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SCIENCE

STUDENT BOOK

10th Grade | Unit 3

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SCIENCE 1003

Microbiology

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Microbiology

Introduction

Biology is the scientific study of God's living creation. There are many, many areas of study that are considered biological studies. In LIFEPAC® 1001, you learned about the science of taxonomy which dealt with classification of living creatures. In LIFEPAC 1002, you studied about molecules, compounds, and chemical reactions as they relate to living organisms, molecular biology. This LIFEPAC will briefly introduce you to **microbiology**, the study of living things too small to be seen without the aide of a microscope. We will also study some larger organisms which are included in the taxonomic kingdoms covered in this LIFEPAC.

The world of microbiology can be described in one word–variety. The differences between the plants and animals we are familiar with seem quite obvious. Green plants carry out photosynthesis. Animals get their energy by ingesting plant material, or by eating animals that ingest plant material.

In the microscopic world, the lines of definition are not quite so clear. Organisms often exhibit characteristics of both plants and animals. For example the euglena can acquire energy in one of two ways. It can produce its food through photosynthesis, or ingest other organisms. There are also cellular differences that, when examined more closely, reveal great differences between organisms.

God has created an amazing world around us that is teeming with life that we cannot see as we go about our days. Isaiah 45:18 states "For thus saith the Lord that created the heavens; God himself that formed the earth and made it; he hath established it, he created it not in vain, he formed it to be inhabited: I am the Lord; and there is none else."

Objectives

Read these objectives. The objectives tell you what you will be able to do when you have successfully completed this LIFEPAC. Each section will list according to the numbers below what objectives will be met in that section. When you have finished this LIFEPAC, you should be able to:

1. List the kingdoms in the six-kingdom classification system.
2. Identify which kingdoms are composed of prokaryotes and which are made up of eukaryotes.
3. Discuss the history and development of the microscope.
4. List some benefits and limitations of the light microscope and electron microscope.
5. List and describe four phyla of fungi.
6. Discuss what characteristics set organisms of a particular kingdom apart from members of other kingdoms.
7. Discuss the structures and characteristics that allow scientists to place organisms in a particular group such as a phylum within a kingdom.
8. Describe some common forms of reproduction and/or locomotion of the microorganisms studied.

9. Discuss the economic and environmental impact of the groups of microorganisms.
10. Use proper technique to culture, observe, and identify microorganisms using a light microscope.
11. List and describe six phyla of animal-like protists.
12. List and describe seven phyla of plant-like protists (algae).
13. Discuss the economic and environmental impact of the groups of microorganisms.
14. List and describe three phyla of fungus-like protists.
15. Discuss the economic and environmental impact of some common fungus-like protists.
16. List and describe eubacteria based on Gram staining and shape.
17. List and describe three groups of archaea.
18. List and describe the structures and characteristics of viruses, prions, and viroids.

Survey the LIFEPAC. Ask yourself some questions about this study and write your questions here.

1. MICROBIAL TAXONOMY

In your first LIFEPAC you were introduced to the very important field of biology called taxonomy. In this section of the Microbiology LIFEPAC, we will briefly revisit this classification process and the six kingdom taxonomy system as it relates to microscopic organisms.

Section Objectives

Review these objectives. When you have completed this section, you should be able to:

1. List the kingdoms in the six-kingdom classification system.
2. Identify which kingdoms are composed of prokaryotes and which are made up of eukaryotes.
3. Discuss the history and development of the microscope.
4. List some benefits and limitations of the light microscope and electron microscope.

Vocabulary

Study these words to enhance your learning success in this section.

Animalia
Eubacteria
prokaryote
Plantae
Protista
Fungi
Archaea

Note: *All vocabulary words in this LIFEPAC appear in* **boldface** *print the first time they are used. If you are not sure of the meaning when you are reading, study the definitions given.*

SIX-KINGDOM CLASSIFICATION

The great diversity of these microscopic organisms has for many years caused much discussion (and often disagreement) among taxonomists who attempt to classify these life forms. While we must recognize that there are many taxonomy systems that are being used, the six-kingdom system is one that is commonly accepted and used. In this system, the kingdoms are **Animalia** (animals), **Plantae** (plants), **Fungi**, **Protista**, **Eubacteria**, and **Archaea**. The kingdoms Plantae and Animalia were introduced in your first LIFEPAC. Since the other four kingdoms include mostly microorganisms, we will be studying them in this microbiology LIFEPAC.

All living organisms can be classified into two groups based on their cellular structure. These two groups are called eukaryotes and prokaryotes. These two groups are based on two very different types of cells. The cellular structure of a prokaryote does not have a true nucleus or any other membrane-bound structures within each cell. The cellular structure of a eukaryote includes a membrane-bound nucleus and various other membrane-bound organelles.

| Phagocytosis

Four of the six kingdoms in the six-kingdom taxonomy system contain organisms classified as eukaryotes. Only two kingdoms, Archaea and Eubacteria, contain all prokaryotes. You will study both of these kingdoms in this LIFEPAC. You will also study two kingdoms containing eukaryotes, Fungi and Protista. In a later LIFEPAC you will study the specific structures common to most eukaryotes, while in this LIFEPAC, we will simply be focusing on the structures that are unique to the microorganisms we will be investigating.

CELL TYPE	KINGDOM	GENERAL CHARACTERISTICS	EXAMPLES
Eukaryote	**Animalia**	All multicellular. True tissue and organ differentiation. No cell walls	Insects, Fish, Birds, Mammals
Eukaryote	**Plantae**	All multicellular. True tissue differentatiation. Cell walls composed of cellulose.	Trees, Flowering plants, Grasses, Ferns
Eukaryote	**Fungi**	No tissue differentiation. Cell walls composed of chitin.	Mushrooms, Mold, Yeast
Eukaryote	**Protista**	Cells with true nucleus. Eukaryotes NOT classified as animals, plants, or fungi.	Amoeba, Paramecium, Algae, Slime mold
Prokaryote	**Eubacteria**	Cells have no true nucleus or membrane-bound organelles. Cell walls contain peptidoglycans.	Common bacteria, Blue-green Algae
Prokaryote	**Archaea**	Cells have no true nucleus or membrane-bound organelles. No peptidoglycans in cell walls.	Extremophiles

Complete these statements.

1.1 List the kingdoms that are composed of eukaryotes. a. _____ , b. _____ , c. _____ , and d. _____ .

1.2 Which kingdoms are composed of organisms with cell structures which do not have a membrane-bound nucleus? a. _____ b. _____

1.3 What is the basis for classifying an organism as a prokaryote or a eukaryote? _____

_____

THE MICROSCOPE

The microscope is a tool used by microbiologists to study organisms which are too small to see with the naked eye. These tiny living organisms are commonly referred to as **microorganisms**. Magnification is required to study microorganisms. Today, magnification is achieved using a wide variety of microscopes. This LIFEPAC section will include a brief history of the microscope as well as techniques necessary for the successful use of microscopes.

Vocabulary

Study these words to enhance your learning success in this section.

microorganisms
monocular
cell
ocular lens
resolving power
cover slip
depression slide
dry-mount
wet-mount
binocular
staining
objective lens
body tube
scanning electron microscope
compound microscope
light (optical) microscope
bright-field microscope
electron microscope
microscope slide

Note: *All vocabulary words in this LIFEPAC appear in* **boldface** *print the first time they are used. If you are not sure of the meaning when you are reading, study the definitions given.*

| Antique Microscope

HISTORY OF THE MICROSCOPE

The development of today's modern microscopes can be traced back well before A.D. 1000 when "burning glasses" were used to focus the sun's rays in order to start a fire. This ability to magnify the sun's rays was accomplished using rock crystals polished to a convex shape. Significant improvements in these basic tools came during the thirteenth century with the invention of spectacles (or eyeglasses). At that time, a single lens that was able to magnify an object to 10 times its actual size was commonly referred to as a "flea glass." As you can imagine, it was often used to view the tiny structures of insects such as fleas. Today, this simple instrument is commonly known as a magnifying glass.

Around 1595, Hans and Zacharias Janssen, Dutch eyeglass makers, experimented with two glass lenses in a tube and found that nearby objects appeared greatly enlarged. The instruments the Janssens' discovered were able to magnify objects to about three to nine times their actual size. In 1609 the Italian physicist and mathematician, Galileo, used mathematics to work out the principles of lenses and made an improved instrument that could be focused. Galileo also took this knowledge about magnification and created one of the first telescopes used extensively in the study of astronomy.

Another Dutchman, Anton van Leeuwenhoek (1632-1723), was one of the earliest and most skillful microscope makers. Leeuwenhoek constructed approximately 400 microscopes during his life, including single-lens microscopes capable of magnification to 270X. Using his microscopes, he was the first to document careful observations and descriptions of blood cells, sperm cells, bacteria, protozoa, and yeasts. Leeuwenhoek described a rainwater drop as having a great multitude of "animalcules."

About the same time that Leeuwenhoek was making his discoveries in Holland, an Englishman, Robert Hooke (1635-1703) was making discoveries of his own, using some of the first microscopes which employed two lenses. These microscopes which use two or more lenses are called **compound microscopes**. Robert Hooke's most famous discovery using his microscopes was his description of a thin slice of cork. Hooke is credited with first identifying and using the term "**cells**" to describe the tiny compartments or chambers that made up the cork. Some historians say that the term "cell" is in reference to the small cells or chambers of a beehive. Other historians say that the term "cells" comes from the fact that what Hooke saw reminded him of the small cells of a monastery.

The next notable improvements in microscopes did not come about until the middle of the

nineteenth century. At that time, an American, Charles A. Spencer, became known for the extraordinary quality of the microscopes he built. Charles built microscopes that were capable of magnification up to 1250 times using regular light, and up to 5000 times using a blue light source. Spencer was known for creating microscopes with clearer images than anyone had ever seen before. In fact, very little has changed in the design of microscopes since the instruments built by Spencer in the 1840s.

In the 1930s, scientific study of microorganisms changed immensely with the invention of the electron microscope by two Germans, Max Knott and Ernst Ruska. Today, the electron microscope has allowed scientists to view individual molecules that make up the structures in a cell and has changed the science of molecular biology. Molecular biologists study the molecules and reactions of living things and often work closely with microbiologists.

Complete these statements.

1.4 Living creatures which can be seen only by using a microscope are _____ .

1.5 Explain the contribution made to the development of the microscope by each person:

a. Hans and Zacharias Janssen _____

b. Galileo _____

c. Anton van Leeuwenhoek _____

d. Robert Hooke _____

e. Charles A. Spencer _____

f. Max Knott and Ernst Ruska _____

1.6 What is a "flea glass"? _____

1.7 What word did Leeuwenhoek use to describe what he saw in a single drop of rainwater?

_____

1.8 What is the significance of Robert Hooke's description of a cork viewed under a microscope?

_____

TYPES OF MICROSCOPES

The modern light (optical) microscope is still one of the most widely used instruments by scientists to magnify microscopic objects for study and experimentation. In this LIFEPAC section we will look at variations of the light microscope.

The invention of the electron microscope has allowed scientists to study individual molecules that are the building blocks of living cells. We will also take a look at two variations of the electron microscope.

The **light (optical) microscope:** A **light microscope** focuses a light source at a specimen through a series of lenses. The light rays which reflect off of the object are then focused into a magnified image. All variations of a light microscope are basically a result of either changing

the light source or changing how the light source illuminates the observed specimen.

The most common type of light microscope is the **bright-field microscope**. The bright-field microscope focuses either natural light or incandescent light on a specimen, which produces a magnified image that appears slightly darker on a bright field background. This type is the most frequently used microscope in a classroom by biology students and is the type of microscope you will learn to use in this LIFEPAC.

Other variations of the light microscope have come as a result of the limited ability to produce a clear, magnified image using the full light spectrum. As an image is magnified to higher and higher levels, the image will tend to become less and less sharp. This is because of limited **resolving power**. Resolving power is the ability to distinguish between two points that are very close to each other. You may be familiar with the concept of resolution from shopping for a new television, computer monitor, or digital camera. A digital camera or computer monitor with a high level of resolution produces a very clear image. This is similar to the effect of changing the resolving power. In order to get a clearer view using a light microscope, the resolving power can be increased by either changing the light source or by manipulating the light source to be directed at the specimen in a different way.

The following chart gives you some commonly used variations of the light (optical) microscope.

TYPES OF LIGHT MICROSCOPES	LIGHT SOURCE	COMMON USE
Bright field microscope	Natural light or incandescent bulb. Oil immersion lens may be used to improve resolution.	Most commonly used by biology students.
Dark field microscope	Field of light controlled to create a bright specimen on a dark background.	Improves apparent resolution to see smaller structures in cells. Used to view unstained specimens.
Phase contrast microscope	Takes advantage of the concept that light bends and changes speed as it passes through cell structures	Makes many structures within a living cell highly visible without staining or altering the cell.
Polarizing light microscope	Limits light wave alignment to vibrate in only one plane.	Used to view molecules or cell structures with highly-ordered patterns.
Fluorescence microscope	Detects the light emitted by fluorescent molecules that are tagged to a specific cell structure. Often uses ultraviolet light.	Used to view very specific cell structures which are prepared using fluorescent molecules.

The electron microscope: Rather than focusing light at a specimen, **electron microscopes** utilize streams of electrons which are accelerated in a vacuum and directed at a prepared specimen. The speeding electrons are either absorbed by or bounce off the object at differing angles similar to light waves. The magnified image is then captured on an electron-sensitive plate, similar to photographs being captured on film. Electron microscopes are capable of magnification up to one million times, though the best images are commonly

magnified only 250,000 times! These microscopes have been very important in the study of individual molecules, for example the DNA molecules which contain the genetic codes for living organisms.

A common type of electron microscope is called a **scanning electron microscope**. The scanning electron microscope is capable of producing images that appear to be three-dimensional. This is very helpful for viewing the surface of a cell structure or organic molecule.

While the observations and discoveries made using the electron microscope are indispensable in scientists' study of our Lord God's creation, there are some major drawbacks to the use of an electron microscope. First, an electron microscope is very expensive compared to even the very best light (optical) microscopes. Second, the process of preparing a specimen to be viewed using an electron microscope is quite extensive and time consuming. Third, it is not possible to view a living organism using an electron microscope, because no living being can survive the vacuum it must be placed in for viewing. This makes it impossible to watch the ever-changing movement of a living cell using these powerful instruments.

Complete these statements.

1.9 Describe how a light microscope creates a magnified image: _____

_____

1.10 What is different about your description in problem 1.9 for an electron microscope? _____

_____

1.11 What limits the amount of magnification that can be produced using light? Why _____

_____

1.12 Name three variations of the light microscope and a common use for each:

a. _____

b. _____

c. _____

1.13 At what level of magnification are the best images produced using an electron microscope?

_____.

1.14 Name three limitations to using an electron microscope to view a microorganism.

a. _____

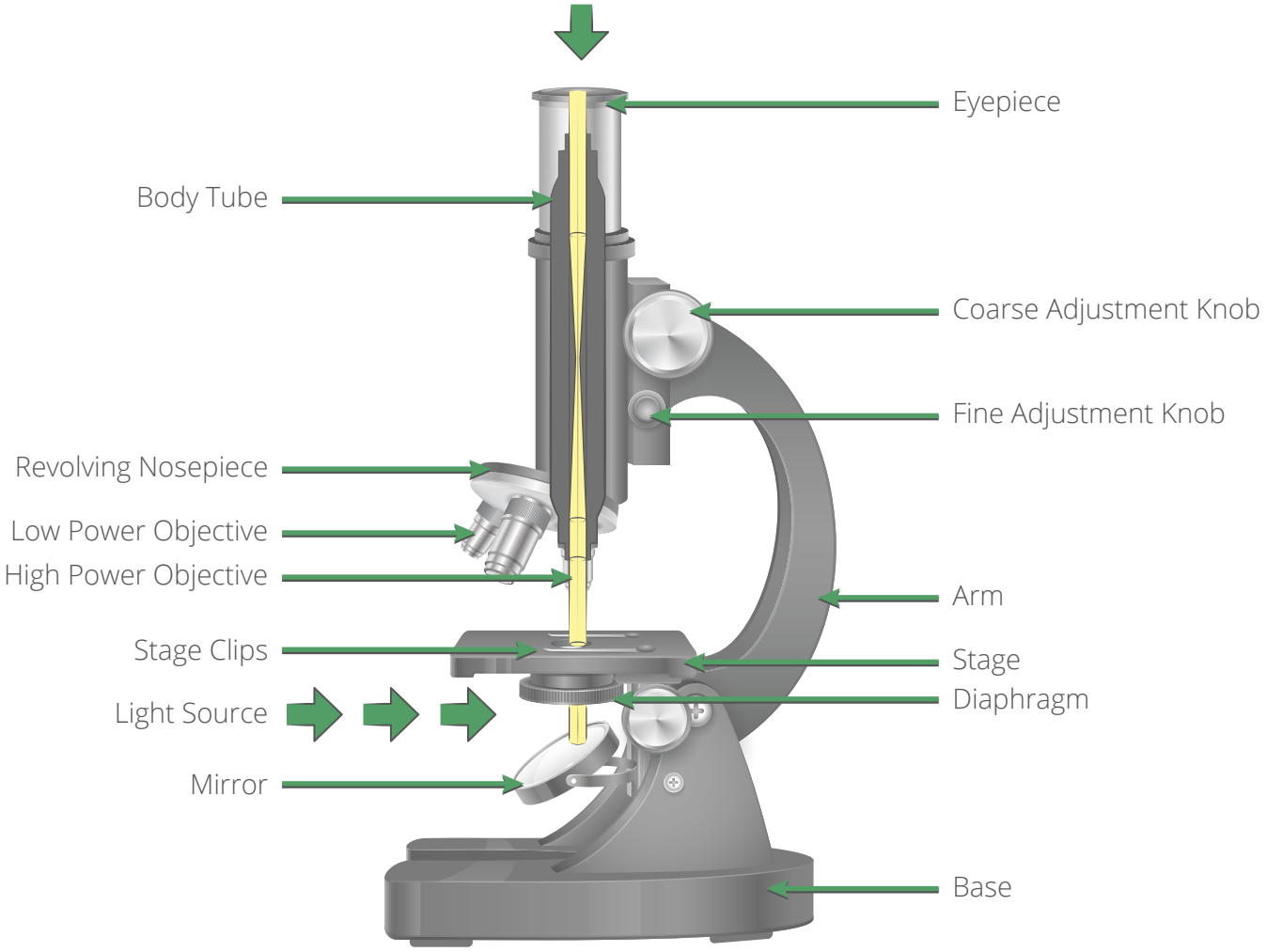
b. _____

c. _____

MICROSCOPE ANATOMY

You learned earlier in this LIFEPAC that a compound microscope uses two or more lenses to create a magnified image. In this section, you will be learning about the parts of a compound microscope and how they are involved in producing a magnified image. In the next LIFEPAC section, you will learn the proper techniques necessary for using a compound microscope to study living and non-living specimens. It may be very helpful for you to get your microscope out and have it available as you continue through this section.

Compound microscopes can be divided into two categories based on the number of tubes used for viewing. A **monocular** microscope has a single body tube, thus only one eyepiece for looking through. A **binocular** microscope has two body tubes, and thus two eyepieces used for viewing. The microscope you are using for this class may be either monocular or binocular; however, the parts and basic functions of those parts will be the same in either case.



MICROSCOPE

Using the microscope and the following list of questions, take some time to identify the parts of your microscope.

- Is your microscope monocular or binocular? _____
- What does the *high power* objective lens on your microscope say? _____
- What does the *low power* objective lens on your microscope say? _____
- Does your microscope use a natural light source directed by a mirror? _____ Or does you microscope have a built-in light source (a light bulb)? _____
- When you turn the adjustment knob, does your *body tube* move up and down or does your stage move up and down? _____

As you identify each piece of your microscope, refer to the following table to learn more about each part and how to use it correctly.

PARTS OF MICROSCOPE	DESCRIPTION
Arm	Supports the body tube of the microscope. Always carry a microscope by grasping the arm with one hand and the base with the other hand.
Base	Supports the entire microscope on a flat, level surface. The arm may be solidly attached to the base; or the arm and base may be attached by a movable hinge that would allow a user to tilt the microscope.
Body Tube(s)	Solid structure that connects the eyepiece to the objective lenses. Light passes through the body tube to the eyepiece.
Eyepiece(s)	Part of the microscope you look through to view an object. The eyepiece contains the **ocular lens**, one of the two lenses in a compound microscope. Most ocular lenses produce a magnification of 10x or 15x.
Revolving Nosepiece	Holds the objective lenses on a plate that can be rotated to change the magnification. An **objective lens** is the lower of two lenses in a compound microscope. Be sure that the nosepiece clicks into place to ensure that you will be able to see through the microscope.
Low Power Objective	Usually has a magnification of 10x. Used to scan a slide for the specimen. May also be used to view small external structures, such as the hairs on the legs of a fly.
High Power Objective	Usually has a magnification of 30x, 35x, or 40x. Can be used to identify and study the nucleus and organelles within many eukaryotic cells.

PARTS OF MICROSCOPE	DESCRIPTION
Coarse Adjustment Knob	Either moves the body tube or the stage up and down to bring the object into view. Use the coarse adjustment knob ONLY with the low power objective. CAUTION: Never use the coarse adjustment knob when viewing an object with the high power objective.
Fine Adjustment Knob	Used to bring objects into clear, sharp focus. Use this knob when focusing with the high power objective. If the object has been properly focused using the coarse adjustment knob, then only a tiny movement of the fine adjustment knob should be necessary to bring the object into sharp focus.
Stage	Supports the slide with the specimen that is being viewed. In the center of the stage is a hole that allows light to pass through from below the stage.
Stage Clips	Hold the slide in place on the stage. Gently move the clips out of the way to place the slide into place, and then gently move the clips back into place on the edges of the slide. CAUTION: Never allow the clips to come into contact with the opening in the stage. They will easily scratch the glass covering the opening.
Diaphragm	A rotating plate located just below the stage with holes of various sizes. Rotating the diaphragm allows you to increase or decrease the amount of light that is allowed to enter the microscope.
Mirror or Light Source	Used to collect light and direct it into the microscope. CAUTION: Never use direct sunlight as a source of light. Sunlight directed off the mirror can damage your eyes. Your microscope may include a built-in light source in the form of an electric light bulb. In that case, there will be no mirror.

Calculation of Magnification. So far, you have seen the strength of the ocular and objective lenses referred to as 10x, 15x, 40x, etc. But how do you calculate the total magnification of the image? As you may have assumed, "10x" means that particular lens magnifies an image to ten times its actual size. The total amount of magnification of your microscope is calculated by multiplying the powers of the ocular lens and objective lens. If the magnification of your microscopes ocular lens it 10x and the high power objective is 45x, then your total magnification on high power is 10 x 45 = 450x.

Complete these statements.

1.15 When using a _____ microscope, you would look through two eyepieces.

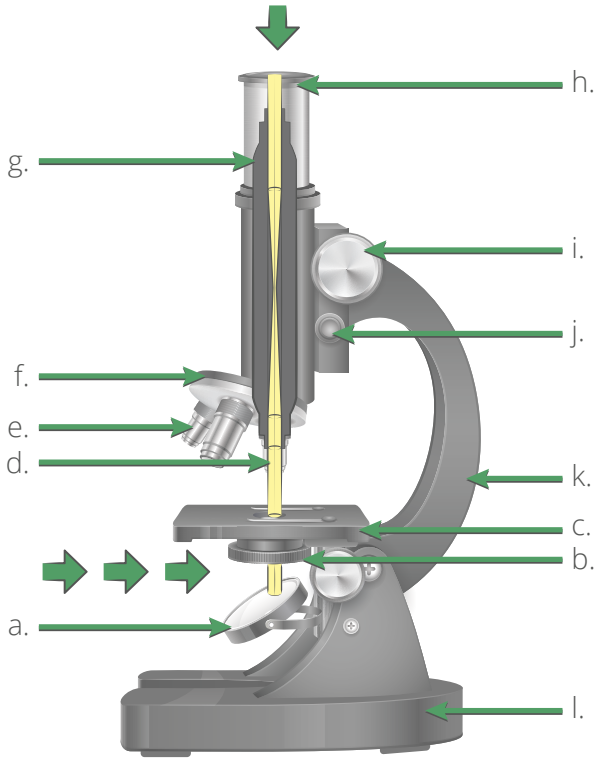
1.16 What part of a microscope rotates to change from the low power objective lens to the high power objective lens? _____

1.17 When are you never supposed to use the coarse adjustment knob? _____

_____

1.18 Which lens is closest to your eye when looking through a microscope? _____

1.19 Which lens is closest to the object that you are viewing? _____



Do the following activities.

1.20 Fill in the following blanks using the diagram of the microscope.

a. _____ b. _____ c. _____

d. _____ e. _____ f. _____

g. _____ h. _____ i. _____

j. _____ k. _____ l. _____

1.21 Complete the following table by calculating the total magnification:

Ocular Lens	Objective Lens	Total Magnification
10x	20x	a.
10x	45x	b.
10x	40x	c.
15x	20x	d.
15x	40x	e.

TECHNIQUES OF MICROSCOPY

Sample Preparation. Objects that are going to be viewed using a microscope must be prepared in such a way as to maximize the usefulness of the microscope. Since the magnified image of the specimen is produced by passing light through the object, it makes sense that the object must be thin enough to allow sufficient light to pass through.

Most specimens being viewed using a light microscope are prepared on a glass **microscope slide**. These preparations are either a **wet-mount** or **dry-mount**. A dry-mount preparation simply means that the object being viewed is placed on the microscope slide and viewed as it is. A wet-mount preparation means that the specimen is immersed in water or another liquid. In both cases, a **cover slip** is placed over the specimen to create a barrier between the specimen and the end of the objective lens. Later in this LIFEPAC, you will be instructed to use a depression slide to prepare a specimen. A **depression slide** has a small well (or depression) in it to allow for a slightly larger volume of water to be held on the microscope slide.

Another common part of preparing a specimen to be viewed under a microscope involves **staining** the cell structures we are interested in viewing. For example, a scientist may add a stain called methylene blue to a cell. Since the methylene blue stain will stain only the DNA and RNA in a cell, it can be used to see the contents of the cell nucleus more clearly. Other means of marking special structures in a cell may include using any of a great variety of other dyes (stains), fluorescent dyes, or even radioactive makers.

View Two 1003 Clips: Ranch Adventure and How to Use a Microscope, from the 10th Grade SCIENCE EXPERIMENTS Video

LEARNING APPLICATION:
Using the microscope.

In the following activity, you will learn how to prepare a wet-mount slide and observe that slide using the microscope.

These supplies are needed:

- Compound Microscope
- Microscope Slide
- Cover Slip
- Pin
- Newspaper
- Medicine Dropper
- Water
- Scissors

Follow these directions. Put a check mark in the box when each step is completed.

☐ 1. Cut a small letter "g" from the newspaper and place it in the center of the glass microscope slide. For this experiment, try to center the letter "g," keep the letter upright, and keep the bottom of the letter parallel to the bottom of your microscope slide. This will make the sketches asked for later simpler. (Newspaper works best for this activity since the paper is fairly thin, this allows enough light to pass through it for viewing with a microscope.)

☐ 2. To make a wet-mount slide, place a small drop of water directly on the specimen (letter "g") using a medicine dropper.

☐ 3. Cover the specimen with a clean cover slip. To do this properly, place one edge of the cover slip at the edge of the drop of water while holding the cover slip at a 45 degree angle to the microscope slide. Using a pin to hold the cover slip, slowly lower the cover slip over the specimen and the drop of water. The goal is to make sure you do not capture any air bubbles under the cover slip.

☐ 4. On the diagram below, draw a picture of the prepared wet-mount slide as you see it sitting on the table in front of you. Do your best to create your drawing to scale.

☐ 5. Clip the wet-mount slide into place on the stage of the microscope. Place the letter "g" directly over the center of the hole on the microscope stage.

(Continued on next page)

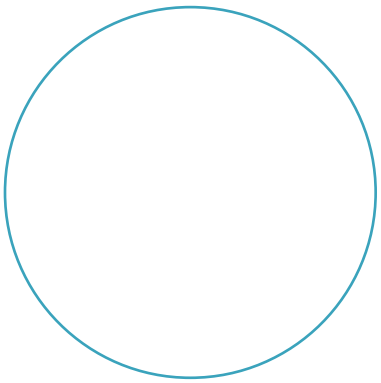
☐ 6. Look at the microscope stage from the side. DO NOT look through the eyepiece yet. Turn the revolving nosepiece to place the low power objective over your specimen. Using the course adjustment knob, lower the tube body (or raise the stage) until the low power objective ALMOST touches the microscope slide.

☐ 7. Looking through the eyepiece, slowly raise the body tube (or lower the stage) until the letter "g" comes into clear view.

☐ 8. Using the fine adjustment knob, while turning no more than a ¼ turn, focus the specimen as clearly as possible. At this point, you may need to adjust your light source to maximize the clarity of your image.

☐ 9. In the circle provided, sketch the letter "g" as it appears through the microscope. Note the low power magnification:

_____



☐ 10. While looking through the eyepiece, carefully move the slide to the left. Which way does the letter move?

_____

Now move the slide to the right. Which way does the letter move?

_____

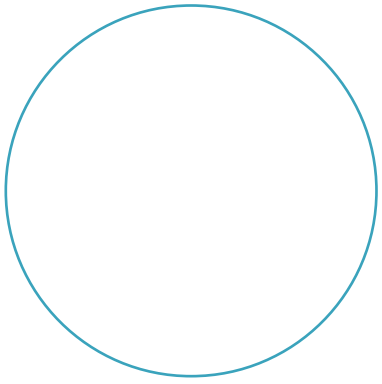
After re-centering the slide, move the slide toward yourself. Which way does the letter move?

_____

☐ 11. To switch to the high power objective: Look at the microscope from the side, (DO NOT look through the eyepiece) then rotate the revolving nosepiece so that high power objective clicks into place. Using the fine adjustment knob ONLY, carefully bring the specimen into focus.

CAUTION: *If you are unable to bring the specimen into focus with a ¼ turn of the fine adjustment knob then STOP! NEVER use the course adjustment knob while viewing using high power. Since high power objectives are longer than low power objectives, by using the coarse adjustment knob you risk forcing the high power objective lens into your slide; thus damaging both the objective lens and your specimen.* Instead turn back to the low power objective; while viewing with the low power objective, follow proper technique as outlined above to re-focus using the coarse adjustment knob and the fine adjustment knob. Then, turn back to the high power objective and use slight movements of the fine adjustment knob to re-focus.

☐ 12. In the circle provided, sketch the letter "g" as it appears through the microscope. (Depending on the power of your microscope, you may only see a very small part of the letter.)



(Continued on next page)

Describe what details you can now see on high power that you could not see on low power.

_____

_____

_____

_____

_____

Note the high power magnification:

_____

☐ 13. Optional Activity: Obtain two more specimens to be viewed under the microscope. Some ideas may be: a piece of colored thread, a piece of your hair, dirt from under your fingernail, the wing of a dead fly, etc. Prepare wet-mount slides of each specimen, and then follow proper procedure to view each one, using low power and high power objectives. In the space provided, names your items, sketch them at low and high power, and discuss what you see with the microscope compared to what you can see with your naked eyes.

Specimen #1: _____

_____

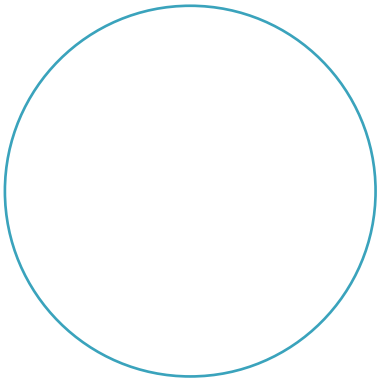
_____

_____

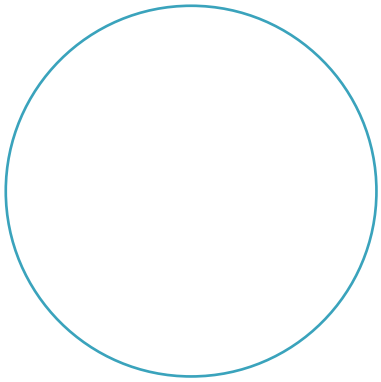
_____

_____

_____



Low Power: _____



High Power: _____

Specimen #2: _____

_____

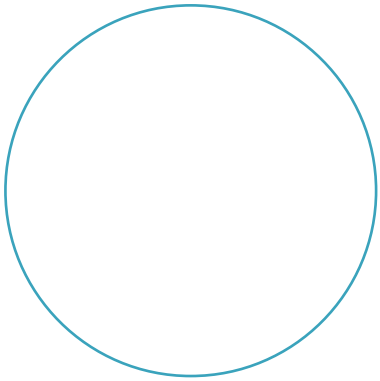
_____

_____

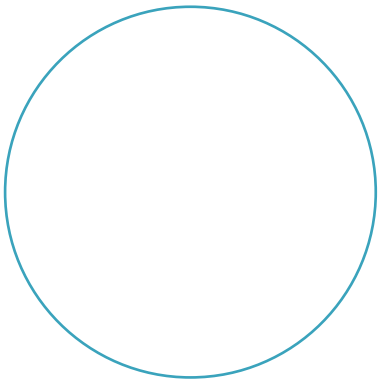
_____

_____

_____



Low Power: _____



High Power: _____

TEACHER CHECK _____ initials _____ date

Complete the statements or answer the questions.

1.22 Why are stains used when observing a specimen under a microscope? _____

_____

1.23 Describe how to prepare a wet-mount slide. _____

_____

_____

1.24 What could happen if you used the coarse adjustment knob while viewing a specimen with the high power objective? _____

_____

_____

Review the material in this section in preparation for the Self Test. The Self Test will check your mastery of this particular section. The items missed on this Self Test will indicate specific areas where restudy is needed for mastery.

SELF TEST 1

Complete these exercises (each question, 6 points).

1.01 Name the two kingdoms where all prokaryotes are classified. _____

_____

1.02 List the four kingdoms where all eukaryotes are classified. _____

_____

1.03 Explain what safety measures you might take to avoid damaging the microscope, microscope slide, or a living specimen on you microscope stage. _____

_____

_____

_____

_____

1.04 Explain three disadvantages to using an electron microscope to view microorganisms

_____

_____

_____

Match these items (each answer, 3 points)

1.05	_____	resolving power	a. cell with no membrane-bound structures
1.06	_____	objective lens	b. ability to tell two points apart
1.07	_____	optical microscope	c. magnifies an object using light and lenses
1.08	_____	monocular	d. magnifies using streams of electrons
1.09	_____	electron microscope	e. single body tube
1.010	_____	prokaryote	f. cell with a true nucleus
1.011	_____	binocular	g. lens found in the eyepiece
1.012	_____	ocular lens	h. two eyepieces
1.013	_____	eukaryote	i. magnifying lens closest to the specimen

Complete these statements (each answer, 4 points).

1.014 As a predecessor to today's microscopes, a _____ was used to focus the sun's light in order to start a fire.

1.015 The Englishman who first used the term "cells" to describe tiny compartments which made up cork was _____ .

1.016 Galileo used _____ to examine the principles of lenses, thus improving on previous attempts at magnification.

1.017 The Dutchman, _____ , was the first to carefully document observations of blood cells, sperms cells, and other microorganisms.

1.018 _____ and _____ , two sixteenth century eyeglass makers, experimented with glass lenses and a tube and found that objects could be magnified greatly.

1.019 Very little has changed in the structure of light microscopes since the 1840s when an American, _____ , was able to significantly improve the quality of the magnified images with his microscopes.

1.020 The electron microscope was invented in Germany by _____ and _____ during the 1930s.

Number the following items (1, 2, 3, 4, 5) **in order from your eye to the specimen on the stage of your microscope** (each answer, 2 point).

1.021 _____ objective lens

1.022 _____ body tube

1.023 _____ ocular lens

1.024 _____ cover slip

1.025 _____ revolving nosepiece

77/97 **SCORE** _____ **TEACHER** _____ _____
initials date

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