blanks on the lab sheet naming the part. Optional: You can also write in one or two words telling what the part does.

Instructions are given for both a binocular and a monocular eyepiece. Some sections have different information/instructions for the different eyepieces.

★ **Monocular eyepiece**: a one-eyed eyepiece; you only need to read the monocular portion.

★ **Binocular eyepiece**: a two-eyed eyepiece; you only need to read the binocular portion.

Chapter 1: Microscope Lab 1 *continued*

Parts of the Microscope

Micro is the Greek prefix for "tiny"; *scope* is the Greek root for "to look at." The ***microscope*** is an instrument that looks at tiny things.

Your Eye

Your eye is not a part of the microscope but we will start with it anyway. People with very good eyesight see things under a microscope more clearly. If you wear glasses, you should wear them when you look through a microscope. It is a good idea to look through the microscope without eye makeup. Small pieces of makeup can fall onto the eyepiece.

- ★ **Monocular microscope**: It is best to look at images with both eyes open, if you can. If it is confusing for you looking at two separate images, you should practice closing one eye on both sides. Does one side close more easily than the other? If so, make sure you close that eye while you look through the microscope with the other eye.

#1 Eyepiece

The ***eyepiece*** is the lens at the top of the microscope. It has a magnification of 10x. ***Magnification*** is the number of times larger that something appears to be when looking at it with that magnification. A lens with a magnification of 10x will make something look 10 times larger.

- ★ **Monocular microscope**: *Mono* is the Greek prefix meaning "one." *Ocu* is the Latin root for "eye." The monocular microscope has a one-eyed eyepiece.
- ★ **Binocular microscope**: *Bi* is the Latin prefix meaning "two." The binocular microscope has a two-eyed eyepiece. The amount of space between eyes varies from person to person. The individual eyepieces of a binocular microscope must be adjustable for optimal use.

#2 Tube

The ***tube*** connects the eyepiece to the nosepiece.

#3 Nosepiece

The ***nosepiece*** is a flat disk that revolves. It holds the objective lenses.

#4 Objective Lenses

The ***objective lenses*** are the magnifying lenses that are closest to the object being magnified (the specimen). By themselves, these lenses magnify 4x, 10x, 40x, or 100x (binocular only). Remember the eyepiece had a magnification of 10x. So when the magnification from the eyepiece is multiplied to the magnification from the objective lens, you get 10x that of just the objective lens.

Chapter 1: Microscope Lab 1 *continued*

Scanning	4x	x 10x = 40x magnification
Low power	10x	x 10x = 100x magnification
High dry	40x	x 10x = 400x magnification
Oil immersion	100x	x 10x = 1000x magnification (binocular microscope only)

Each objective lens has important information stamped into the metal.

The 40x lens has this stamp:

4/0.10
160/0.17

4 = Magnification. The object will appear 4 times bigger using this lens alone, but remember it is used with the eyepiece.

0.10 = Numerical aperture (abbreviated NA). The larger the NA, the sharper the object will appear.

160 = Optical tube length. Even though the objective lenses are not the same strength, they all have the same optical tube length of 160mm.

0.17 = Suggested thickness for the slide cover of slides used with this lens. Pay close attention to this number when purchasing slide covers and making up slides.

★ **Monocular microscope**: There are three objective lenses that magnify to: 40x, 100x, 400x.

★ **Binocular microscope**: There are four objective lenses that magnify to: 40x, 100x, 400x, and 1000x. The 1000x lens is an oil immersion (OI) lens. "Oil" is stamped into this lens.

#5 Arm

The ***arm*** connects the tube to the base.

#6 Stage

The ***stage*** is where you place slides to look at. There are stage clips on the stage. There are two stage knobs on the stage.

#7 Stage clips (monocular), Slide (binocular)

The ***stage clips*** hold the ***slide*** in place on the stage. There can be stage clips on binocular microscopes. Draw them in if your binocular microscope has them.

#8 Stage knobs (binocular)

There are two ***stage knobs*** on the stage. One moves the stage left to right. The other moves the stage toward and away from you. There can be stage knobs on monocular microscopes. Draw them in if your monocular microscope has them.

Chapter 1: Microscope Lab 1 *continued*

#9 Monocular microscope only: 5-hole rotating disc diaphragm

The ***diaphragm*** has five different-sized holes. The purpose of the diaphragm is to focus light up from the base through the specimen. Each hole lets through a different amount of light. With light microscopy, more is not always better.

#9 Binocular microscope only: Condenser lens

The ***condenser lens*** is also called the Abbe condenser, after its inventor. The purpose of the condenser lens is to focus light up from the base through the specimen. There is an arm on the condenser that moves back and forth to adjust the amount of light. With light microscopy, more is not always better.

#10 Coarse focusing adjustment knob and **#11 Fine focusing adjustment knob**

The ***coarse*** and ***fine focusing adjustment knobs*** are nested. They are located on the side of the arm. The larger knob is the coarse focusing adjustment knob. The smaller knob is the fine focusing adjustment knob. The coarse and fine focusing knobs move the stage up and down, closer to and farther away from the objective lens.

#12 Illuminator

The ***illuminator*** is the light source for a compound microscope.

#13 Base

The ***base*** supports the microscope and houses the light source.

#14 Compound light microscope

All these parts make up your ***compound light microscope***. Compound microscopes have two lenses, the eyepiece and the objective lens, which work together to magnify the specimen. Light microscopes use visible light. Therefore, the ***compound light microscope*** magnifies through two lenses, the eyepiece and the objective lens, using visible light. 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.

Another name you should know: **specimen** or **object**

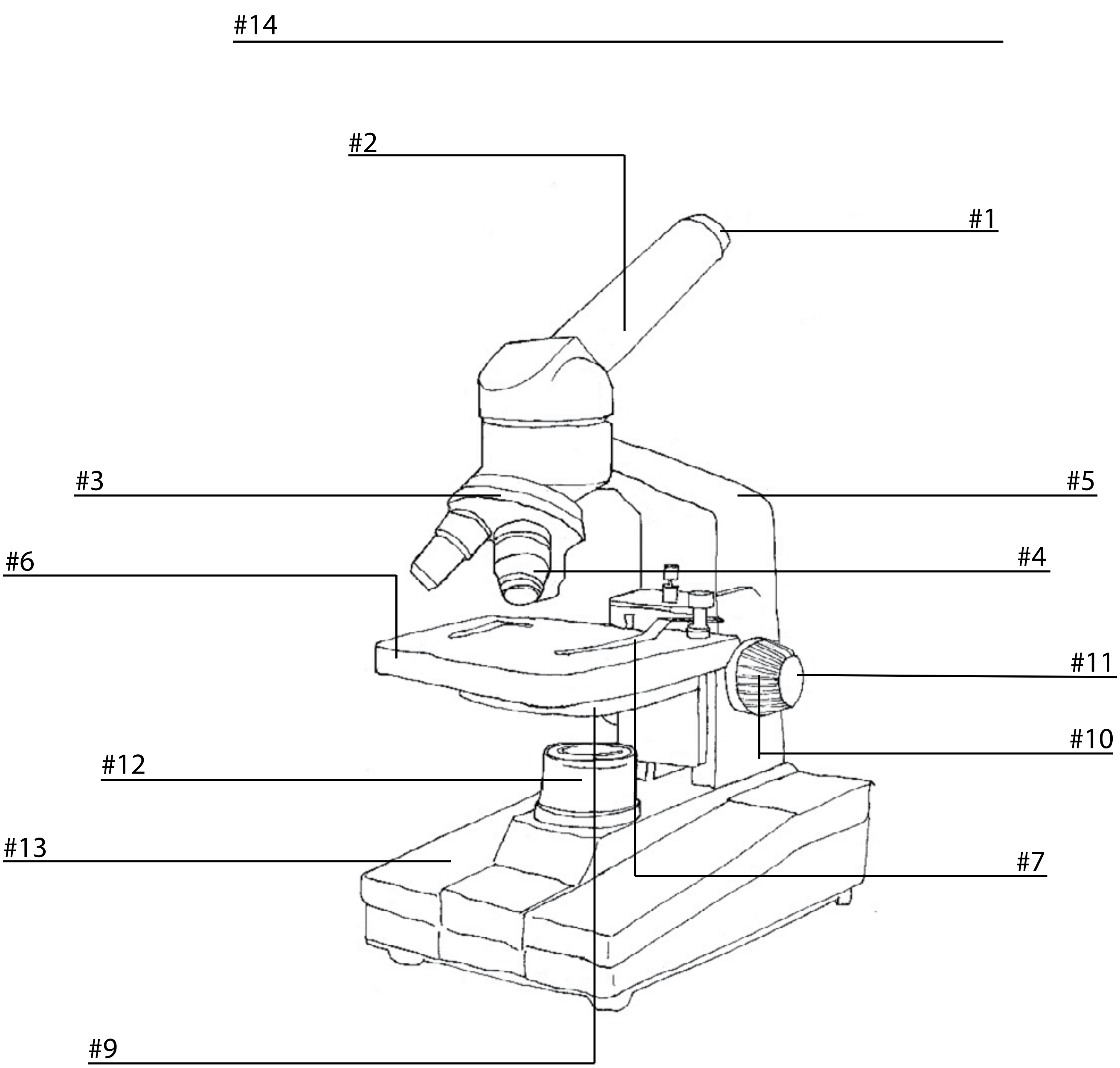
The ***specimen*** or ***object*** is the item being looked at on the slide.

Your Microscope: Parts

Chapter 1: Microscope Lab Sheet

Name________________________________ **Date**_______________

Monocular Microscope



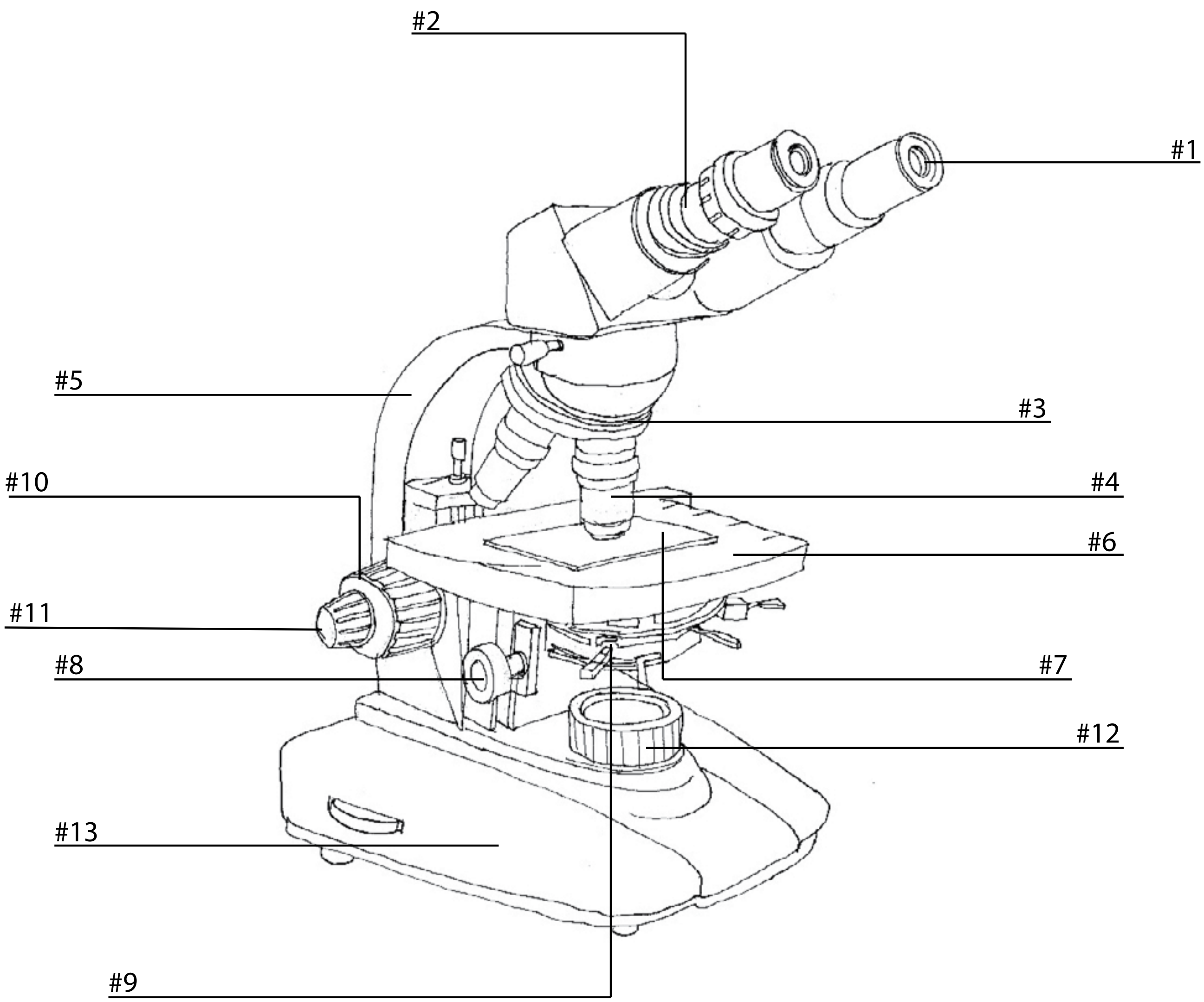
Your Microscope: Parts

Chapter 1: Microscope Lab Sheet

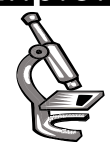
Name_________________________________ **Date**_______________

Binocular Microscope

#14 ____



Explore



Your Microscope: Focus

Chapter 1: Microscope Lab 2

Materials

- Compound light microscope
- 9cm x 4cm piece of smooth white paper with black type printed on it
- Scissors
- X-Acto knife
- Tape
- Slide
- Catalogue with color pictures
- Microscope view sheet
- Pencil with eraser (just in case)
- Piece of cardboard or a cutting mat

Procedure

1. Rotate the nosepiece so that the lowest power objective lens, 40x, will be focused on the specimen, the piece of paper. This is ALWAYS the starting position when you use your microscope. The lowest-power objective lens is the shortest one with the 4 stamped on it.

2. Put the piece of paper that has type onto the stage, using the stage clips to hold it in place. You will not use the slide for this part of the experiment.

3. Turn the coarse focusing knob until the stage has been moved up as close to the objective lens as it will go.

4. Turn on the light for the microscope.

5. Look through the eyepiece. Do not worry about focusing yet. Are you looking at type when you look through the eyepiece? If not, turn the knobs on the stage until you can see the black type. Find a letter and center it. Because there is no slide, you might need to move the paper with your finger.

   ★ **Monocular microscope** – Use the circle and pointer you see through the eyepiece to help center the paper on a letter.

   ★ **Binocular microscope** – Adjust the eyepieces for your eyes. Use the pointer you see through the eyepiece to help center the paper on a letter.

6. Turn the coarse focusing knob while you are looking through the eyepiece. Stop turning the knob at the clearest point.

Chapter 1: Microscope Lab 2 *continued*

7. Adjust the amount of light.
    - ★ **Monocular microscope** – Rotate the disc diaphragm located under the stage to see which of the five holes lets through the optimum amount of light. Hold the microscope with one hand while rotating the disc with the other.
    - ★ **Binocular microscope** – Move the arm on the condenser lens to the position that lets through the optimum amount of light. Also, turn the illuminator knob on the base.
8. Turn the fine focusing knob so that the print is very clear. You should see random dots of overspray from the print.
9. Draw what you see through the eyepiece on the microscope view sheet.
10. Rules for drawing specimens:
    a. Use pencil
    b. Write a title
    c. Write the date that you are drawing the specimen
    d. Label each drawing
    e. Make sure the magnification is correctly labeled
    f. Do your best at drawing the specimen the same size as seen in your field of view. The ***field of view*** is what you see when you look through the eyepiece.
11. Turn the nosepiece so the 100x lens is focused on the specimen. Look at the specimen. Do you still see type? When you look at a higher magnification, you are looking at a smaller overall area. Sometimes the part you are looking at will no longer be in the area seen through the lens. If you don‘t see the type, carefully move the knobs on the stage so the type is seen through the lens.
12. Draw what you see through the eyepiece on the microscope view sheet.
13. Turn the nosepiece so the 400x lens is focused on the specimen. Look at the specimen. Remember, when you look at a higher magnification you are looking at a smaller overall area. Sometimes the part you were looking at will no longer be in the area seen through the lens. Do you still see type? If not, move the stage until you do. What you will also see at this magnification are the fibers making up the paper. You might need to play with the focus to see the paper fibers.
14. Draw the view you see through the eyepiece on the microscope view sheet.
15. Look through the catalogue and find a picture with lots of different colors in it.
16. Cut or tear out this picture.
17. Take the slide and CAREFULLY use the X-Acto knife to cut the picture so that it is the same size as the slide.

Chapter 1: Microscope Lab 2 *continued*

18. Using small pieces of tape, carefully tape the edges of the picture to two ends of the slide. Make sure the picture is flat on the slide. Do not have tape running the length of the slide.

19. Make sure the lowest-power objective lens, the shortest, is focused on the specimen. Put the slide on the stage. Focus and look at the picture with the 40x, 100x, and 400x objective lenses. Play around with the stage knobs to see how they move the slide. Find out how color catalogs are made using only four colors (CMYK = cyan, magenta, yellow, and black). Amazing, isn't it?

20. When you are finished with this lab, remember to
    - Remove the specimen from the stage
    - Turn off the microscope light
    - Cover your microscope
    - Clean off the slide

How to Clean Slides

Slides and slide covers can be cleaned and reused. They are glass and break easily, especially the slide covers, so you need to be careful. To properly clean your slides in this course, you will need: a small dish, dish soap (Dawn is recommended), water, and a place to dry slides.

1. Separate the slide covers and slide.
2. Rinse the specimen and stain off the slide and slide cover.
3. Put a very small amount of dish soap on the slide where the specimen was and rub the slide. Take your soapy fingers and rub the slide cover. If you used the oil immersion lens, make sure you get all the oil off of the slide cover.
4. Rinse off the soap. Make sure you get all the soap off the slide and slide cover.
5. Set them out to dry. Or dry with a soft cloth, especially if you have hard water.
6. If any slides or slide covers break, throw them in the trash.

For More Fun:

Check out the drawings you created on the microscope view sheet. How does ink from a pen look different from ink from a printer with a microscope?

"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.

Notes:

- The 1000x oil immersion lens on the binocular microscope is not used in the lab.
- Color print uses CMYK processing. These four colors *reflect* or *absorb* light on the page. But your computer screen *emits* only three colors as light—red, green, and blue light (or RGB).

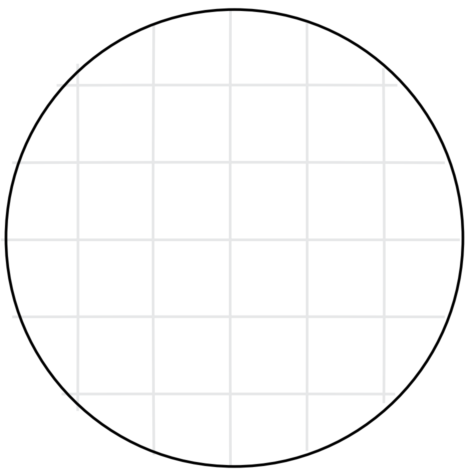
Your Microscope: Focus

Chapter 1: Microscope View Sheet

Name________________________________ **Date**______________

Specimen ____

Type of mount________________________ Type of stain used___________________________________



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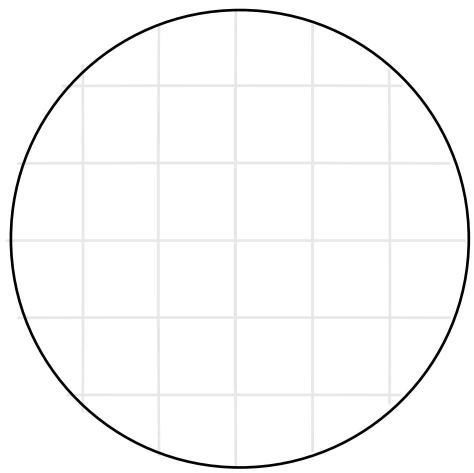
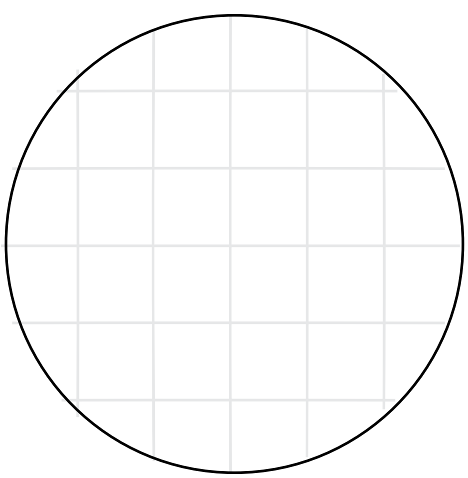


100x



400x

Comments:

Absorb

Polio

Chapter 1: Famous Science Series

The Famous Science Series is a research assignment. Use your computer or library to find the answers to the questions.

Famous Pathogen: Polio (Poliomyelitis virus)

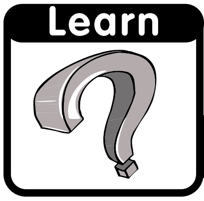
What is polio? How is it transmitted?

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

How long has polio been infecting people?

Which U.S. president had polio? When did he serve as president? How old was he when he contracted polio?

Who discovered the polio vaccine?



All Living Things

Chapter 1: Show What You Know

Fill in the blanks

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

____.

Use the nine characteristics of life in the blanks below:

The penguin eats fish. This is how it takes in ____ .

After it eats fish, it has to get rid of ____.

Laying eggs is part of how the penguin ____.

Penguins ________________________ 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 ____.

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

This penguin is made from many more than one ____.

Penguins get energy from the food they eat. Penguins have ____.

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

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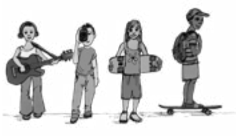
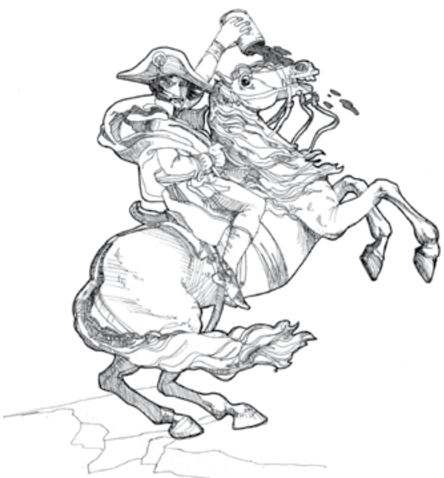


Chapter 2: Types

Explore

Death to the Prokaryotes!

Chapter 2: Lab



In 1795, Napoleon Bonaparte needed to feed the French army while they were on the march. In those days, most armies traveled by walking. The French were at war, and men at war doing all that fighting and walking needed to be well fed. A famous quote of Napoleon's is, "An army travels on its stomach." This means a hungry army doesn't do very well, and a well-fed army does. He was concerned about the quality of the food available to his men. Food spoilage was a major problem in those days. There were no refrigerators. Food was kept safe by salting it, drying it, smoking it, or cooking with sugar. Napoleon wanted something healthier. He offered a prize of 12,000 francs to the person who figured out a better method for preserving food.

In 1809, a French chef named Nicolas Appert claimed the prize. Appert had spent ten years experimenting with a method that eliminated air from containers of food. At that time, people thought air caused food to spoil, which is why Appert's method focused on eliminating it. Appert discovered that if you heat jars with a cork tightly sealing the jar to make it an airtight container, the cork will form an airtight seal and the food will not spoil. Appert is considered the "father of canning." If you have ever eaten food that comes out of a jar or a can, you have eaten canned food.

It was not until 50 years later that the famous scientist Louis Pasteur determined the true cause of spoilage. It was not the air. The cause of the spoilage was microorganisms in unsterilized foods. One major type of microorganism that causes spoilage is bacteria, which are prokaryotes.

The experiment you are performing today deals with the area of biology referred to as food safety. Food safety is as important today as it was in Napoleon's day. Unless you eat food fresh from scratch every time you eat, you eat food that has been preserved, most likely by someone you do not know. Every so often, you hear in the news about a food processing plant that has not been careful about following all the steps needed to keep the food they sell safe. Today you are going to learn what some of those steps are.

In this lab, you are going to can applesauce. The process of sterilizing food in containers using heat is called canning, even when you use a jar. You will be using a similar method to that developed by Nicolas Appert. The equipment used has changed quite a bit, but the method hasn't changed much since it was developed over 200 years ago. Microorganisms, which are invisible to the naked eye, are all around you and on the food you eat. Many of them, like those in yogurt, are good for you. Some

Chapter 2: Lab *continued*

are harmful. Using heat to destroy microorganisms kills them. When you kill the organisms that cause spoilage, you stop the spoilage from occurring. You will be killing lots of prokaryotes when you heat the applesauce. When the jars are boiled, air is forced out of the jar and a vacuum seal forms between the lid and the jar. This prevents new microorganisms from entering and contaminating the food. Sterilizing the contents of the jars takes time. It does not take very long to force the air from the jars, but it takes several minutes of boiling to kill certain strains of bacteria. One sample will not go through the sterilization process, so you can see what happens to unsterilized applesauce. Do you think it will spoil? What will happen to the applesauce that is sterilized? Let's experiment and find out.

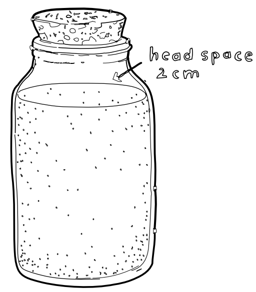
Materials

- Two ½ pint canning jars
- Two unused rings and lids that fit the jar
- Hot water, for washing the jars and lids before use
- Dish soap
- 1 kg 500g (1½ kg) apples (any variety works). This looks like a lot of apples, but it isn't. DO NOT use bruised, old, or rotting fruit.
- Knife
- ½ cup sugar (optional)
- Apple peeler
- Cutting board
- Tall pot, tall enough for the jars + 8 cm (3 in) of water + some room above that so the water does not boil over
- Lid for pot (optional)
- Pot for cooking applesauce
- Plastic container with lid
- Cooking source
- Wooden spoon
- Food processor or blender for smooth applesauce (optional)
- Potato masher for less chunky applesauce (optional)
- Permanent marker
- Timer

Procedure

1. Wash the jars, rings, and lids with warm, soapy water. Rinse them well and set them aside.
2. Wash and peel the apples. Cut away any bruises you see. Chop the apples, discarding the apple cores with their seeds.
3. Put the apples and sugar (if using) into a pot on your stove. Turn the burner to medium. Set the timer for 20 minutes. Stir occasionally. Do not let the bottom scorch. The heat of stove burners varies; therefore cooking times vary. The apples in the applesauce should be soft when the applesauce is done.
4. Take a small sample of applesauce, let it cool and taste it, and make sure there is enough sugar. Add a little more sugar if necessary. When the apples have softened, turn off the heat. Let the apple mixture cool until it is cool enough for you to spoon into the jars.

Chapter 2: Lab *continued*



5. Use the potato masher to mash the applesauce until it has very few chunks. If you want applesauce that has no lumps, you can put this mixture into a food processor or blender, and process until it is smooth.

6. Fill the two jars with applesauce. It is VERY important you leave headspace in the jar. Headspace is air between the top of the jar and the product being canned. Make sure there is 2 cm, a little less than 1 in, headspace between the top of the jar and the applesauce.

7. Wipe the rim of the jars. Set the lid onto the jar and screw the ring over the top of the lid.

8. Take ¼ cup of the applesauce and put it into the plastic container. Set the cover on the container but do not seal the container. This applesauce will sit loosely covered, until it begins to go bad. Once it starts to spoil, you will be looking at lots of microorganisms. You cannot see just one; there have to be lots for you to see them. Do not eat this now or at any time. There is a range of time this will take to spoil. If you live somewhere warm and humid, the applesauce will spoil quickly. If you live somewhere cool and dry, the applesauce will take longer to spoil.

9. The rest of the applesauce is for you to eat today.

10. Put the two jars into a pot. Fill the pot with water so that the water is 8 cm above the top of the jars. Put a lid on the pot. Turn the heat up to high. When the water boils, set your timer for 30 minutes. You can turn the heat down, but make sure the water continues to boil.

11. After 30 minutes has elapsed, turn off the heat. The jars and water are VERY hot right after the canning process is complete. When the water has cooled, take the jars out of the water. Press lightly on the tops of the lids. The lids should feel tightly sealed.

12. Dry the jars.

13. With a permanent marker, write the date that is two weeks away on one of the jars and the date that is two months away on the other jar. Those are the dates you get to open and eat your applesauce. You have preserved it and killed a whole lot of prokaryotes in the process, so it will be okay to eat.

14. Complete the lab sheet.

15. When you are ready to eat the applesauce, make sure the lids are still vacuum-sealed. If they are not, DO NOT eat the applesauce. That means the applesauce has spoiled.

Preparation for the next lab: Soak a cork in water the night before.

Death to the Prokaryotes!

Chapter 2: Lab Sheet

Name______________________________ **Date**______________

There are several steps in the canning process that need to be followed to make sure canned food is safe. Explain the danger to food safety at each of the following steps if the proper procedure was not followed.

If old or rotting apples were used . . .
If bruises were not cut from the apples . . .
If the jars, rims, and lids were not clean . . .
If the seal between the jar and rim was not tight . . .
If the applesauce was not cooked as long as it should have been . . .

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Explore

Discovering Cells

Chapter 2: Microscope Lab

*** Lab preparation: Soak the cork in water the night before performing this lab.**

Robert Hooke

In 1665, Robert Hooke cut a very thin slice from a piece of cork. Then he put the cork under a compound microscope that he made. Looking through his microscope, he saw tiny boxlike structures that reminded him of monk's cells, the living quarters of monks. That is how cells were discovered and named.

The cork cells that he saw were dead cells. For that reason, he did not see a nucleus, cell membrane, cytoplasm, or genetic material. He saw the cell wall that surrounds plant cells and gives plants their structure, even after the cells have died.

In this experiment, you will take a thin slice of cork and look at it under your microscope. Through the lens of your microscope, you will "discover" cells, just as Robert Hooke did over 300 years ago.

You will make a wet mount slide. Wet mount slides are made with a slide, a specimen, a little bit of water, and a slide cover. The water fills up the space between the slide cover and the slide, this allows light to pass more easily through the prepared slide. Many types of specimen look better with wet mount technique.

Materials

- Compound light microscope
- Slide
- Slide cover (glass is preferred over plastic)
- Optical lens wipes
- Bottle Cork
- X-Acto knife with new blade
- Cutting board
- 1 cc syringe, without the needle (optional, but very handy when making wet mount slides)
- Glass
- Water
- Tweezers with pointed tips, optional

Procedure

How to Prepare a Wet Mount Slide

★ Do not let wet mount slides sit too long after they have been prepared. They will dry out.

★ Make sure your slide and slide cover are clean with no fingerprints or other smudges. Slides and slide covers should be handled on the sides to avoid this.

Chapter 2: Microscope Lab *continued*

1. Take the cork out of water. Slice as thin a slice of cork as you can. Be VERY CAREFUL when making these slices so you do not cut yourself. The slice does not need to be very big around. You are going to look at it under a microscope. The slice I used was .3 cm by .15 cm. Make several slices. You will get better making thin slices with some practice. If the cork is too thick, you will not have a good clear view of the cells. For the best view, the light from the base of the microscope needs to shine through the cork.

2. When you have a cork slice you are satisfied with, put it on the slide.

3. Syringe up about 4 ml of water. One drop at a time, drip water onto the cork on the slide. One to two drops should be enough. Make sure the cork does not float off the slide. Do not put on too much or too little water. The more slides you make the better you will get at judging the amount of water to put on the slide. Be careful to keep the specimen on the slide and under the slide cover with very little to no visible air. Do not worry about it being off center a bit.

4. Put the slide cover on, being careful not to make fingerprints. You want to have the slide cover on the slide with no, or very few, air bubbles. Do not worry about water squishing out of the slide cover at this point. If air bubbles are visible under the slide cover, take the cover off, drip one or two more drops of water onto the slide and put the cover back on. Squeeze all the water out of the syringe into the glass of water. Very carefully, so you do not break it, press on the slide cover with the end of the syringe to try to squeeze the air out. If this doesn't work, you may need to shave a thinner slice of cork. Either that, or try thinning the slice you are working with.

5. If water has leaked out from under the slide cover, put the end of a paper towel on the water so that the paper towel passively soaks up the water. Do not let it soak up all the water from under the slide cover, though. Make sure there is no water on the bottom of your slide.

Viewing the Slide

★ Warning: You need to be very careful when rotating and focusing the higher-magnification objective lenses. The objective lenses can break the slides if they are focused down too hard; even worse, you could damage the objective lens. Just pay attention and always start with the 40x objective lens when you are focusing on a specimen.

6. Rotate the nosepiece so that the lowest-power objective lens, 40x, is focused on the stage.

7. Put the cork slide onto the stage using the stage clips to hold it in place. To do this: Pull back on the lever on the right stage clip, then put the slide resting against the bottom corner of the left side stage clip. With your finger, carefully let the right side stage clip close to hold the slide in place.

8. Turn on the microscope light. Use the knobs on the stage to move the specimen into the circle of light coming from the illuminator up through the specimen. Take your eyes away from the microscope and slowly move the slide with the knobs on the stage. Notice that when you do this the slide moves in the opposite direction you would expect. This is called ***microscopic inversion***.

Chapter 2: Microscope Lab *continued*

9. Look through the eyepiece:
   A. Center the specimen.
   B. Turn the coarse focusing knob while you are looking through the eyepiece. Stop turning the knob at the clearest point for this knob.
   C. Adjust the amount of light using either the diaphragm or the condenser lens.
   D. Refocus with the coarse focusing knob.
   E. Focus with the fine focusing knob.

10. You should see the cork cells clearly. If you have a very small specimen, you might see all of it. Look over the specimen. Find the part that looks like the thinnest slice; this is where the most light is getting through the sample. You might need to move the stage knobs to move the cork. Check for air bubbles. Move away from air bubbles; they interfere with your view. If the thinnest part of the cork is also the part with air bubbles, you might want to work with the slide some more. Possibly make a thinner slice from the cork or take off the cover and add more water.

11. Draw what you see through the eyepiece on your microscope view sheet. Your view will have many similar-looking cells:
    - Draw the entire outline of the specimen, if the specimen does not take up the entire field of view.
    - Draw a few of the cells.
    - Note on your view sheet that the rest of the inside of the specimen looks like what you have already drawn.

12. Turn the nosepiece so the 100x lens is focused on the specimen. Look at the specimen. Do you still see cork? When you look at a higher magnification, you are looking at a smaller overall area. Sometimes the part you are looking at will no longer be in the area seen through the lens. If you don't see the cork, move the stage knobs so the lens is centered on the cork. Use the focusing knobs so that the cork is at its clearest.

13. Draw the view through the eyepiece on your lab sheet. Use the same strategy you used at 40x.

14. Turn the nosepiece to the 400x lens and repeat the above procedure.

Finishing Up

15. When you are finished with this lab, remember to
    - Remove the specimen from the stage
    - Turn off the microscope light
    - Cover your microscope
    - Clean off the slide and slide cover

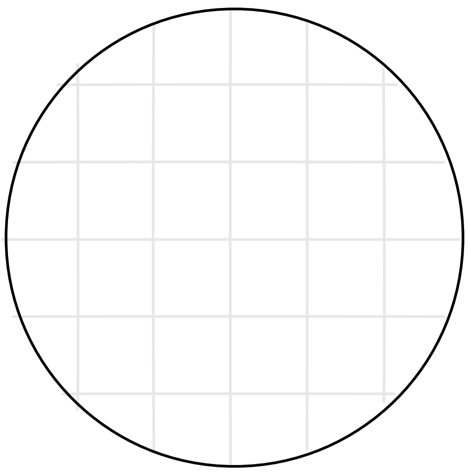
Discovering Cells

Chapter 2: Microscope Lab Sheet

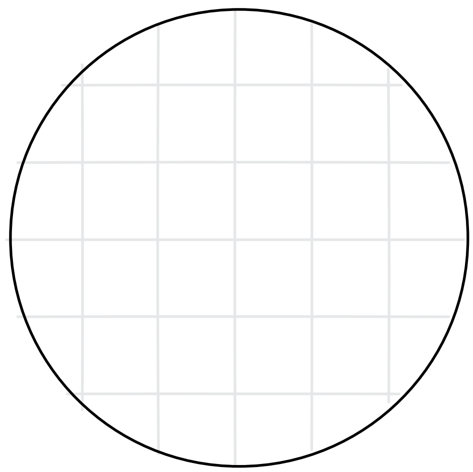
Name________________________________ **Date**______________

Specimen ____

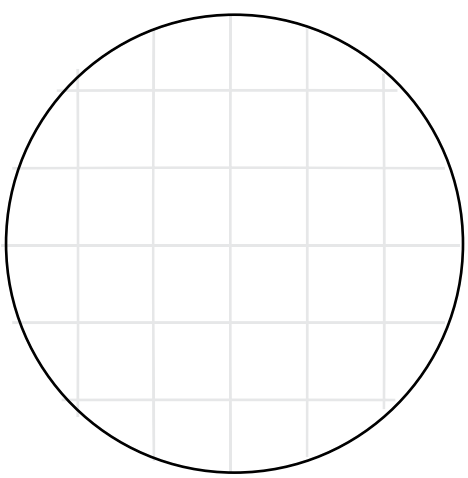
Type of mount___________________ Type of stain used____________________________



40x



100x



400x

Comments:

Absorb

Antonie van Leeuwenhoek

Chapter 2: Famous Science Series

Father of Microbiology: Antonie van Leeuwenhoek [LAYU-wen-hook]

Why is Antonie van Leeuwenhoek famous? What did he discover? What did he use to discover them?

Antonie van Leeuwenhoek

When and where was he born?

When did he die?

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

It has been speculated that the Dutch painter Johannes Vermeer used optical aids produced by van Leeuwenhoek. How would these have helped Vermeer?

How many microscopes did van Leeuwenhoek make? What happened to them?

Learn

Types

Chapter 2: Show What You Know

Multiple Choice

1. A shark is made from

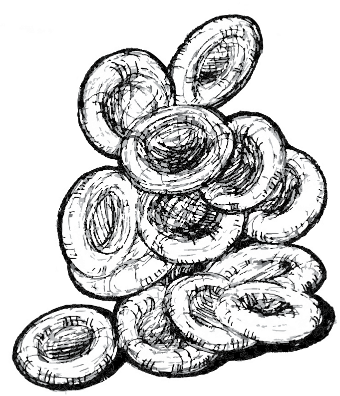
○ prokaryotic cells
○ eukaryotic cells
○ prokaryotic and eukaryotic cells
○ I need more information

2. The bacteria that causes strep throat are made from

○ prokaryotic cells
○ eukaryotic cells
○ prokaryotic and eukaryotic cells
○ I need more information

3. The basic unit of structure and function of an organism is called

○ a prokaryote
○ an eukaryote
○ a cell
○ an amoeba



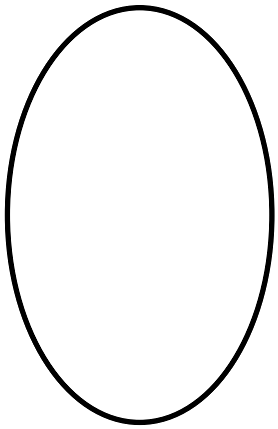
4. Unicellular organisms are

○ all prokaryotes
○ all eukaryotes
○ prokaryotes and eukaryotes

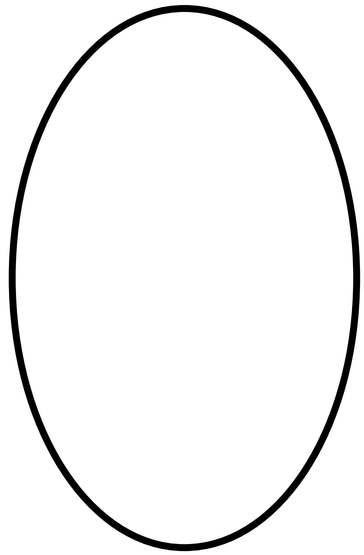
Chapter 2: Show What You Know *continued*

Draw

5. Draw and label the cell membrane, the cytoplasm, and the genetic material. Draw the nucleus, where applicable.



Prokaryotic Cell



Eukaryotic Cell

Fill in the Blanks

The ____________________ theory states . . .

6. Every _________________ is made of one or more ________________ .

7. ______________________ come only from other living _____________ .

8. ______________________ are the basic unit of _________________ and ______________________ needed to support ____________________ .

Question

9. What famous scientist coined the term *cell*? Why didn't he see a nucleus, cell membrane, cytoplasm, or genetic material?

Chapter 2: Show What You Know *continued*

10. Match the word with the best definition.

Unicellular	many-celled
Cell	a jelly-like material inside all cells
Cell membrane	genetic material, deoxyribonucleic acid
Cytoplasm	one-celled
DNA	an organism whose DNA is located in the cytoplasm
Eukaryote	the basic unit of life
Multicellular	an organism whose DNA is located inside the nucleus
Prokaryote	encloses and protects the inside of the cell

Chapter 10: Your Inheritance

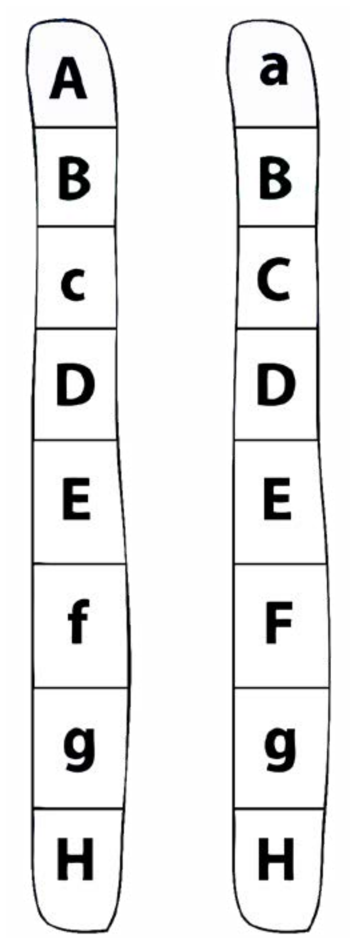
Read

What Makes You You?

Chapter 10: Lesson Activity

The following coloring activity is found in Chapter 10 Lesson in your Textbook.

Homologous Chromosomes



1. Each segment is a gene. The genes come in pairs, one on each homologous chromosome.
2. The set of all the genes in an organism is their genotype. An organism's genotype has all their alleles.
3. Phenotype is the appearance and chemical makeup of an organism. Brown eyes and sickle cell anemia are both examples of phenotype. An organism's phenotype is determined by its genotype.
4. Letters are used for alleles. The same letters are used for alleles of the same gene. Different letters are used for different genes. A and a are alleles of each other but B is not. Color the alleles the same color, different from the others. For example, A and a are the same color as each other but not the same color as B and B, which are the same color as each other.
5. When two alleles are written exactly the same, the organism is homozygous for that allele. The chromosome pair is homozygous for the BB alleles. Write "ho" between the homozygous alleles.
6. When the two alleles are written differently, the organism is heterozygous for that allele. This chromosome pair is heterozygous for the Aa alleles. Write "hz" between the heterozygous alleles.
7. Alleles can be dominant or recessive. Uppercase letters are used to show an allele is dominant. Lowercase letters are used to show an allele is recessive.
8. A dominant allele is one that is expressed in the phenotype even if there is only one copy of it present in the genotype. Write a "D" next to hz or ho, if a dominant allele is in the pair.
9. A recessive allele is one that is expressed in the phenotype only if there are two copies of it present in the genotype. Write an "r" next to "ho" if there is a pair of recessive alleles in the pair.

Family Traits

Chapter 10: Lab

Blood-related members of a family inherit a unique set of genes. Members of the same family also share some genes. For this lab, you will be filling out a questionnaire for yourself and your family members. If you are adopted or otherwise don't have access to your own blood-related family members, then complete this lab with another group of blood-related individuals choosing one member to represent "Me" on the lab sheets. You are going to interview members of the family, asking them about their phenotype for different traits. Using the phenotype, you will be able to determine the genotypes of the family for these traits. In the case of a dominant trait that is present in the family, you might only be able to determine that the family members are heterozygous dominant or homozygous dominant for the trait. In some cases an exact genotype can be determined using family members. For example, a non-tongue-rolling mother and a tongue-rolling father can only have a non-tongue-rolling child *if* the father was heterozygous for this trait because tongue-rolling is dominant over non-tongue-rolling. The father must have passed his allele for non-tongue-rolling to his offspring.

Materials

- Blood-related family members to interview (The more the better. There's space on the chart for up to 6 family members including "Me.")

Procedure

1. Fill in the questionnaire for yourself and several of your blood-related relatives, or for another group of blood-related members if you are unable to interview yours. The more relatives you interview, the more accurate the results will be.

2. When you have finished the questionnaire, complete the Who Shares the Good Looks? worksheet. For each relative, write their relationship to you (or to the person you've chosen to be the "Me" in this lab), e.g., mother, grandfather, sister, etc. For each phenotype, write each relatives' genotype. For example, if you have light blue eyes and your mother has brown eyes, write eeeeeeee for your eye color genotype, and EEEEEEEe for your mother's.

3. Look at the traits you have listed as either homozygous dominant or heterozygous recessive on the worksheet. Do you have enough information to determine whether you or your relative is one or the other? For example, if you can't roll your tongue but both your parents can, then you will know that they each carry the recessive allele. So their genotype must be Rr in order for yours to be rr.

Chapter 10: Lab *continued*

4. Check the box for each genotype that matches yours for dominant or recessive. These are the relatives who share traits with you, and in some cases where you got your good looks. For example:

	Me	Relative 1	Relative 2	Relative 3	Relative 4	Relative 5
	Jake	*Mom*	*Mike*	*Uncle Terry*	*Grace*	*Dad*
Relationship	*Myself*	*Mother*	*Cousin (Dad's side)*	*Mom's brother*	*Sister*	*Father*
Phenotype			**Genotype**			
Tongue Rolling	*rr* ☐	*rr* ☑	*Rr or RR* ☐	*rr* ☑	*Rr* ☐	*Rr* ☐

Phenotype Descriptions and Instructions

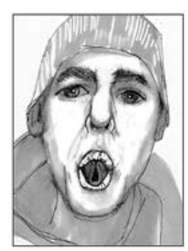
Blood Type. You inherit the type of blood you have from your mother and father. Here is a Punnett square showing how it works:

blood type allele	A	B	O
A	AA	AB	AO
B	BA	BB	BO
O	OA	OB	OO

AA = blood type A
AB and BA = blood type AB
AO and OA = blood type A
BB = blood type B
BO and OB = blood type B
OO = blood type O

Eye Color. The genes that code for eye color are on four different chromosomes. Therefore there are eight alleles for eye color (4 x 2). These are represented by E and e on your questionnaire. The number of genes that code for eye color leads to the amount of variability of eye color found in humans. The eye colors on your questionnaire are listed in order of their dominance, starting with black as the most dominant and ending with blue as the most recessive.

Tongue Rolling. Can you roll your tongue into a tube shape? The ability to tongue-roll is controlled by a dominant allele, R. People who are tongue-rollers have at least one copy of the dominant, R, allele. They are either homozygous dominant, RR, or heterozygous dominant, Rr, for this trait. People who are not tongue rollers are homozygous recessive, rr, for this trait.



Rr or RR

Widow's Peak. Push your hair back off your forehead and look in a mirror. If your hairline has a V at the top of your forehead, you have a widow's peak. People with a widow's peak have the dominant phenotype for this trait. People with a straight hairline have the recessive phenotype for this trait.

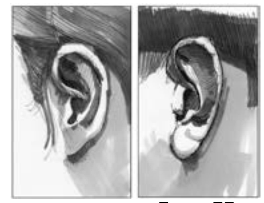
Ww or WW

Chapter 10: Lab *continued*

Freckles. Freckles are controlled by the dominant gene F. If you do not have freckles, you are homozygous recessive for them, ff. (Sun freckles do not count.)

Dimples. Do you have dimples? They may be cute but a dimple is actually an anomaly of face muscle that causes a dent in the cheek, especially when smiling. Dimples are a dominant trait (Dd or DD).

Detached Earlobes. Are you lobeless or do you have earlobes? If your earlobes are detached from the side of your face, you have free ear lobes, which is the dominant trait. If your earlobes are attached to the side of your face, you are lobeless, and are homozygous recessive for this trait, ee.



ee   **Ee or EE**

Hair Color. Hair color, like eye color, comes over a broad range. Hair color is controlled by three different chromosomes (six alleles). The alleles for dark hair color are dominant over the alleles for light hair color. The lighter someone's hair is, the more recessive hair color alleles that person has.

Hair Texture. The dominant phenotype for hair texture is straight. People with curly hair have the recessive phenotype.

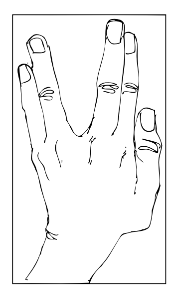
Wears Glasses. Good eyesight is dominant over impaired eyesight. If you wear glasses or contacts, you have the recessive phenotype.

Straight Teeth. Straight teeth are dominant over crooked teeth. Make sure and ask your older relatives if they have always had straight teeth; braces have been around a long time.

Hairy Fingers. Your fingers have three segments. Look at the middle segment to see if hair is growing on it. Hair growth on this part of your finger is a dominant phenotype.

Short Big Toe. Is your big toe shorter than the second toe that is right next to it? A longer second toe is a dominant phenotype. If the big toe is longer or the same length as the second toe, you have the recessive phenotype.

Vulcan Sign. Can you make the Vulcan sign (pictured at the right)? If you can, you and Mr. Spock have something in common. You both have the dominant phenotype for this trait.



Vv or VV

Top Thumb. Clasp your hands together. Which thumb is on top, on the outside closest to you? The dominant phenotype is to have the left thumb on top. I bet you didn't know that was an inherited trait!

Family Traits Questionnaire

Chapter 10: Lab Sheet

Name______________________________ Date______________

Phenotype	Genotype	Me ________	Relative 1 ________	Relative 2 ________	Relative 3 ________	Relative 4 ________	Relative 5 ________
Blood Type		A	A	A	A	A	A
		B	B	B	B	B	B
		O	O	O	O	O	O
		AB	AB	AB	AB	AB	AB
Eye Color	EEEEEEEE	black	black	black	black	black	black
	EEEEEEEe	brown	brown	brown	brown	brown	brown
	EEEEEEee	hazel	hazel	hazel	hazel	hazel	hazel
	EEEEEeee	gray	gray	gray	gray	gray	gray
	EEEEeeee	amber	amber	amber	amber	amber	amber
	EEEeeeee	blue green	blue green	blue green	blue green	blue green	blue green
	EEeeeeee	green	green	green	green	green	green
	Eeeeeeee	dark blue	dark blue	dark blue	dark blue	dark blue	dark blue
	eeeeeeee	light blue	light blue	light blue	light blue	light blue	light blue
Tongue Rolling	Rr, RR	yes	yes	yes	yes	yes	yes
	rr	no	no	no	no	no	no
Widow's Peak	WW, Ww	yes	yes	yes	yes	yes	yes
	ww	no	no	no	no	no	no
Freckles	FF, Ff	yes	yes	yes	yes	yes	yes
	ff	no	no	no	no	no	no
Dimples	DD, Dd	yes	yes	yes	yes	yes	yes
	dd	no	no	no	no	no	no

Chapter 10: Lab Sheet *continued*

Phenotype	Genotype	Me ________	Relative 1 ________	Relative 2 ________	Relative 3 ________	Relative 4 ________	Relative 5 ________
Detached Earlobes	EE, Ee	yes	yes	yes	yes	yes	yes
	ee	no	no	no	no	no	no
Hair Color	HHHHHH	black	black	black	black	black	black
	HHHHHh	brown	brown	brown	brown	brown	brown
	HHHHhh	light brown	light brown	light brown	light brown	light brown	light brown
	HHHhhh	auburn	auburn	auburn	auburn	auburn	auburn
	HHhhhh	red	red	red	red	red	red
	Hhhhhh	dark blond	dark blond	dark blond	dark blond	dark blond	dark blond
	hhhhhh	blond	blond	blond	blonde	blonde	blonde
Hair Texture	AA, Aa	straight	straight	straight	straight	straight	straight
	aa	curly	curly	curly	curly	curly	curly
Wears Glasses	GG, Gg	no	no	no	no	no	no
	gg	yes	yes	yes	yes	yes	yes
Straight Teeth	TT, Tt	yes	yes	yes	yes	yes	yes
	tt	no	no	no	no	no	no
Hairy Fingers	HH, Hh	yes	yes	yes	yes	yes	yes
	hh	no	no	no	no	no	no
Short Big Toe	BB, Bb	yes	yes	yes	yes	yes	yes
	bb	no	no	no	no	no	no
Vulcan Sign	VV, Vv	yes	yes	yes	yes	yes	yes
	vv	no	no	no	no	no	no
Top Thumb	TT, Tt	left	left	left	left	left	left
	tt	right	right	right	right	right	right

Who Shares the Good Looks?

Chapter 10: Lab Sheet

Name: ______________________________ Date: ________________

	Me	Relative 1	Relative 2	Relative 3	Relative 4	Relative 5
	________	________	________	________	________	________
Relationship						
Phenotype	Genotype					
Blood Type						
Eye Color						
Tongue Rolling						
Widow's Peak						
Freckles						
Dimples						
Detached Earlobes						
Hair Color						
Hair Texture						
Wears Glasses						
Straight Teeth						
Hairy Fingers						
Short Big Toe						
Vulcan Sign						
Top Thumb						

Phenotype Under the Scope

Chapter 10: Microscope Lab

What do you think different-colored strands of hair will look like under the microscope? Will you be able to see why they are differently colored from one another? Today you will find out. You need to collect strands of human hair in as many colors as possible. The hairs do not need to be long, just different colors. Try to get strands of hair that have not been artificially colored. You might include one strand that has been dyed and one that has been bleached, but you do not need more than that. This lab looks at phenotype. When you are looking at chemically processed hair, you are not seeing phenotype; you are looking at a chemical process. Try to get two hairs from someone who is going gray. Get one hair from your graying subject that has not turned silver yet and one that has, examine the difference.

Materials

- Hair strands in different colors
- Slides (same number as strands of hair)
- Slide covers
- Scissors
- Tape
- Syringe
- Water
- Metric ruler
- Microscope

Procedure

1. Cut one strand of hair 3 cm long. Lay the cut piece of hair across a slide lengthwise. Tape the very ends of the hair with two small pieces of tape. Drip water along the hair. Cover with a slide cover. Look at it under the microscope. Leave this slide intact as a reference.

2. Repeat the procedure for each piece of hair, mounting each on its own slide.

3. Draw a view of a strand of your own hair at your favorite magnification on the Microscope Lab Sheet.

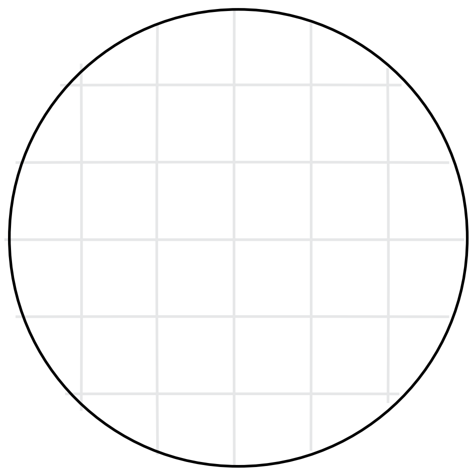
Phenotype Under the Scope

Chapter 10: Microscope Lab Sheet

Name________________________________ Date______________

Specimen__________________________ Type of Microscope _______________________________

Type of Stain______________________ Magnification ____________________________________



1. Describe what makes hair different in color.

2. What did you notice about the gray versus the colored strand of hair from the same person?

3. If you include bleached and/or dyed hair, what did you notice different about it?

Additional Comments:

Absorb

Gregor Mendel

Chapter 10: Famous Science Series


Gregor Mendel

Father of Modern Genetics

When and where was Gregor Mendel born?

What did Mendel do so that he could continue his education?

What is the blending theory of inheritance?

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

What seven traits did he study in these plants?

1.

2.

3.

Chapter 10: Famous Science Series *continued*

4.

5.

6.

7.

Did Mendel prove or disprove the blending theory of inheritance?

What two laws did Mendel discover?

1.

2.

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?

Was Mendel famous in his lifetime?

Explore

Make Your Own Qwitekutesnute

Chapter 10: Activity

Gregor Mendel formulated two laws of science based on his research data: the Law of Segregation and the Law of Independent Assortment. The ***Law of Segregation*** states that allele pairs separate (segregate) during meiosis when gametes form. When a cell goes from being diploid, with two sets of paired homologous chromosomes, to haploid, with only one set of chromosomes, the allele pairs on each chromosome separates. The ***Law of Independent Assortment*** states that allele pairs assort independently of one another during gamete formation.

Even organisms from the Island of Mythical Creatures reproduce using Mendelian genetics. When qwitekutesnutes have offspring, the allele pairs of the parents separate, following the Law of Segregation. The allele pairs separate independently of one another, following the Law of Independent Assortment. When the alleles from the mother and father pair during fertilization, the dominant phenotype will be expressed even if only one copy of the dominant allele is present.

Qwitekutesnutes have 12 different traits that have been identified (unless you add one more that you have identified during the course of your research). You are going to cut (segregate) the allele pairs of each parent found on the Qwitekutesnute Traits sheet into separate cards. You will flip a coin to determine independently which allele from each parent the offspring receives. You will do the same to determine the gender of your qwitekutesnute.

Materials

- Scissors
- Coin
- Colored pencils or markers

Chapter 10: Activity *continued*

Procedure

1. Both Qwitekutesnute Traits sheets have 12 traits listed, plus the sex chromosomes. There is one blank row of squares at the bottom of each sheet, so that you can add traits of your own if you want. If you add traits, choose one choice for that trait and write them into the squares next to each other. If you add traits, decide which allele is dominant and which is recessive.

2. For both sheets, cut out the first row of rectangles. Turn them over and put them next to each other. Make sure you keep the male and female cards separate. Cut out the second row of squares and turn them over. Put them next to each other below the first set of squares. Do this for all the traits and the gender-determination squares.

3. Go down the rows choosing the traits. You do this by flipping the coin. Heads means the trait on the top is the one your qwitekutesnute has. Tails means the trait on the bottom is the one your qwitekutesnute has. Do this for both the male and female cards. As you choose each of one of the two choices, put it on the qwitekutesnute template. You will have one choice from the male and one from the female for a total of two squares for each trait. You will draw the phenotype for that trait on the Qwitekutesnute Template.

4. Each trait has a dominant and a recessive allele. Look for a D or an r written in the bottom right hand corner of each card. If you choose one to two cards with the dominant allele, the qwitekutesnute has the dominant trait. If you choose two recessive alleles, the qwitekutesnute is homozygous recessive for the trait and has the recessive trait.

5. Draw each trait in the following order. The choices for each trait are:

   - Small-body size (3 kilograms) or large-body size (5 kilograms). Choose the correct body-size template, large-bodied or small-bodied.
   - Big fluffy tail or a thin short tail, add the tail to your qwitekutesnute.
   - Stars or stripes, qwitekutesnutes come in two fur patterns. Draw the fur pattern on the template.
   - Spiked hair or ear tufts, qwitekutesnutes have two possible hairstyles that are genetically controlled. Draw the hairstyle on the template
   - A male qwitekutesnute has an X and a Y chromosome. A female qwitekutesnute has two X chromosomes. You cannot tell a male and female qwitekutesnute apart by looking at them. Male qwitekutesnutes have boy names and female qwitekutesnutes have girl names. Choose a name for your qwitekutesnute based on its gender.
   - Almond-shaped eyes or round-shaped eyes, qwitekutesnutes have almond-shaped eyes or round-shaped eyes. Draw eyes in the appropriate shape on the face of your qwitekutesnute.

Chapter 10: Activity *continued*

- ○ Gray eyes or green eyes, color the eyes of the qwitekutesnute either green or gray.
- ○ 3 toes or 5 toes on their feet, draw either three toes or five toes on each of your qwitekutesnutes' feet.
- ○ 3 fingers or 4 fingers on their hands, draw either three fingers or four fingers on each of your qwitekutesnutes' hands.
- ○ Have a cry that goes Kee-Kee, or one that goes Koo-Koo. Your qwitekutesnute is probably calling to you, telling you it is hungry. They are ALWAYS hungry. Draw a carton bubble above your qwitekutesnute's head and write in the call your qwitekutesnute makes.
- ○ Bushy eyebrows or no eyebrows, if your qwitekutesnute has bushy eyebrows, draw them over its eyes. If it has no eyebrows, do not draw any.
- ○ Qwitekutesnutes can be dark gray, light gray, or white. This is an example of incomplete dominance; neither dark gray nor white alleles are dominant over each other. When a qwitekutesnute is heterozygous for fur color, the two colors mix and they are light gray.
    - 2 dark gray alleles make a dark gray qwitekutesnute
    - 1 dark gray + 1 white allele make a light gray qwitekutesnute
    - 2 white alleles make a white qwitekutesnute
- ○ 4 whiskers on each cheek or 7 whiskers on each cheek, draw either four whiskers or seven whiskers on each side of your qwitekutesnute's face.
- ○ Finish with any traits you added.
- ○ I would love to see your qwitekutesnutes! If you can, please email an image of them to blair@pandiapress.com. (Disclaimer: Your pictures could be used online or in a publication.)

Make Your Own Qwitekutesnute

Chapter 10: Activity Sheet

Female Qwitekutesnute Traits

small-body size, 3 kg r	large-body size, 5 kg D
big fluffy tail r	thin short tail D
stars D	stripes r
spiked hair D	ear tufts r
X	X
almond-shaped eyes r	round-shaped eyes D
gray eyes D	green eyes r
3 toes r	5 toes D
3 fingers D	4 fingers r
says Kee-Kee D	says Koo-Koo r
bushy eyebrows r	no eyebrows D
dark gray	white
4 whiskers r	7 whiskers D

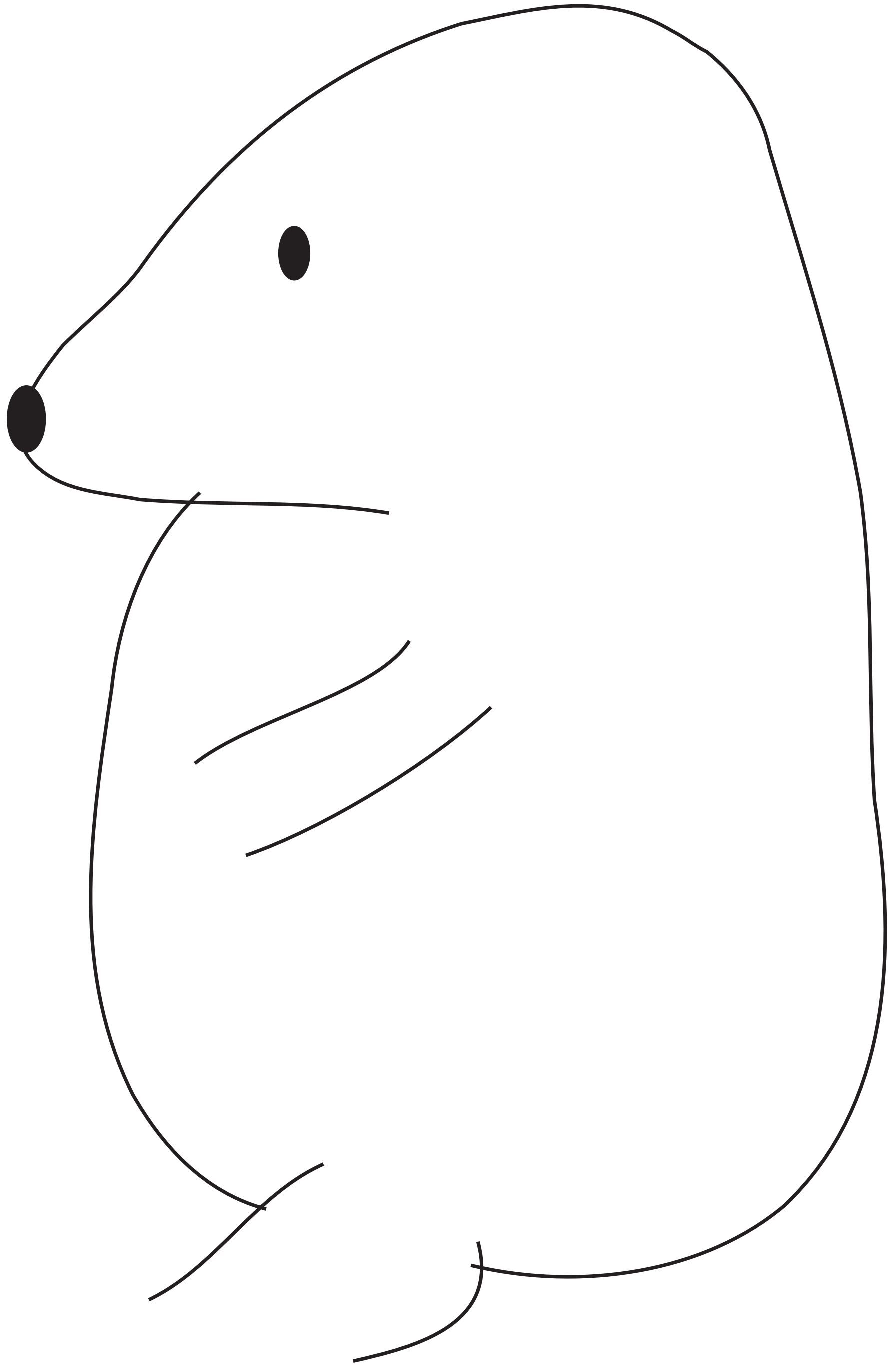
Chapter 10: Activity Sheet *continued*

Male Qwitekutesnute Traits

small-body size, 3 kg r	large-body size, 5 kg D
big fluffy tail r	thin short tail D
stars D	stripes r
spiked hair D	ear tufts r
Y	X
almond-shaped eyes r	round-shaped eyes D
gray eyes D	green eyes r
3 toes r	5 toes D
3 fingers D	4 fingers r
says Kee-Kee D	says Koo-Koo r
bushy eyebrows r	no eyebrows D
dark gray	white
4 whiskers r	7 whiskers D

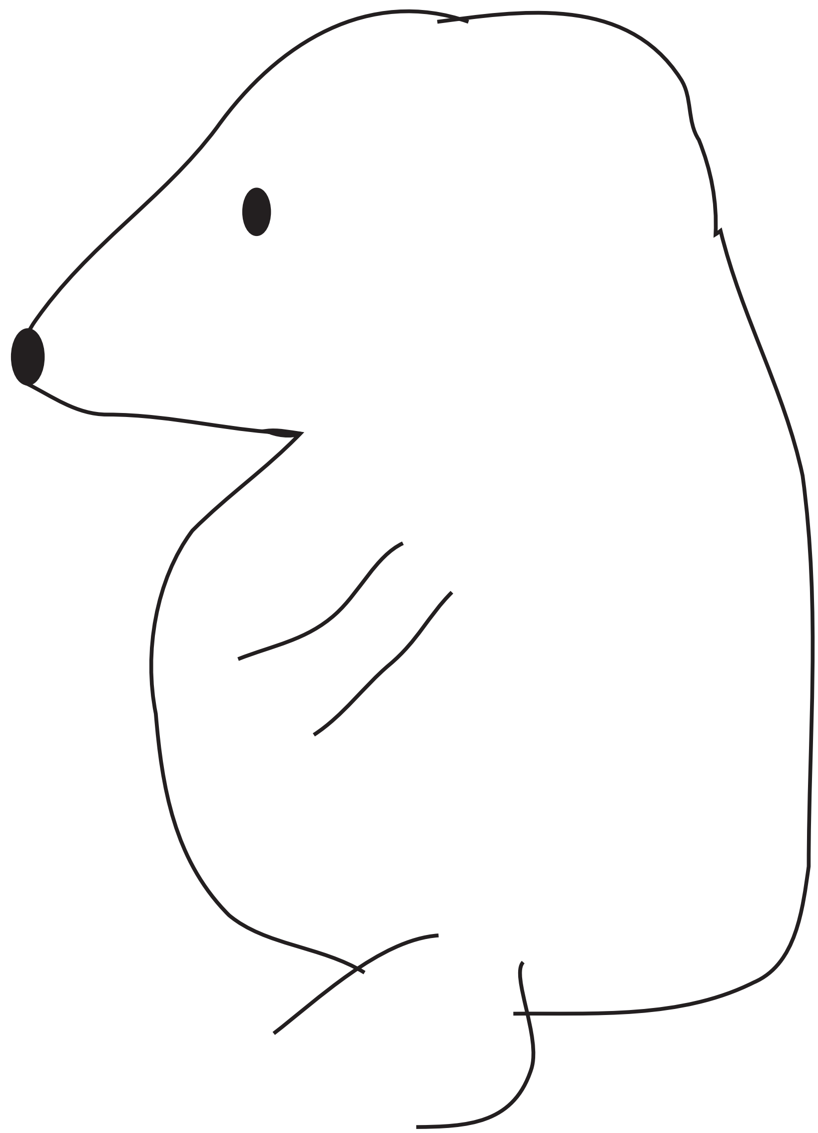
Chapter 10: Activity Sheet *continued*

Large-Bodied Qwitekutesnute



Chapter 10: Activity Sheet *continued*

Small-Bodied Qwitekutesnute



Learn

Inheritance

Chapter 10: Show What You Know

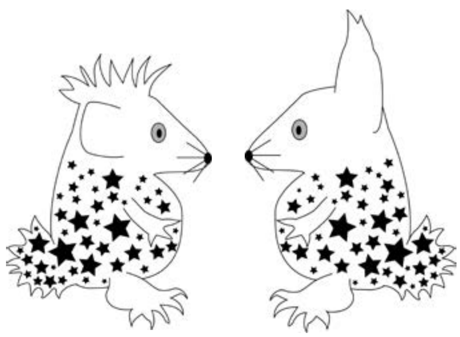
1. Match the word with the best definition.

allele	the set of genes in an organism
homologous chromosomes	an allele that is expressed only if two copies are present in the genotype
genotype	a chart used to predict genotype based on the parents' alleles
phenotype	forms of a gene
dominant allele	two of the same copies of an allele
recessive allele	an organism's appearance
homozygous	chromosome pairs
heterozygous	an allele that is expressed if one or more copies are present in the genotype
Punnett square	two different copies of an allele

Chapter 10: Show What You Know *continued*

2. Complete the Punnett Square.

Qwitekutesnutes can have either a spiked hairdo or flat hairdo with elaborate ear tufts. One qwitekutesnute parent has a spiked hairdo (Hh), and one has ear tufts (hh). With these two parents, what is the probability of a qwitekutesnute with ear tufts? Use the Punnett square to determine this, and then transfer the information to Table 1 and answer the questions.



H = spiked hairdo **h = ear tufts**

Table 1

Genotype	Genotype Probability	Genotype Fraction	Genotype Percentage	Phenotype	Phenotype Probability	Phenotype Fraction	Phenotype Percentage

What is the probability of a qwitekutesnute baby from this pair having ear tufts?

If the qwitekutesnute parents have 12 babies, how many should have ear tufts? Will that many definitely have ear tufts?

If qwitekutesnute parents both have gray eyes (a dominant trait among qwitekutesnutes), could they have green-eyed offspring (a recessive trait)? Explain your answer.

If qwitekutesnute parents both have 4 whiskers, a recessive trait, could they have offspring with 7 whiskers? Explain your answer.

Chapter 10: Show What You Know *continued*

Multiple Choice

3. Law of Segregation states
   - ○ alleles for different traits don't mix
   - ○ allele pairs separate during meiosis
   - ○ different species can't reproduce with each other
   - ○ cell segregate after cytokinesis

4. Law of Independent Assortment states
   - ○ allele pairs assort independently of one another
   - ○ allele pairs separate during meiosis
   - ○ different species can't reproduce with each other
   - ○ cells segregate after cytokinesis

5. A scar on your chin is an example of
   - ○ dominant alleles
   - ○ recessive alleles
   - ○ genotype
   - ○ phenotype

6. The allele pair Ww is
   - ○ homozygous dominant
   - ○ homozygous recessive
   - ○ heterozygous

7. The allele pair BB is
   - ○ homozygous dominant
   - ○ homozygous recessive
   - ○ heterozygous

8. The allele pair ee is
   - ○ homozygous dominant
   - ○ homozygous recessive
   - ○ heterozygous

9. If two parents with brown hair have a baby with blond hair, the allele for blond hair must be
   - ○ recessive
   - ○ dominant
   - ○ there is not enough information
   - ○ heterozygous

10. Traits are
    - ○ determined by only genotype
    - ○ determined by phenotype
    - ○ inherited and acquired
    - ○ your alleles

11. Your genotype is
    - ○ different for different specialized cells
    - ○ the set of genes in the somatic cells in your body
    - ○ the same in gametes and somatic cells

12. Your traits are your
    - ○ phenotype
    - ○ alleles
    - ○ genotype
    - ○ ploidy

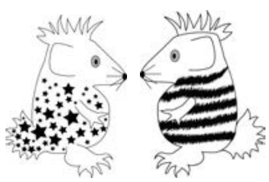
Chapter 10: Show What You Know *continued*

13. Extra Practice. As you know, qwitekutesnutes can have a spiked hair or ear tufts. The allele for spiked hair, H, is dominant over ear tufts, h. Below are six Punnett squares, with possible crosses for qwitekutesnutes hair. When you complete the Punnett squares, write the possible percentage of each phenotype beside the Punnett square.

HH x HH

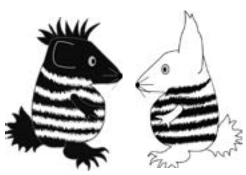
phenotype percentage:

HH x Hh



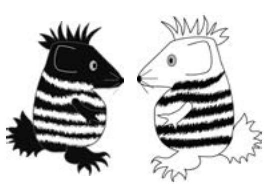
phenotype percentage:

HH x hh



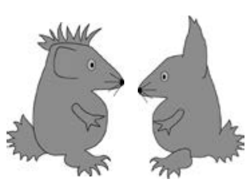
phenotype percentage:

Hh x Hh



phenotype percentage:

Hh x hh



phenotype percentage:

hh x hh

phenotype percentage:

Chapter 13: Plant Reproduction

Explore

Flower and Seed: Inside View

Chapter 13: Dissection Lab

The day before: If your bean is not fresh (i.e., it's a dried bean), it needs to be soaked in room temperature water overnight.

Angiosperms have flowers and produce seeds. You have probably admired many different flowers in your life. And you have most likely eaten many seeds. Beans are seeds, and most berries cannot be eaten without eating their seeds. In all that time, have you ever wondered what the flower you were admiring or the seeds you were eating looked like inside? Today you will dissect a flower and a seed and do just that. When choosing a flower to dissect, choose a perfect flower. Perfect flowers have male and female parts together in the same flower. A big, showy flower with a large pistil and stamens is best. You also need a big seed. A large lima bean is a good choice to look at for a seed.

Materials

- Large perfect flower, with the male and female parts (lilies are great). Flowers to avoid are daisies, asters, calla lilies, roses, and irises.
- Lima bean
- X-Acto knife
- Scissors
- Tape
- Magnifying glass

Procedure

1. If the bean is not fresh, it needs to be soaked in room temperature water overnight.
2. As you read about each part, tape and label the dissected part to the lab sheet. For example, when you separate the petals and stamens, tape one of each to the lab sheet.

Chapter 13: Dissection Lab *continued*

The Angiosperm

3. Carefully remove the stamens and the petals. Look at the petal with the magnifying glass, then tape it to your lab sheet.

4. Cut off the stamens. Tape a stamen to the lab sheet. On your lab sheet, shake pollen from a stamen and put a piece of tape over it.

5. Examine a little bit of pollen with a magnifying glass. Draw a picture of a magnified pollen grain.

6. Cut away all parts, except the pistil, from the stem. Cut the pistil from the stem below the ovary. Examine the stigma with the magnifying glass.

7. Cut the pistil in half from the top, the stigma, down through the center of the style through the ovary base. This gives you a good view down the inside of the flower.

8. With a magnifying glass, look at the style. Look for ovules in the ovary. With the tip of the X-Acto knife, dig out some ovules and look at them with the magnifying glass. Draw the magnified ovules. Tape the piece of pistil you cut away to the lab sheet.

The Seed

9. Take the bean out of water. Carefully, using the X-Acto knife, split the bean into its two halves at the seam on the thin side of the bean. Compare your seed to the illustration of the dicot seed found on the lab sheet. Identify each of the parts. Look carefully at each part with the magnifying glass. Write a description of your seed below each part label.

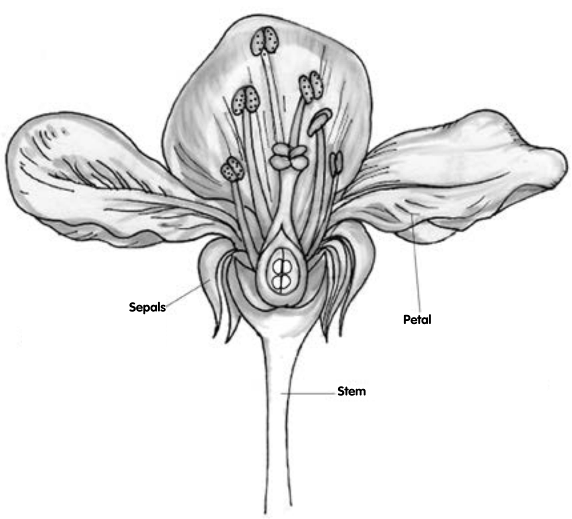
The world's largest seed is a double coconut. A single seed can be nearly 3 feet in circumference and weigh 40 pounds.

Flower and Seed: Inside View

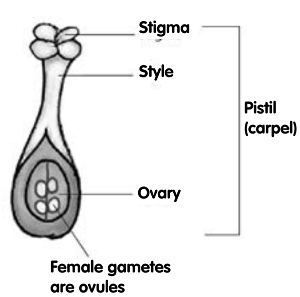
Chapter 13: Dissection Lab Sheet

Name________________________________ **Date**______________

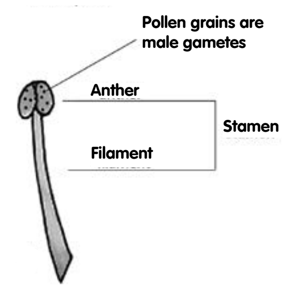
My Flower's Parts



Female Part

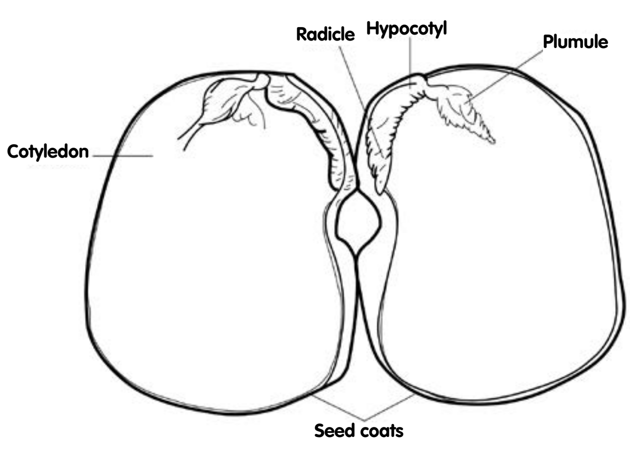


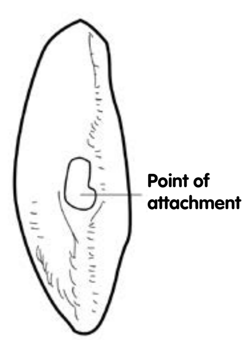
Male Part



Chapter 13: Dissection Lab Sheet *continued*

My Seed's Parts

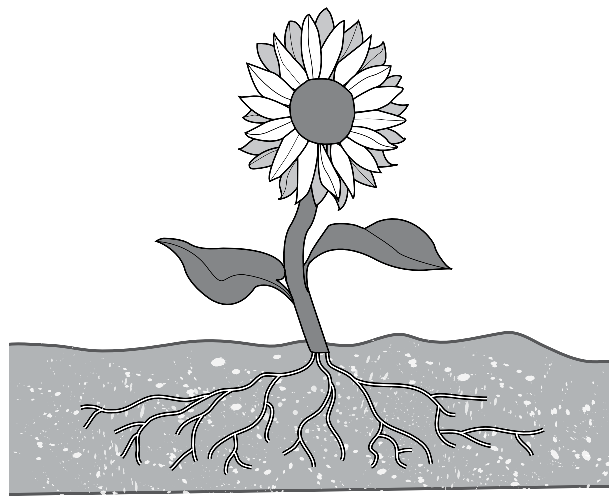




Absorb

Sunflower

Chapter 13: Famous Science Series



Famous Flower

If you drove a car through Russia, Ukraine, Hungary, and Austria, you would see miles and miles of fields planted with sunflowers.

Where did sunflowers originate?

Sunflowers have been found at archaeological sites. How old are the remains?

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

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.

Chapter 13: Famous Science Series *continued*

The rulers of this country sent soldiers into battle with packages of sunflower seeds in what quantity?

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?

Learn

Plant Reproduction

Chapter 13: Show What You Know

1. Match the vocabulary word on the left side with its definition on the right side.

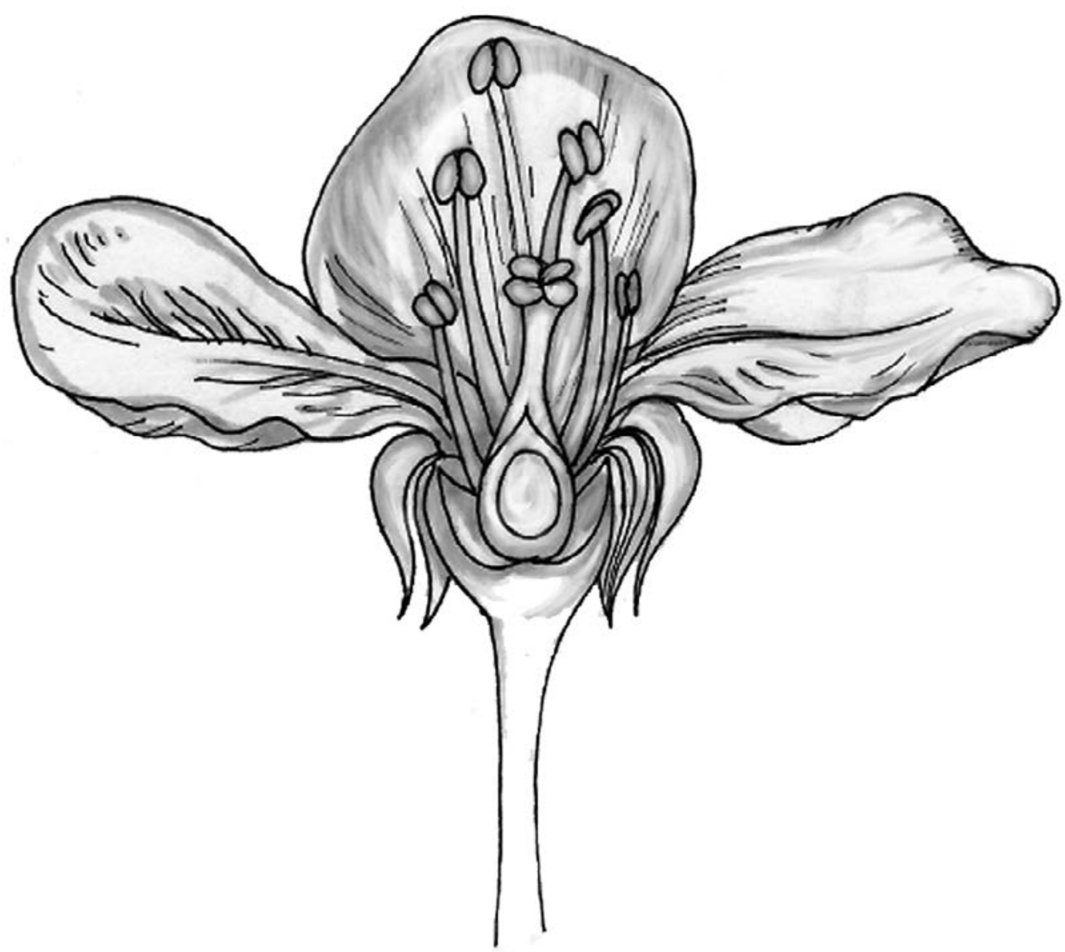
pistil	flowering plant
seed	top part of the pistil where pollen is trapped
petals	reproductive organ of angiosperms
stamen	female reproductive structure of an angiosperm
anther	where the ovules are stored in an angiosperm
pollen	used by mosses and ferns in reproduction
ovules	male reproductive structure of an angiosperm
flower	where pollen is produced for an angiosperm
angiosperm	male gametes
gymnosperm	survival capsules, seed coat on outside and food inside
cones	part of the pistil that joins the stigma and the ovary
style	the part of the stamen that supports the anther
fruit	when a seed first begins to grow
ovary	the part of an angiosperm that attracts pollinators
filament	protects seeds and aids in their dispersal
spore	female gametes
stigma	seed-producing plants that do not produce fruit
pollen tube	reproductive organs of gymnosperms
germination	tube that grows through the stigma to the ovary when pollen comes in contact with the stigma

Chapter 13: Show What You Know *continued*

2. Label the flower.

Parts to label:

- ○ Stem
- ○ Sepals
- ○ Petal
- ○ Stigma
- ○ Style
- ○ Ovary
- ○ Ovules
- ○ Filament
- ○ Anther
- ○ Pistil
- ○ Stamen
- ○ Pollen grains (draw)



Chapter 21: How

Explore

Natural Selection

Chapter 21: Lab

If you were a mouse, what color would you want to be?

Have you ever been to a pet store and observed all the different colors of mice they have? Have you ever wondered why wild mice are brown or brownish-gray? Why aren’t they black, white, or spotted like pet store mice? Think about mice in all these colors running across the lawn. Now imagine a hungry owl is sitting in a tree. The owl hears all the mice. He looks around. Which mouse will be his dinner? Mice are quick. When the owl flies down from the tree, he has one chance to catch dinner before the mice can get back to their burrow. Which mouse do you think the owl will see first? Which mouse will stand out the most on the surface? Which mouse is the most likely to be caught and eaten?

This is how selection works. The mouse that is caught and eaten will not produce any more offspring. It will not pass any more of its genes on to future generations. The mice that are most likely to escape are those that are best adapted to their environment. Which mice have the best color adaptation for this environment: the black, white, spotted, brown, or brownish-gray mouse?

Today you are going to be a hungry owl. You will use pompoms for the mice. A helper will scatter the “mice.” You will have just seconds to “catch” all the mice you can. Which color mice do you think you will catch the most of, and which mice are best adapted to their environment?

Chapter 21: Lab *continued*

This lab can be done outside or inside. The list of materials is slightly different depending on where you conduct it. If you do this lab outside, the weather can affect the outcome. During times of snow, some mice burrow through the snow instead of spending time on top of it. Why do you think that is?

Materials

Outside List

- Pompoms in each of the colors listed below. You need at least one color pompom that really blends in with the surface where they are spread. For example, add 20 light green pompoms if your outside area is grassy. There will be pompoms that are not used, but you cannot assume which color this will be.

    20 brown pompoms

    20 black pompoms

    20 gray pompoms

    40 white pompoms

    20 additional pompoms if your chosen surface is not brown, black, or gray
- Black magic marker
- An extra person to scatter the "mice"
- Timer

Inside List

- All the materials from the outside list. (The 20 additional pompoms should blend into the color of your inside surface. For example, if you have violet shag carpet (nice!), you will need 20 violet pompoms.)
- 2- to 3-meter surface to put the pompoms on that has some depth to it. Shag carpet, furry fleece, faux bear fur, or other rough cloth will work.

Procedure

1. Using the black marker, put black spots on 20 of the white pompoms.
2. Write your hypothesis on the lab sheet. Will there be selection for the "mice"? If yes, which color do you think will be selected most strongly for, and which will be selected most strongly against when you try to catch them?
3. Have another person scatter **five** of each color of pompoms in a 2- to 3-meter square area. Do not peek to see where they are. Close your eyes until they lead you to one side of the area.

Chapter 21: Lab *continued*

4. **Note to the person scattering the pompoms:** Scatter the pompoms randomly. Make sure not to bunch one color all together. Try to cover the area. If possible, put the pompoms slightly down into the nap of the surface material. The person scattering the mice must time the "owl." When you are done scattering the mice, lead the "owl" person to the area. Make sure the "owl" does not observe the area until you are ready with the timer. Count 1, 2, 3, go, and start the timer for 30 seconds while the "owl" catches mice. At the end of 30 seconds, say *stop*.

5. **Do not peek until the scatterer says go**. On the count of 1, 2, 3, go! Open your eyes, survey the landscape, and start catching mice. Toss the first mouse aside so you can remember what mouse that was when the 30 seconds are done. When the person timing says stop, you need to immediately stop collecting mice.

6. Pick up the first mouse you caught and record the color. Record the rest of the pompoms you caught on the lab sheet. Subtract the number of mice caught from the number that were scattered when you started the round. Put the pompoms you caught aside. They are done.

7. The "mice" you did not catch have now reproduced and passed on their fur color genes to their offspring. Add one mouse to the area for every mouse that was not caught, matching the colors. The number of mice that were not caught, going into the next round, has now doubled.

8. **Round two:** Repeat the above procedure from #3 through #7.

9. Record your results on the lab sheet.

10. **Round three:** Repeat the above procedure from #3 through #7.

11. Finish filling in your lab sheet.

12. Complete a formal Lab Report for this lab.

Explore

Natural Selection

Chapter 21: Lab Sheet

Name________________________________ **Date**______________

Objective: To determine which mice have the best color adaptation for their environment.

Hypothesis:

Results and Observations

Round 1 – color of first mouse caught:

Round 2 – color of first mouse caught:

Round 3 – color of first mouse caught:

Data Table

Color / Round		Black	Brown	Gray	Spotted	White	
1	Amount caught						
	Amount left						
	Amount added						
	Total mice for next round						
2	Amount caught						
	Amount left						
	Amount added						
	Total mice for last round						
3	Amount caught						
	Amount left						

Chapter 21: Lab Sheet *continued*

Questions

Did you catch the same color mouse first every time? What do you interpret from that?

Which colored mouse was best adapted for the environment? Which colored mouse was the worst adapted for the environment?

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.

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

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?

What happened to the mouse that had the best fur color once it became more numerous?

Natural Selection

Chapter 21: Lab Report

Name________________________________ **Date**______________

Title/Location____

Hypothesis

Procedure

Observations

Results and Calculations

Conclusions

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Explore

Function and Form

Chapter 21: Microscope Lab

Fur, hair, wool—call it what you want, but scientifically it's all fur. All mammals have it. The first definitive fossil with fur is an animal from 164 million years ago. Fur doesn't fossilize well, so no one can be sure when it first evolved. The function of fur is to insulate and protect. Why are there so many different forms, though, in all those different colors? The evolution of fur between different species of mammals, and even within a species, has led to many different forms, but it all has the same function. Today you will look at some different forms of fur under the microscope.

Materials

- Samples of hair, fur, and/or wool from as many different types of mammals as possible (dog, cat, hamster, sheep, cow, human, chinchilla, horse, etc.)
- Microscope
- Slides (as many as your fur samples)
- Slide covers
- Water
- Dropper

Procedure

1. Answer the initial questions on the lab sheet.
2. Make wet mount slides one at a time, one for each fur type. Do not clean slides until the end, in case you want to refer back to a slide.
3. Look at them under the microscope.
4. Take notes on the lab sheet as you go along.

Function and Form

Chapter 21: Microscope Lab Sheet

Name_______________________________ **Date**______________

Before You Begin

All these questions refer to the texture of the fur, not the color.

What two fur samples from different types of animals do you think will look the most alike with a microscope? Why?

What two fur samples from different types of animals do you think will look the most different with a microscope? Why?

While You're Working

List the name of each type of fur (name of the mammal it came from). Jot down notes about the appearance of each. Compare the fur samples with each other. Write down any differences you observe.

Type of Fur	Appearance Description	Comments: Compare/Contrast

Chapter 21: Microscope Lab Sheet *continued*

Type of Fur	Appearance Description	Comments: Compare/Contrast

Conclusions

What two fur types looked the most alike with a microscope? Why?

What two fur types looked the most different with a microscope? Why?

Were you surprised by anything you saw? If so, what?

Absorb

Evolution Act 1: First Theories

Chapter 21: Famous Science Series

Jean-Baptiste Lamarck

Imagine you live your whole life with no car, no bus, no train, and no plane. Some people have horses and buggies, but not many. Imagine that you walk everywhere you go. There are no televisions, there are no movies to watch, and no video games to play. You spend your entire life in a small area, looking at the plants and animals right where you live. You might see an exotic plant or animal, but only two or three times in a lifetime, if that many.

This would have been what it was like for many western Europeans in the fifteenth century. By the late 1400s onward, explorers returned to Europe with fantastic stories of animals, plants, and people they had never seen before. As people began traveling the globe, there came an understanding that the world was filled with all sorts of different organisms. Another surprise was that the plants and animals you looked at your whole life were not in other places around the world. There were no horses on the American continents. In Australia, there were no rabbits or dogs, but there were koala bears and duck-billed platypuses. In China, there were funny-colored black and white bears. In the Arctic, the bears were white. The insects and plants were different. People in Europe were amazed and intrigued. In England in the 1800s there was even a beetle-collecting craze. Some people had large collections of beetles from locations around the globe.

People started to wonder, why were there different organisms in different locations? Why were there so many different types when fewer would work just as well? Then there was the fossil evidence. People had been discovering fossils for a long time. People wondered what had happened to all the types of organisms that had gone before and no longer existed.

Chapter 21: Famous Science Series *continued*

In 1809, Jean-Baptiste Lamarck proposed a theory of evolution. What was his theory and was it correct?

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

Learn

Evolution: How

Chapter 21: Show What You Know

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:
   - ○ Natural selection
   - ○ Extinction
   - ○ Overproduction
   - ○ Genetic drift
   - ○ Speciation

2. The case of the peppered moths is a good example of how ______ works.
   - ○ natural selection
   - ○ reproductive isolation
   - ○ mutation
   - ○ speciation

3. What two mechanisms lead to genetic variation?
   - ○ Overproduction and natural selection
   - ○ Genetic recombination and mutation
   - ○ Natural selection and reproductive isolation
   - ○ Speciation and adaptation

4. Aquatic birds, like ducks, have webbed feet that help them paddle through water. This is an example of
   - ○ genetic drift.
   - ○ natural selection.
   - ○ genetic variation.
   - ○ an adaptation.

5. Dogs and cats are not the same species because
   - ○ cats are carnivores and dogs sometimes eat grass.
   - ○ they have reproductive isolation.
   - ○ they cannot breed with each other and have offspring.
   - ○ they have the same number of chromosomes but different genes.

6. Which of the following statements are true?
   - ○ Mutations can be passed from parent to offspring.
   - ○ Mutations lead to genetic variability.
   - ○ Mutations can cause traits that are beneficial, neutral, or harmful.
   - ○ All of the above

Chapter 21: Show What You Know *continued*

7. A population of beetles lives on an island. The beetles come in two colors green and brown. A hurricane blows five green beetles off their island onto another where there are no beetles. It does not take long for the beetles to colonize and have a healthy beetle population on their new island. All the beetles on the new island are green. This change to an all-green population on the new island is an example of

   - ○ genetic drift.
   - ○ genetic recombination.
   - ○ genetic variation.
   - ○ speciation.

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 _____ trait that became a _____ trait.

   - ○ neutral, harmful
   - ○ beneficial, harmful
   - ○ beneficial, neutral
   - ○ harmful, beneficial

9. Reproductive isolation is necessary for speciation because

   - ○ harmful mutations can accumulate and extinction will occur without it.
   - ○ different species cannot reproduce with each other.
   - ○ gene flow must be stopped between populations for one to evolve into a new species.
   - ○ mutations are more likely to occur when organisms are isolated.

10. Mutations are ______; selection for the traits they cause is not.

    - ○ common
    - ○ uncommon
    - ○ random
    - ○ dangerous

11. What is the name of the process that explains how all the species of organisms have come to be?

    - ○ Evolution
    - ○ Genetic recombination
    - ○ Genetic drift
    - ○ Meiosis

12. Overproduction should lead to there being many more organisms alive than the earth can support. What are the controls on overproduction?

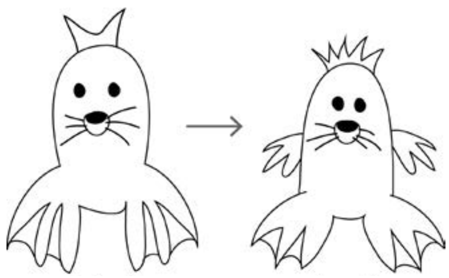
    - ○ Predation
    - ○ Disease
    - ○ Scarce food resources
    - ○ Weather
    - ○ All of the above

Chapter 21: Show What You Know *continued*

Essay and Timeline

1. The sealocrab and the aquanotic are two different species of marine mammals that were discovered on the Island of Mythical Creatures. The sealocrab is the ancestral species to the aquanotic. On a separate sheet of paper, write a story of a possible scenario for how the evolution from sealocrab to aquanotic could have happened. Use some or all of the following terms:

genetic variation	genetic recombination	mutation	reproductive isolation
speciation	natural selection	genetic drift	adaptation
time	traits	evolve	evolution



2. You learned about the cell theory in Chapter 2. Along with the theory of evolution, this is one of the central theories of biology. Below is a timeline in the development of the cell theory. At what point did the cell theory actually become a theory? To answer this question, use the definition and explanation of what scientific theory is. Circle the point on the timeline where the cell theory becomes a theory. If you are working on a history timeline, add some or all of the cell theory development dates to your timeline.

1665 Robert Hooke discovers squarish-looking structures in a specimen of cork with his microscope. He names these structures *cells*.

1674 Antonie van Leeuwenhoek is the first person to see a live cell with his microscope.

1831 Robert Brown discovers the cell nucleus.

1839 Thoedor 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.

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.

1855 to present day. The cell theory has been tested many times by many different researchers. Their results have confirmed the cell theory.

Chapter 25: Predator and Prey

Backyard Food Web

Chapter 25: Lab

Have you ever wondered who was eating whom in your backyard? If you have animals and insects in it, someone is eating somebody; that is a given. In this lab you will learn about the food web that is occurring around you every day. If you don't have a yard, then take a field trip to a place where you can observe nature, like a park, a meadow, or a forest. Only include organisms that occur naturally, however, in your food web. Your dog or cat should not be included. Plants that were planted in your yard might not be included, unless (unfortunately) they have become food for some organism.

Materials

- Colored pencils, optional
- Field guides for the plants and animals in your area (optional)

Procedure

1. Go to your site and study it. Sit quietly to see what is flying or walking around. You do not need to see an animal to include it in your food web, but you do need to know it lives in your environment. For example, if you had a raccoon in your garage a month ago, you know you have raccoons in your ecosystem and you can include raccoons in your food web.
2. Walk around looking at plants and the insects that inhabit them. Look for spiderwebs.
3. Jot down potential candidates for including in your food web. You do not need to document every organism that spends time in your backyard. You can make it as big as you want, but don't let the list get unwieldy. About ten is a good number to document.

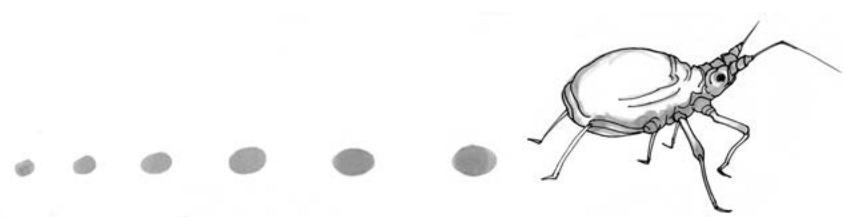
Chapter 25: Lab *continued*

4. Start by choosing two or three plants that you know are being eaten. Next, determine what is eating them. It might help to identify the species of organism to assist you in determining what it eats. For example, if you see a squirrel in your food web and you know squirrels eat nuts, but you don't see nuts in your area, maybe they are buried, or maybe the squirrel is just "passing through," or perhaps it's eating something other than nuts. You will have to make these types of determinations based on the evidence you see today or have seen in the past.

5. Record the organisms you identify in your food web on your lab sheet with the following initials (you do NOT need to have all of these in your web).
   - Write P for producers
   - Write C for carnivores
   - Write H for herbivores
   - Write D for a decomposer
   - Write O for omnivores

6. Draw a picture of your food web on the lab sheet. Draw the arrows going away from the organism that is being eaten and going toward the predator. Identify symbiotic relationships, if you observe any:
   - Write CM for organisms practicing commensalism
   - Write M for organisms practicing mutualism
   - Write PS for organisms practicing parasitism

7. OPTIONAL: Color the organisms in your food web.



Backyard Food Web

Chapter 25: Lab Sheet

Name______________________________ **Date**_____________

Organisms in my food web:

My food web

Key: P = Producer C = Carnivore H = Herbivore D = Decomposer O = Omnivore
CM = Commensalism M = Mutualism PS = Parasitism

Explore

Plant Predation

Chapter 25: Microscope Lab

The predation of plants, such as grass, is called ***grazing***. Like other forms of predation, most grazing is helpful in maintaining diversity in the community. But it can be harmful to the organism that is the prey. Let's look at a plant before and after it has been preyed upon by you. Grazers bite on grass and tear it. You will use pliers to simulate the teeth of a grazer.

Materials

- Microscope
- Slides
- Water
- Slide cover
- One piece of freshly picked green grass
- Pliers

Procedure

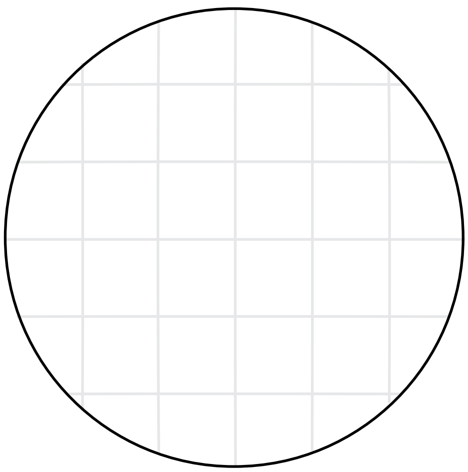
1. Make a wet mount slide with the blade of grass at a 90-degree angle to the slide. It will hang over the sides. View the piece of grass at a place where it was not picked. This is the Before view. Find the magnification you prefer and draw this view. Remove the slide and take off the slide cover.
2. At about the point you viewed with the microscope, take the pliers, squeeze them on the blade of grass, and tear it in two pieces.
3. Make a wet mount slide so you can view the site of the tear. This is the After view. Draw this view at the same magnification you drew the Before view. Remove the slide and take off the slide cover.

Plant Predation

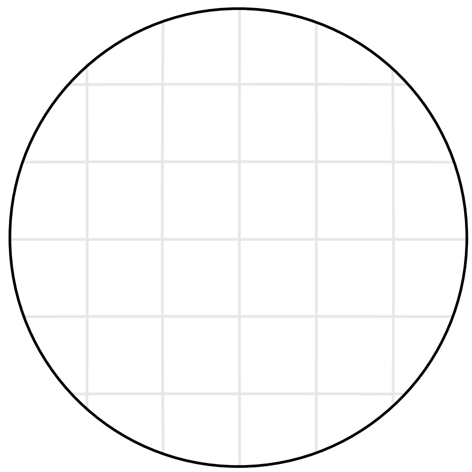
Chapter 25: Microscope Lab Sheet

Name________________________________ **Date**_______________

Specimen ____ Type of mount_______________________



Before



After

Describe the differences between the two blades of grass.

Why do you think grazing can be harmful to the organism to which it happens?

Sometimes when grass is cut, the tip turns brown. Use the differences you observed between the two blades to explain why this might occur.

Jane Goodall

Chapter 25: Famous Science Series

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?

What are the two main threats that chimps face today?

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?

Chapter 25: Famous Science Series *continued*

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

A famous anthropologist gave Jane Goodall her start. What is his name and why is he famous?

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

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

What famous explorer discovered the lake's only outlet?

At Gombe National Park, humans need to keep 10 meters away from the chimps. Why?

Predator and Prey

Chapter 25: Show What You Know

Questions

1. If you have a pet, look at the list of ingredients on your pet's food. Write down the ingredients here and answer this question: 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.

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 organisms that make their own food with a P, for producer.

Chapter 25: Show What You Know *continued*

3. List three adaptations predators have for catching prey.

4. List three adaptations prey animals have for avoiding being caught. Explain the benefits of each adaptation.

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

- ○ predation.
- ○ symbiosis.
- ○ mutualism.
- ○ All of the above

Going from producer to herbivore to carnivore:

- ○ There is more energy
- ○ There is less energy
- ○ There is the same amount of energy

When two species have a similar niche, they use ______ to reduce competition.

- ○ resource partitioning
- ○ a predator/prey relationship
- ○ intraspecific interactions
- ○ mimicry

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

- ○ bioluminescence.
- ○ camouflage.
- ○ disruptive coloration.
- ○ aposematic coloration.

Commensalism is a symbiotic relationship where

- ○ both species benefit.
- ○ neither species benefits.
- ○ one species benefits and the other is harmed.
- ○ one species benefits and it doesn't affect the other species.

The most intense competition is

- ○ intraspecific competition.
- ○ interspecific competition.
- ○ between predators and their prey.
- ○ between species that mimic each other.

Chapter 25: Show What You Know *continued*

Plants defend themselves against predators using

- ○ chemicals.
- ○ hard shells to protect seeds.
- ○ thorns.
- ○ All of the above

An example of intraspecific competition is

- ○ a dog chasing a cat.
- ○ a dog marking its territory.
- ○ a dog barking at a strange person.
- ○ a dog eating grass.

The predator/prey relationship is beneficial to a community because

- ○ they are cool to look at.
- ○ they limit the damage done to plants.
- ○ they increase the diversity in the community.
- ○ they decrease the diversity in the community.

A population's niche is its

- ○ feeding strategy.
- ○ job in the community.
- ○ adaptation.
- ○ type of symbiosis.

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)

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)

Pandia PRESS

Chapter 31: Kingdom Animalia

Explore

Arthropod Arrangement

Chapter 31: Lab and Microscope Lab

Insects are in class Hexapoda. Spiders and ticks are in class Arachnida.

If you were asked to list the differences between mammals and insects, it would be easy, wouldn't it? The more related two organisms are, the harder it is, though. Today you are going to examine an arachnid and a hexapod. Arachnids are spiders or ticks. Hexapods are insects. Because they are both arthropods, they do have many things in common. They share more derived traits with each other than either shares with mammals. They are two different classes of arthropods, though, so there are differences too. What do you think the differences are? Today you will research and find out!

No arthropods have to be harmed to perform this experiment! Take a few days leading up to this experiment looking on your windowsills or outside on the ground for dead spiders and insects; maybe you can find a dead (hopefully) tick on your dog or cat. You will probably find many parts and pieces of specimens, but you need at least one good arachnid and one good insect that are undamaged and are completely intact. That smushed mosquito on your arm might be cool, but it's not going to be a good anatomical specimen for under your microscope

Materials

- Magnifying glass
- Arachnid specimen (spider)
- Insect specimen
- Microscope (optional)
- White-out or liquid paper
- Scalpel
- Slides (optional)
- Slide covers (optional)
- A white sheet of copy paper
- Syringe
- Water
- Tweezers
- Flashlight

Chapter 31: Lab and Microscope Lab *continued*

Procedure

Be VERY careful when you are working with the specimens; they are delicate.

1. Put the spider and the insect next to each other on the piece of white paper. Examine them with your naked eye and with the magnifying glass. Be careful not to damage them as you examine them, but try to move them around and look at them from all sides; the tweezers and flashlight can be useful for this. As you examine them, find the labeled parts on your lab sheet.
2. The illustrations are not very detailed. You can add details to the drawings if you like. You might need to remove details as well. For instance, not all insects have wings. White-out any body parts missing from your insect. Count the arachnid's and insect's legs; do they have the correct number?
3. All arthropods have an exoskeleton, jointed legs, and multiple body parts.
   - Gently, without smashing them, examine the exoskeletons with your naked eye, the magnifying glass, and the microscope (optional). On your lab sheet describe what you see.
   - How do the body parts connect? Examine the site of connection. On your lab sheet describe what you see.
4. Take the specimens off and carefully begin dissecting each. For example, use the scalpel and tweezers and look at the leg from one of the animals and then the leg from the other.
   - Look at the leg joints on both animals. How are they similar? On your lab sheet describe what you see.
5. On your lab sheet, summarize the differences and similarities between hexapods and arachnids, using your insect and your spider as examples.

There is a weakness with this experiment; have you thought of what it is? This experiment assumes the one insect and the one arachnid represent all hexapods and all arachnids. The scientists that classified arachnids and insects and divided them into different classes looked at many different species of arachnids and insects, not just one of each class.

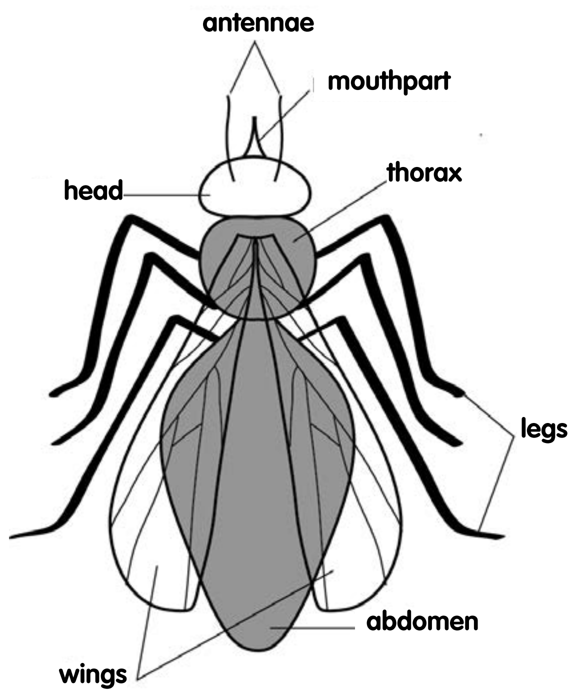
Explore

Arthropod Arrangement

Chapter 31: Lab Sheet

Name______________________________ **Date**______________

My Insect, Class Hexapoda



My Observations

Exoskeleton:

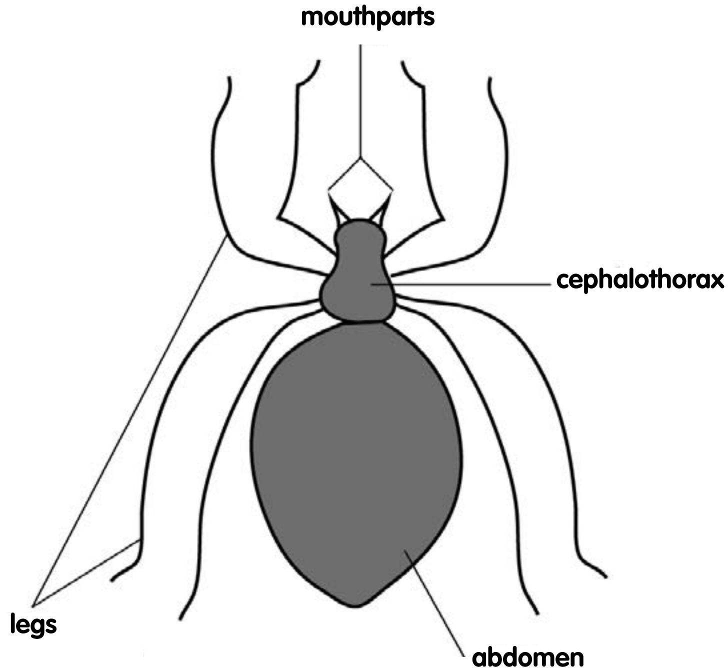
Body parts:

Joints and legs:

Other observations:

Chapter 31: Lab Sheet *continued*

My Arachnid, Class Arachnida



My Observations

Exoskeleton:

Body parts:

Joints and legs:

Other observations:

Similarities and Differences of Hexapods and Arachnids

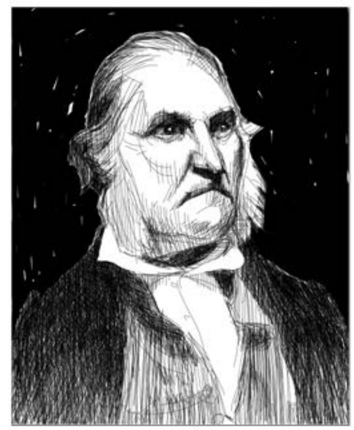
Absorb

John James Audubon

Chapter 31: Famous Science Series

Famous Observer of Birds

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?



James Audubon

What was the name of the book Audubon wrote about birds?

What society is named after him? What is its purpose?

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?

Kingdom Animalia

Chapter 31: Show What You Know

1. The words outside the box are out of order. Write those words in the correct places in the table on the left. This is the classification for the Southern Hairy-Nosed Wombat. Wombats are marsupials native to Australia and the island of Tasmania.

	Eukarya
	Animalia
	Chordata
	Mammalia
	Diprotodontia
	Vombatidae
	Lasiorhinus
	latifrons

Order
Kingdom
Genus
Phylum
Class
Domain
Species
Family

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

2. Each one of the statements about animals is false. Fix each statement to make it true.

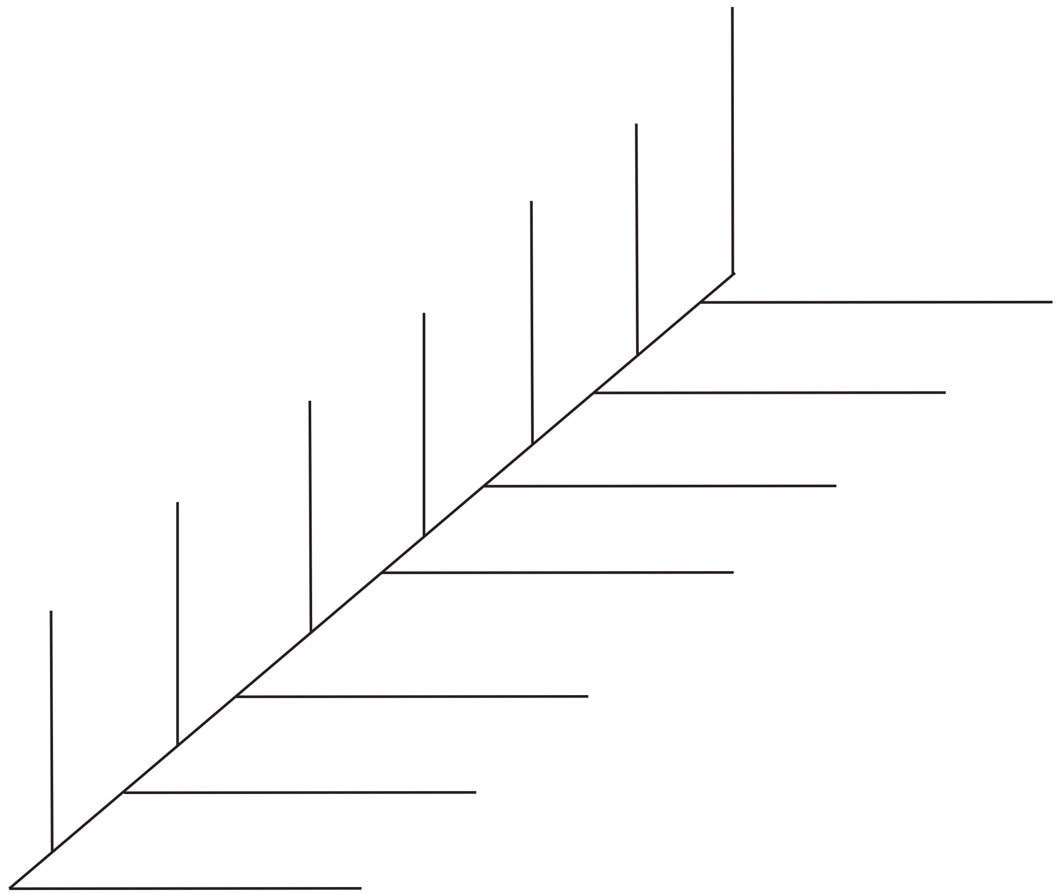
All animals . . .
are unicellular. ______________________
are immobile. ______________________
have prokaryotic cells. ______________________
have cell walls. ______________________
are autotrophs, which means they make their own food using photosynthesis. ______________________

3. There are four groups of arthropods. 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

Chapter 31: Show What You Know *continued*

4. Fill in the cladogram. Put the shared derived traits on the horizontal lines and the organisms at the top of the vertical lines.



Organisms

1. Opossum
2. Army ant
3. Starfish
4. Duckbilled platypus
5. Red-tail hawk
6. Mountain gorilla
7. Chameleon

Shared Traits

1. Heterotroph
2. Placenta develops in female when she is pregnant
3. Endoskeleton
4. Endotherm
5. Lives on land
6. Mammary glands
7. Long pregnancy, followed by the delivery of more developed offspring

Chapter 31: Show What You Know *continued*

Multiple Choice

1. A squid is an invertebrate animal, meaning
   - ○ it lives in water.
   - ○ it has a backbone.
   - ○ it does not have a backbone.
   - ○ it is cold-blooded.

2. An animal that has one muscular foot and a soft body is a(n)
   - ○ mollusk.
   - ○ echinoderm.
   - ○ porifera.
   - ○ arthropod.
   - ○ cnidaria.
   - ○ chordate.

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)
   - ○ mollusk.
   - ○ echinoderm.
   - ○ porifera.
   - ○ arthropod.
   - ○ cnidaria.
   - ○ chordate.

4. An animal with jointed legs, a segmented body, and an exoskeleton is a(n)
   - ○ mollusk.
   - ○ echinoderm.
   - ○ porifera.
   - ○ arthropod.
   - ○ cnidaria.
   - ○ chordate.

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)
   - ○ mollusk.
   - ○ echinoderm.
   - ○ porifera.
   - ○ arthropod.
   - ○ cnidaria.
   - ○ chordate.

6. An aquatic animal with a radial body plan, a tough spiny skin, and tube feet it uses to move is a(n)
   - ○ mollusk.
   - ○ echinoderm.
   - ○ porifera.
   - ○ arthropod.
   - ○ cnidaria.
   - ○ chordate.

7. An animal with a backbone, a head, and a sophisticated body plan is a(n)
   - ○ mollusk.
   - ○ echinoderm.
   - ○ porifera.
   - ○ arthropod.
   - ○ cnidaria.
   - ○ chordate.

8. Segmented worms
   - ○ have both male and female parts.
   - ○ are endotherms.
   - ○ have a flat body with a mouth at one end.
   - ○ have a long, threadlike body.

Chapter 31: Show What You Know *continued*

9. Nematodes are roundworms that
   - ○ have segmented, tube-shaped bodies.
   - ○ are endotherms.
   - ○ have a flat body with a mouth at one end.
   - ○ have a long, threadlike body.

10. Platyheminthes are worms that
    - ○ have segmented, tube-shaped bodies.
    - ○ are endotherms.
    - ○ have a flat body with a mouth at one end.
    - ○ have a long, threadlike body.

11. This animal gets food when it moves food and water through pores in its body. It is a
    - ○ starfish.
    - ○ worm.
    - ○ sea anemone.
    - ○ sponge.

12. The term *radial body plan* means an organism
    - ○ has a backbone.
    - ○ has no backbone.
    - ○ has a central point that the rest of their body is arranged around.
    - ○ has a sac-like body in the shape of a circle.

13. A vertebrate has
    - ○ an exoskeleton.
    - ○ an internal skeleton.
    - ○ a hard coating on the outside of its body.
    - ○ a shell.

14. Endoskeletons are made from
    - ○ bone and cartilage.
    - ○ chitin.
    - ○ collagen.
    - ○ glycogen.

15. An ectotherm
    - ○ regulates its own body temperature internally.
    - ○ regulates its body temperature by exchanging heat with the environment.
    - ○ has no endoskeleton.
    - ○ has no backbone.

16. An endotherm
    - ○ regulates its own body temperature internally.
    - ○ regulates its body temperature by exchanging heat with the environment.
    - ○ has no endoskeleton.
    - ○ has no backbone.

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)
    - ○ mamma.
    - ○ reptile.
    - ○ amphibian.
    - ○ bird.
    - ○ fish.

Chapter 31: Show What You Know *continued*

18. This vertebrate animal lives in water, has fins, breathes through gills, lays eggs, and is an ectotherm. It is a(n)

   ○ mammal.
   ○ reptile.
   ○ amphibian.
   ○ bird.
   ○ fish.

19. This vertebrate animal has feathers and wings, a beak, lays eggs, and is an endotherm. It is a(n)

   ○ mammal.
   ○ reptile.
   ○ amphibian.
   ○ bird.
   ○ fish.

20. This vertebrate animal has dry scaly skin, lays eggs, and is an ectotherm. It is a(n)

   ○ mammal.
   ○ reptile.
   ○ amphibian.
   ○ bird.
   ○ fish.

21. This vertebrate animal has mammary glands, hair or fur, and is an endotherm. It is a(n)

   ○ mammal.
   ○ reptile.
   ○ amphibian.
   ○ bird.
   ○ fish.

22. The purpose of mammary glands is to

   ○ regulate body temperature.
   ○ make hormones.
   ○ make milk.
   ○ fight infections.

23. A mammal that lays eggs is a

   ○ marsupial.
   ○ monotreme.
   ○ placental mammal.
   ○ mammals do not lay eggs.

24. Organisms with gills

   ○ transfer oxygen and carbon dioxide across them.
   ○ are only fish.
   ○ are anaerobic.
   ○ use sulfur dioxide for cellular respiration.