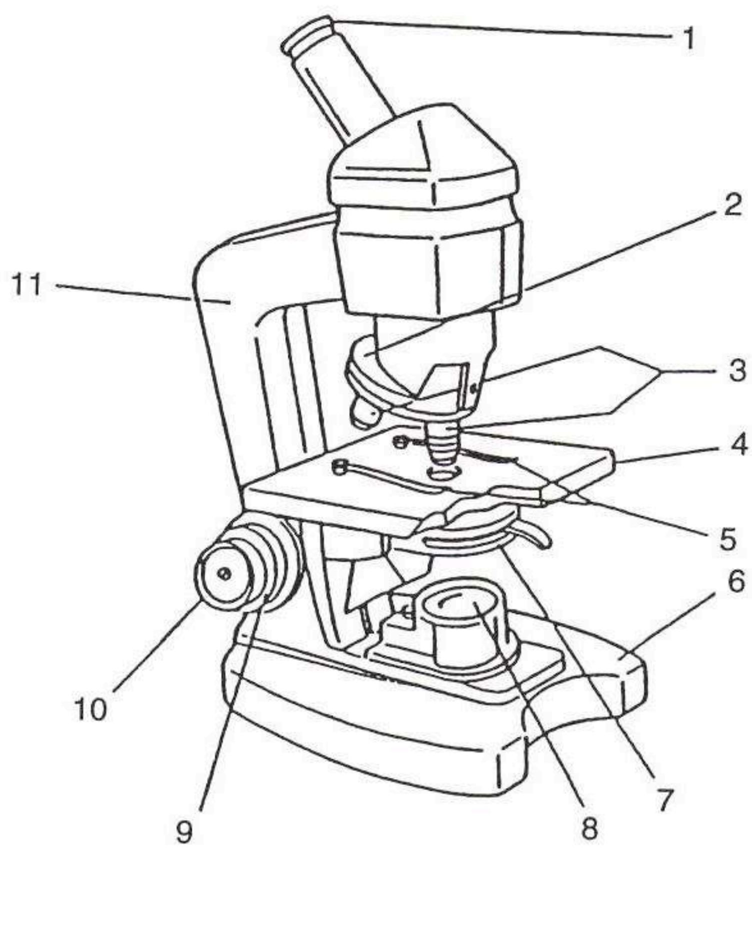
MICROBE MISSION – PRACTICE ACTIVITIES

PARTS OF THE MICROSCOPE: For each of the following parts of the microscope, give the letter representing it's function and the number representing it's location.

PART	FUNCTION
__ ocular	A. holds slide in place
__ coarse adjustment	B. foundation to keep scope stable
__ fine adjustment	C. controls the amount of light to specimen
__ arm	D. supports slide and specimen
__ nosepiece	E. lens that form initial image of specimen
__ objectives	F. holds objectives - allows changing power
__ stage	G. used for initial & low power focusing
__ stage clips	H. supports ocular, objectives & body tube
__ diaphragm	I. source of light
__ illuminator	J. magnifies image formed by objective
__ base	K. used for fine tuning & high power focusing

LOCATION

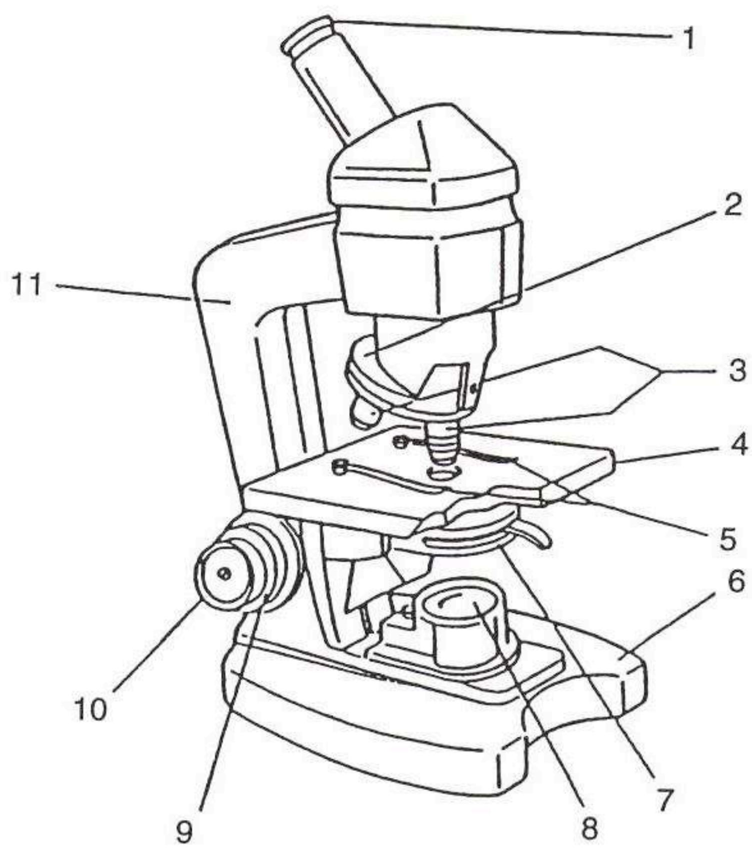


MICROBE MISSION – PRACTICE ACTIVITIES

PARTS OF THE MICROSCOPE: For each of the following parts of the microscope, give the letter representing it's function and the number representing it's location.

PART	FUNCTION
1. J ocular	A. holds slide in place
9. G coarse adjustment	B. foundation to keep scope stable
10.K fine adjustment	C. controls the amount of light to specimen
11.H arm	D. supports slide and specimen
2. F nosepiece	E. lens that forms initial image of specimen
3. E objective	F. holds objectives - allows changing power
4. D stage	G. used for initial & low power focusing
5. A stage clips	H. supports ocular, objectives & body tube
7. C diaphragm	I. source of light
8. I illuminator	J. magnifies image formed by objective
6. B base	K. used for fine tuning & high power focusing

LOCATION



MICROBE MISSION – PRACTICE ACTIVITIES

MICROSCOPE USAGE

Equipment: a compound microscope with scanning power (4-5X), low power (10X) and high high power objectives (40-45X)

Use the microscope to answer the following questions.

1. What is the power of the ocular or eye piece of this microscope?

2. List the powers of each objective for this microscope.

3. What is the range of magnification (lowest to highest) of this microscope?

Place the transparent millimeter ruler on the stage in the normal reading position and examine it with the scanning power objective (4X or 5X). Hint: the ruler is not as thick as a slide so applying gentle pressure to one end may make it easier to focus.

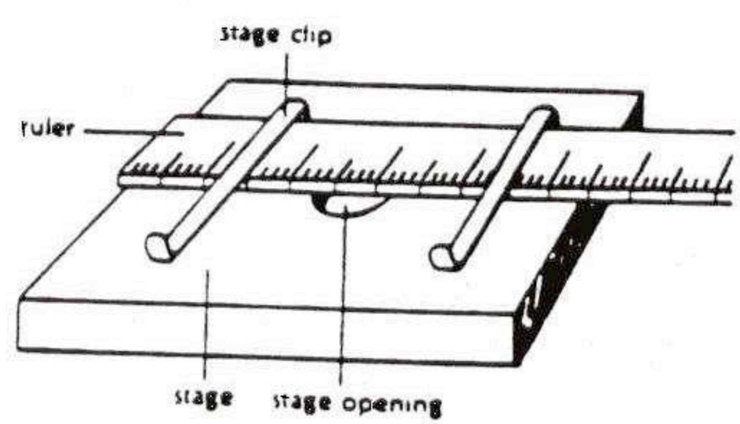
4. Find the number 5 on the ruler. Draw how it looks when viewing ruler on the stage and how it looks when viewed using the ocular. How do the two images compare?

5. Arrange the ruler so the metric scale is visible (see diagram below). Measure the diameter of the field of view in millimeters. Now convert the millimeters to micrometers.

6. Examine the transparent millimeter ruler with the low power objective (10X) and again measure the diameter of the field in millimeters. Now convert the millimeters to micrometers.

7. Assume that the high power field is ¼ of the diameter of the low power field. What is its diameter?

8. What is the ratio of the diameter of scanning power to low power?



MICROBE MISSION – PRACTICE ACTIVITIES

MICROSCOPE USAGE

Equipment: a compound microscope with scanning power (4-5X), low power (10X) and high high power objectives (40-45X)

Use the microscope to answer the following questions.

1. What is the power of the ocular or eye piece of this microscope?
Depends on microscope (10X or 12X most common)

2. List the powers of each objective for this microscope.
4X, 10X, 40X most common

3. What is the range of magnification (lowest to highest) of this microscope?
40X to 400X most common

Place the transparent millimeter ruler on the stage in the normal reading position and examine it with the scanning power objective (4X or 5X). Hint: the ruler is not as thick as a slide so applying gentle pressure to one end may make it easier to focus.

4. Find the number 5 on the ruler. Draw how it looks when viewing ruler on the stage and how it looks when viewed using the ocular. How do the two images compare?
Image will be inverted and reversed

5. Arrange the ruler so the metric scale is visible (see diagram below). Measure the diameter of the field of view in millimeters. Now convert the millimeters to micrometers.

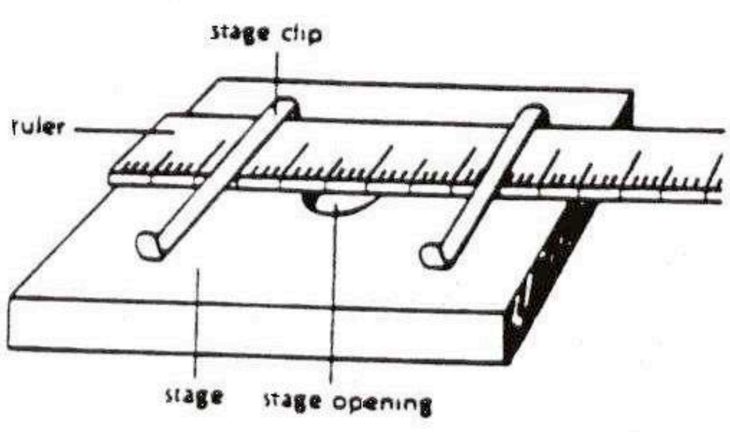
Depends upon microscope usually about 3 mm or 3000 mcm

6. Examine the transparent millimeter ruler with the low power objective (10X) and again measure the diameter of the field in millimeters. Now convert the millimeters to micrometers.

Depends upon microscope usually about 1.5 mm or 1500 mcm

7. Assume that the high power field is ¼ of the diameter of the low power field. What is its diameter?
Depends upon microscope usually about 3.5 - 4 mm or 350 -400 mcm

8. What is the ratio of the diameter of scanning power to low power?
Scanning power is usually about twice the diameter of low power



MICROBE MISSION – PRACTICE ACTIVITIES

PROPERTIES OF MICROSCOPY

Materials: Microscope with 10X ocular and 5X, 10X, and 40X objectives, clear mm ruler, photo of protozoan.

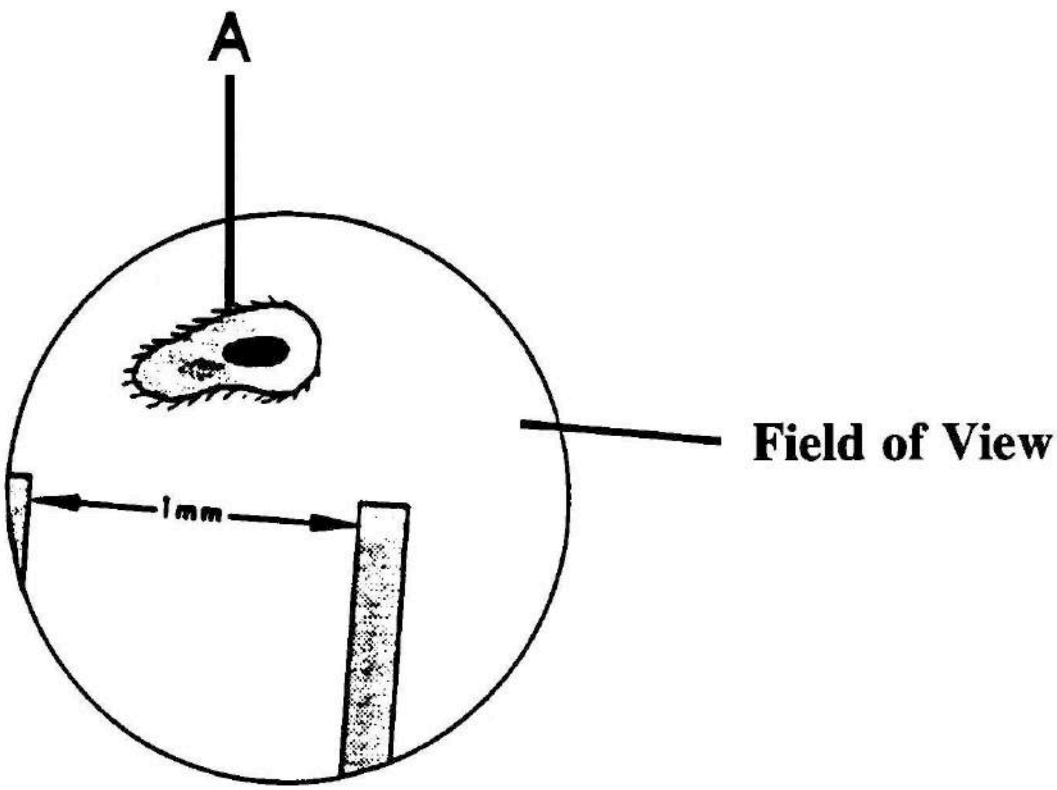
1. A student prepares a slide of the letter "d" and positions the slide on the stage of the microscope so the letter is in the normal reading position. Draw how the “d” will appear when viewed.

2. How many millimeters is the field of view containing critter A? (diagram) How many micrometers is it?

3. What is the approximate length of critter A in micrometers?

4. When viewing critter A, if it appears to be moving toward 8 o’clock, what direction is it actually moving? (Use the numbers on the clock as directions for the field of view)

5. Assuming critter A is observed under low power, how will the appearance of critter change when he is observed under high power as to size, detail, and brightness?



MICROBE MISSION – PRACTICE ACTIVITIES

PROPERTIES OF MICROSCOPY

Materials: Microscope with 10X ocular and 5X, 10X, and 40X objectives, clear mm ruler, photo of protozoan.

1. A student prepares a slide of the letter "d" and positions the slide on the stage of the microscope so the letter is in the normal reading position. Draw how the "d" will appear when viewed. **It will be inverted and reversed.**

2. How many millimeters is the field of view containing critter A? (diagram) How many micrometers is it? **about 1600 mcm**

3. What is the approximate length of critter A in micrometers?

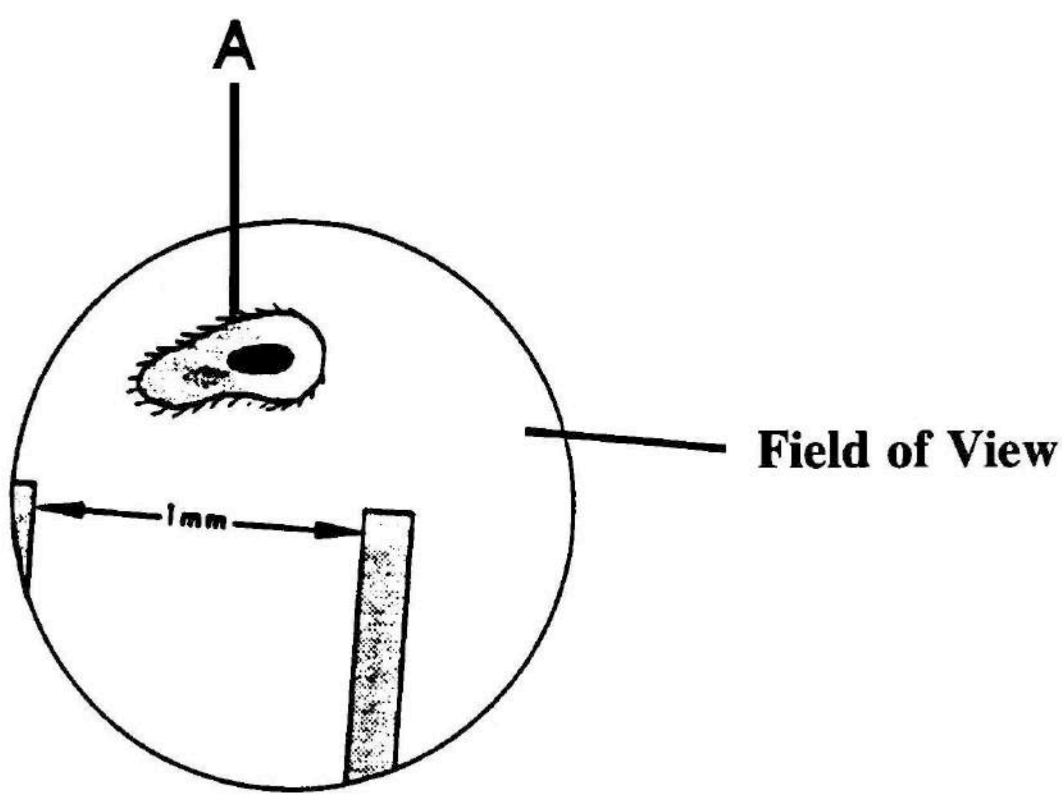
about 600 mcm

4. When viewing critter A, if it appears to be moving toward 8 o'clock, what direction is it actually moving? (Use the numbers on the clock as directions for the field of view)

toward 2 o'clock

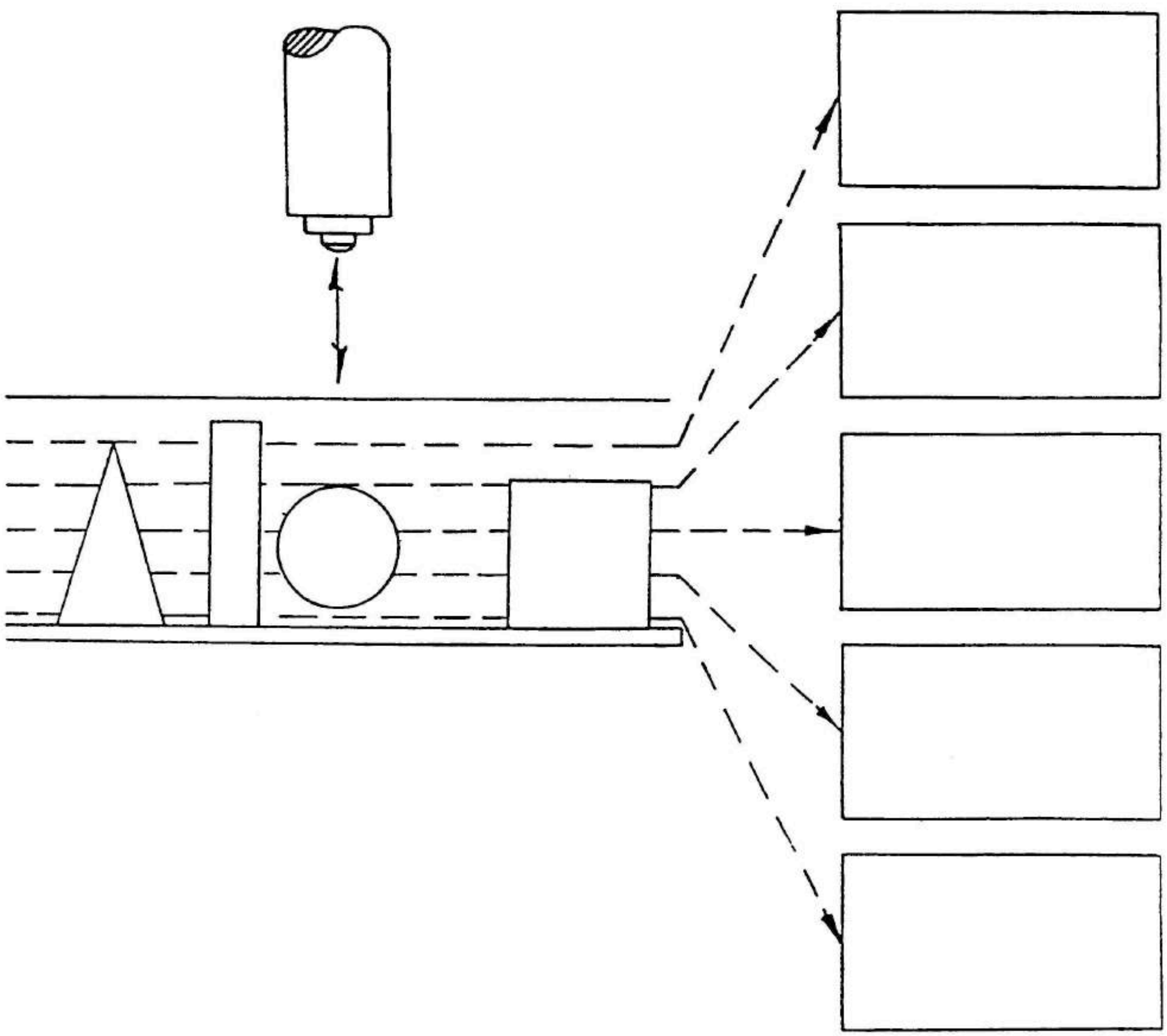
5. Assuming critter A is observed under low power, how will the appearance of critter change when he is observed under high power as to size, detail, and brightness?

Larger, greater detail, and darker



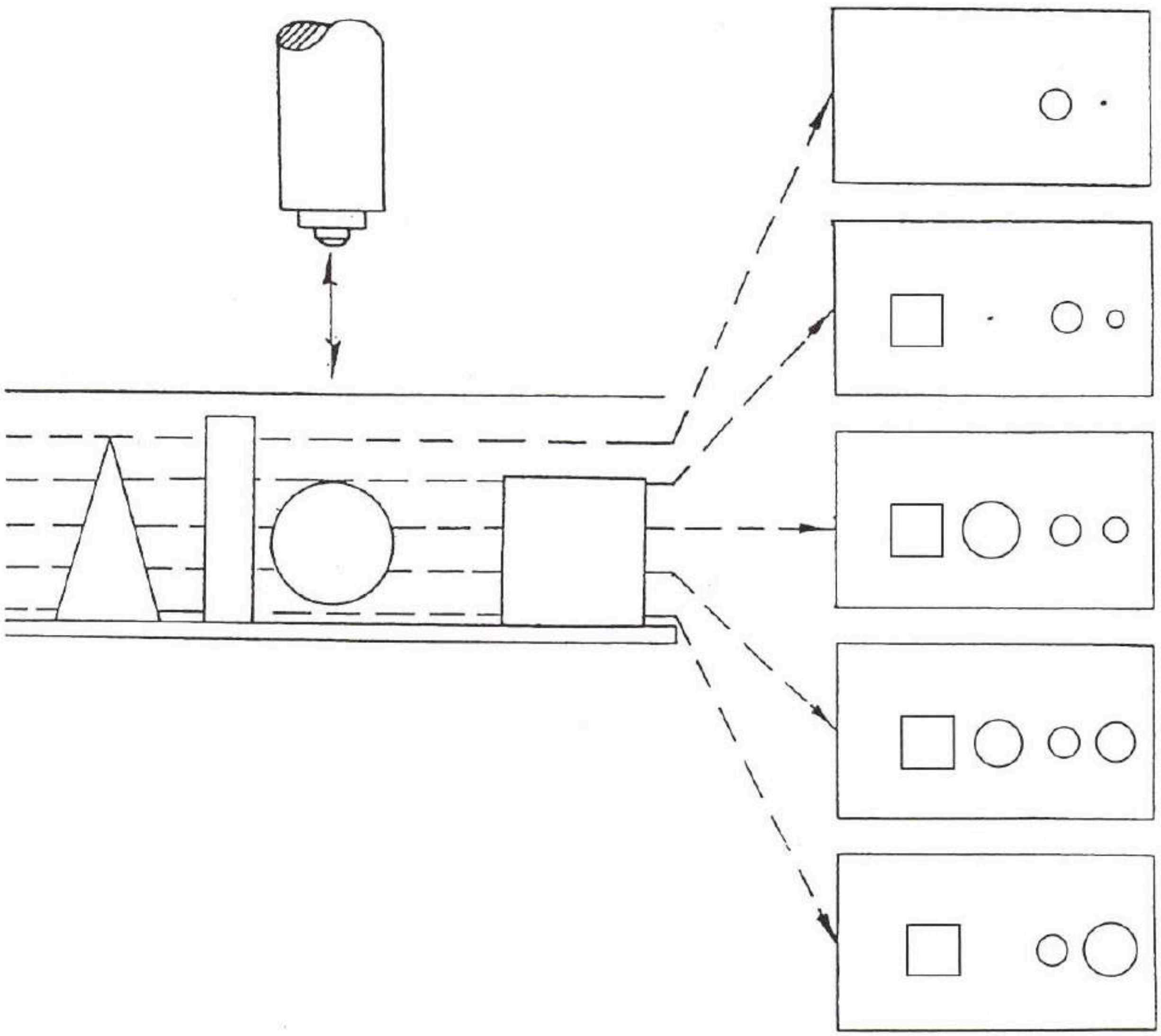
DEPTH OF FOCUS EXERCISE

Below are four objects located between a slide and a coverslip. The actual objects would of course be 3-D. The objects are left to right; a cone, a cylinder, a sphere and a cube. As one focuses down through the various levels a two dimensional representation will be visible. At each level (represented by the dotted lines to the slide diagram) **draw what two dimensional shapes would be present and give their proper location on the slide diagram.**



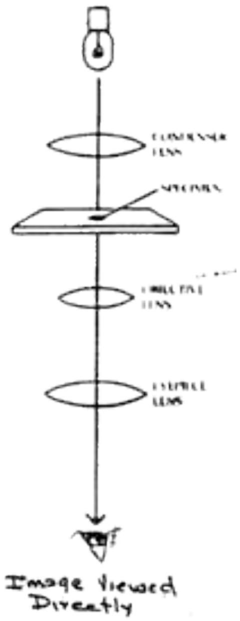
DEPTH OF FOCUS EXERCISE

Below are four objects located between a slide and a coverslip. The actual objects would of course be 3-D. The objects are left to right; a cone, a cylinder, a sphere and a cube. As one focuses down through the various levels a two-dimensional representation will be visible. At each level (represented by the dotted lines to the slide diagram) draw what two dimensional shapes would be present and give their proper location on the slide diagram.

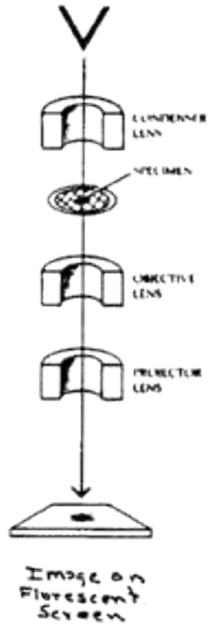


MICROBE MISSION – PRACTICE ACTIVITIES

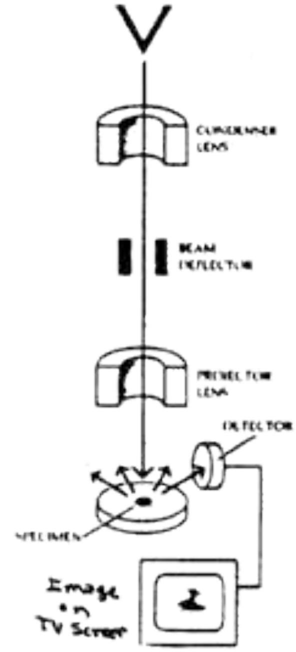
TYPES OF MICROSCOPE IMAGES



(a)



(b)

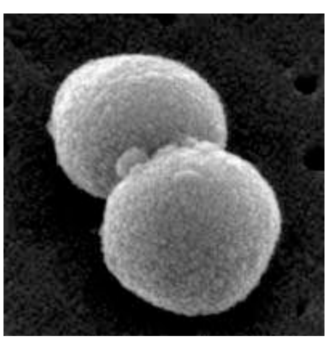


(c)

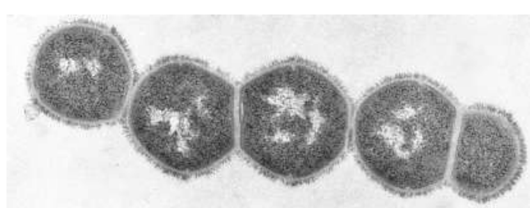
Types of Microscopes:

1. Give the letter of the diagram which illustrates the operation of a transmission electron microscope. How should the image appear?
2. Give the letter of the diagram which illustrates the operation of a scanning electron microscope. How should the image appear?
3. .Give the letter of the diagram which illustrates the operation of a light microscope. How should the image appear?
4. With which type of microscope can examine a living organism. ? How can you examine the exterior surface and internal features of a living organism with this of microscope?
5. Examine the images below and indicate which type of microscope was used to obtain each image. Use the letters of the Images (**C, D, E**) as reference

Images from Different Microscopes



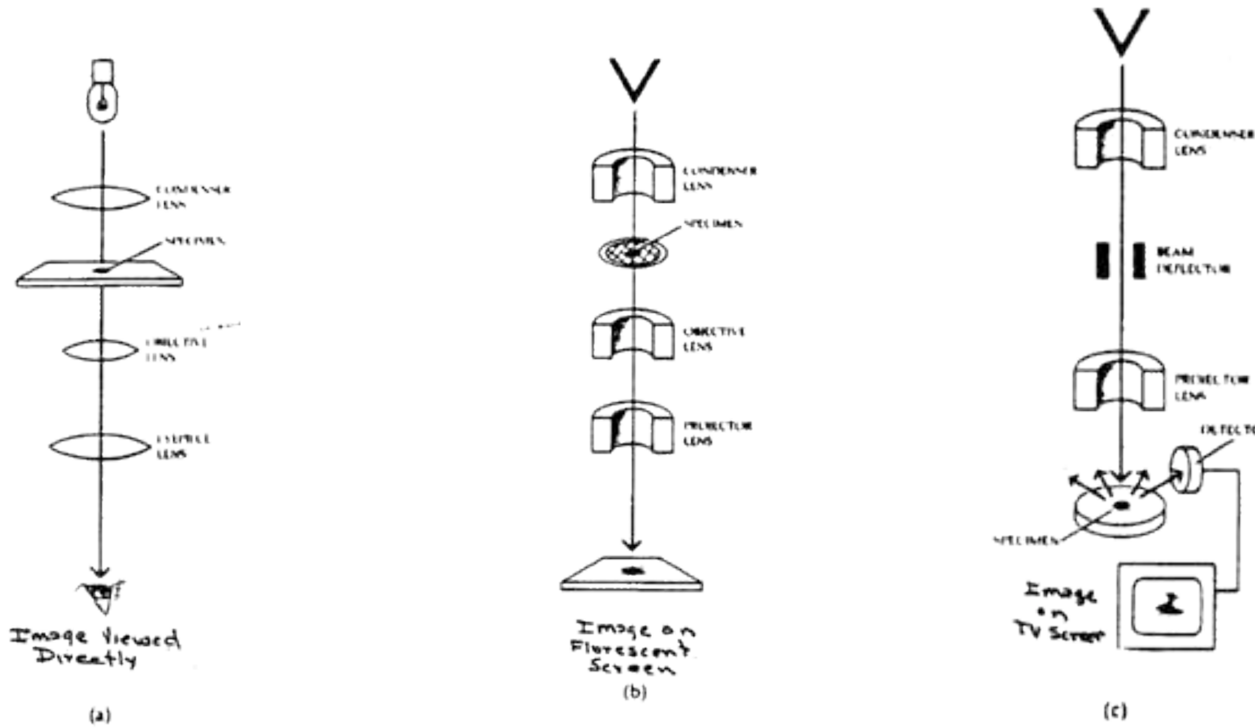
C



D

E

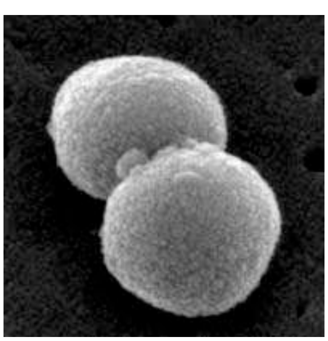
TYPES OF MICROSCOPE IMAGES



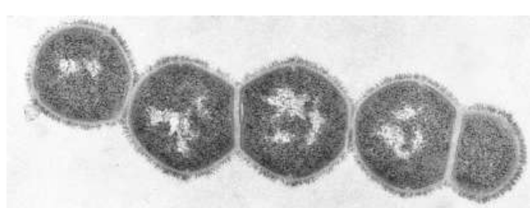
Types of Microscopes:

1. Give the letter of the diagram which illustrates the operation of a transmission electron microscope. How should the image appear? **B – thin slice**
2. Give the letter of the diagram which illustrates the operation of a scanning electron microscope. How should the image appear? **C – 3-dimensional**
3. .Give the letter of the diagram which illustrates the operation of a light microscope. How should the image appear? **A- two-dimensional - can be alive**
4. With which type of microscope can examine a living organism? **Light microscope – A** How can you examine the exterior surface and internal features of a living organism with this of microscope? **Focus through the object**
5. Examine the images below and indicate which type of microscope was used to obtain each image. Use the letters of the Images (**C, D, E**) as reference **C = SEM, D= TEM, and E = light microscope**

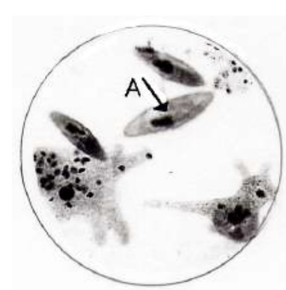
Images from Different Microscopes



C



D



E

MICROBE MISSION – PRACTICE ACTIVITIES

OBSERVATIONS:

Examine the slide and use the information provided below to answer the following questions.

The diameter of the field of view is ___________________ millimeters.

1. What objective (scanning, low, or high) power of the microscope is appropriate for observing these Microbes?

2. What is the diameter of this field of view in millimeters?

3. What is the size of this microbe in millimeters?

4. Using the fine adjustment knob, carefully focus up and down through the specimen to determine its 3-dimensional shape. Draw the microbe.

5. Describe the characteristics of this microbe that are visible to you?

MICROBE MISSION – PRACTICE ACTIVITIES

OBSERVATIONS: Key depends upon microscope used and slide observed.

Examine the slide and use the information provided below to answer the following questions.

The diameter of the field of view is ___________________ millimeters.

1. What objective (scanning, low, or high) power of the microscope is appropriate for observing these Microbes?

2. What is the diameter of this field of view in millimeters?

3. What is the size of this microbe in millimeters?

4. Using the fine adjustment knob, carefully focus up and down through the specimen to determine its 3-dimensional shape. Draw the microbe.

5. Describe the characteristics of this microbe that are visible to you?

MICROBE MISSION – PRACTICE ACTIVITIES

FORMULATING A DICHOTOMOUS KEY

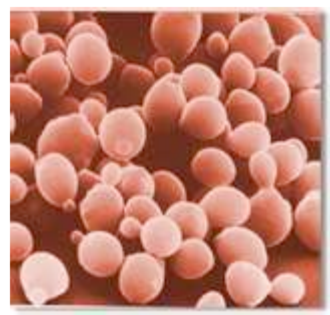
Make a list of observations for each of these 5 microbes. Volvox, Euglena, Amoeba, Paramecium, And Yeast (If possible, observe them using the microscope. Otherwise use pictures)

Volvox colony (800 mcm)

Euglena (130 mcm)

Amoeba (500 mcm)

Paramecium (250 mcm)



Baker's yeast (10 mcm)

<u>Observations:</u>

Volvox

Euglena

Amoeba

Paramecium

Baker's yeast

MICROBE MISSION – PRACTICE ACTIVITIES

Using the observations, formulate a dichotomous key to identify 5 microbes. There should be one less step than the total number of organisms to be identified in your dichotomous key. The key need not be the same as the ones produced by others.

1.
1.

2.
2.

3.
3.

4.
4.

RELATIVE SIZE OF THESE MICROBES:

Draw these microbes to scale: Volvox, Euglena, Amoeba, Paramecium and Yeast

FORMULATING A DICHOTOMOUS KEY

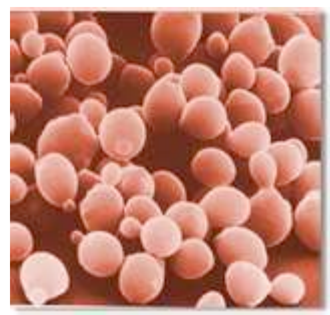
Make a list of observations for each of these 5 microbes. Volvox, Euglena, Amoeba, Paramecium, And Yeast (If possible, observe them using the microscope. Otherwise use pictures)

Volvox colony (800 mcm)

Euglena (130 mcm)

Amoeba (500 mcm)

Paramecium (250 mcm)



Baker's yeast (10 mcm)

<u>Observations:</u>

Volvox - largest specimen – round colony of cells – special cells within colony – green color

Euglena – 4th largest specimen – long cell with flagella – green in color – chloroplasts

Amoeba – 2nd largest – has long arm-like projections (pseudopods) – gray colored

Paramecium – 3rd largest – slipper shaped – has many cilia – internal organelles – macronucleus & micronucleus

Baker's yeast – smallest cells – round to oval shaped, many have buds or small circles attached

MICROBE MISSION – PRACTICE ACTIVITIES

Using the observations, formulate a dichotomous key to identify 5 microbes. There should be one less step than the total number of organisms to be identified in your dichotomous key. The key need not be the same as the ones produced by others.

Sample Key – There are several possible ways the key can be made.

1. Green colored cells – has chloroplhyll . . . . **2.**
1. Not green in color – no chlorophyll . . . . **3.**

2. Colony with many cells – some specialized . . . .**Volvox**
2. Single long cell with flagella . . . . **Euglena**

3. Long arm-like projections or pseudopods . . . . **Amoeba**
3. No pseudopods . . . .**4.**

4. Slipper shaped cell with cilia . . . . **Paramecium**
4. Round or oval cells - many with buds . . . . **Baker's Yeast**

RELATIVE SIZE OF THESE MICROBES:

Draw these microbes to scale: Volvox, Euglena, Amoeba, Paramecium and Yeast

Draw these to scale:

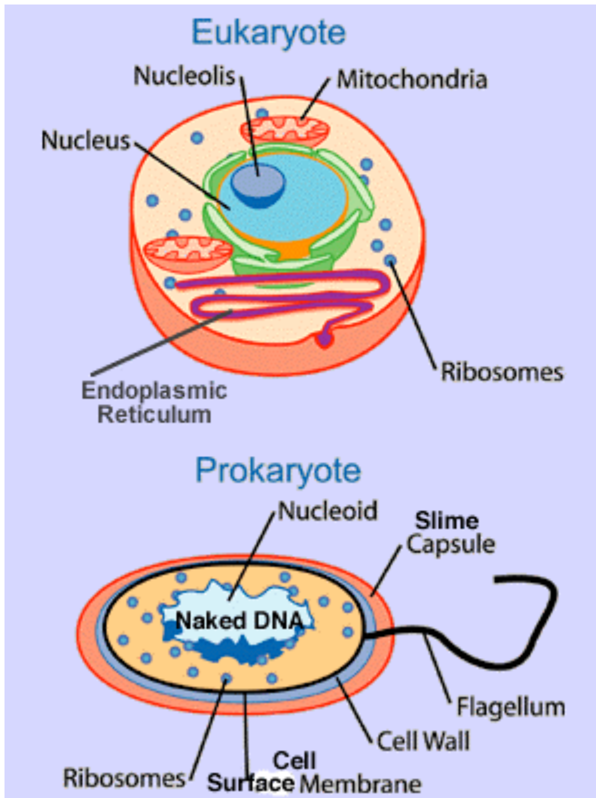
Yeast (10mcm) - Euglena(130mcm) - Paramecium(250mcm) - Amoeba(500mcm) - Volovx(800mcm)
Smallest --Largest

MICROBE MISSION – PRACTICE ACTIVITIES

MICROBIAL STRUCTURE:

Some microbes are considered acellular, others are prokaryotic cells and still others are eukaryotic cells. **Distinguish between acellular and cellular microbes. Which types of microbes are acellular**?

PROKARYOTIC VS EUKARYOTIC CELLS



Compare the prokaryotic and eukaryotic cells.

List the **<u>Similarities</u>** **<u>Differences</u>**

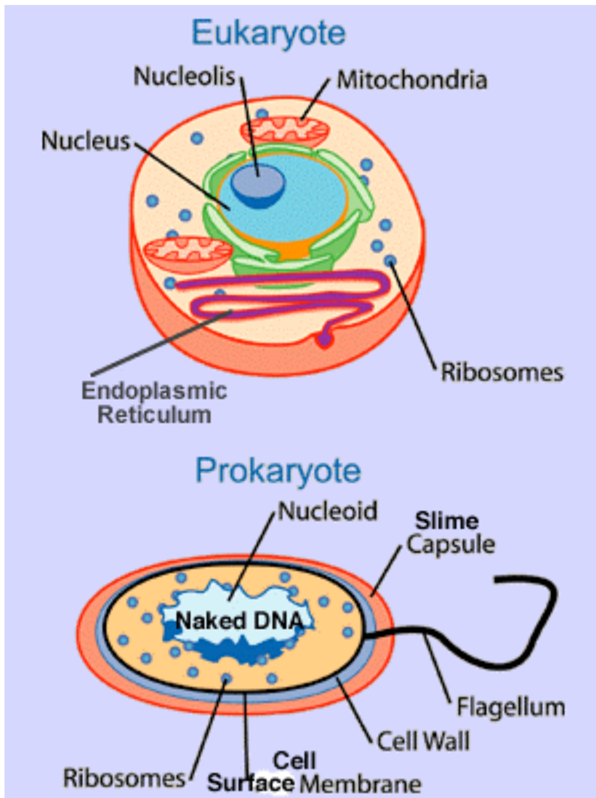
Which microbes are Prokaryotic?

Which microbes are Eukaryotic?

MICROBIAL STRUCTURE:

Some microbes are considered acellular, others are prokaryotic cells and still others are eukaryotic cells. Distinguish between acellular and cellular microbes. Which types of microbes are acellular?
A cellular organisms only have DNA or pieces of protein. They can not carry on life activities or reproduce by themselves. They must use the cell structures from another living cell they invade. Viruses and prions are considered a cellular.

PROKARYOTIC VS EUKARYOTIC CELLS



Compare the prokaryotic and eukaryotic cells.

List the	Similarities (in both)	Differences
	nuclear material	**no organized nucleus in Prokaryotic**
	ribosomes	**membrane bound organelles in Eukaryotic but lacking in Prokaryotic**
	cytoplasm	**Slime capsule in Prokaryotic**
	Surface membrane	**Make up of cell wall different**
	May have cell wall	**Structure of flagellum different**
	Both may have flagellum	**Prokaryotic – single celled**
		Eukaryotic may be multlple celled organisms
		Circular DNA vs Linear DNA
		Sizes of ribosome subunits differ
		Prokaryotic has plasmids

Which microbes are Prokaryotic? **Bacteria and Archaea**
Which microbes are Eukaryotic? **Algae, Protozoa, Fungi, Parasitic worms**

MICROBE MISSION – PRACTICE ACTIVITIES

CELL ORGANELLE/STRUCTURES AND THEIR FUNCTIONS

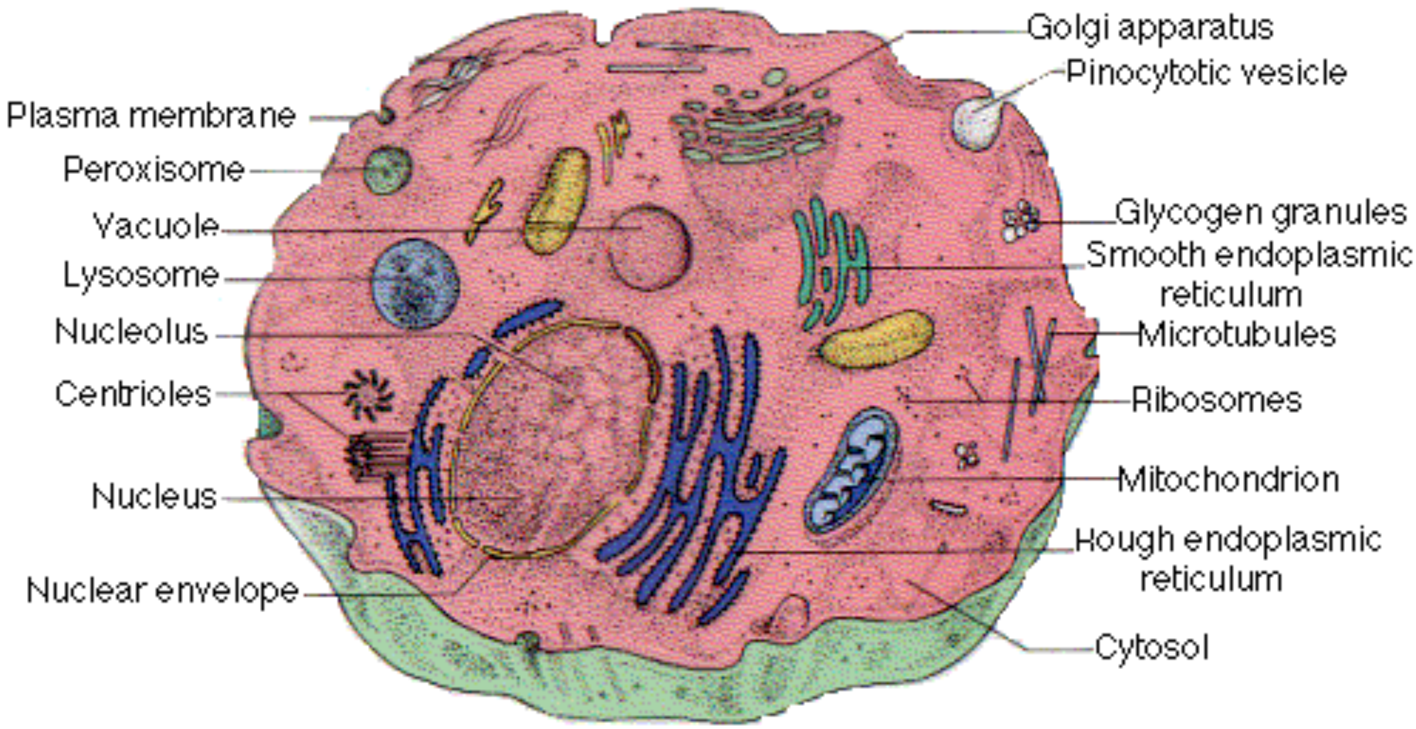
Use the organelles for the Plant and Animal Cell diagrams for answering the questions.

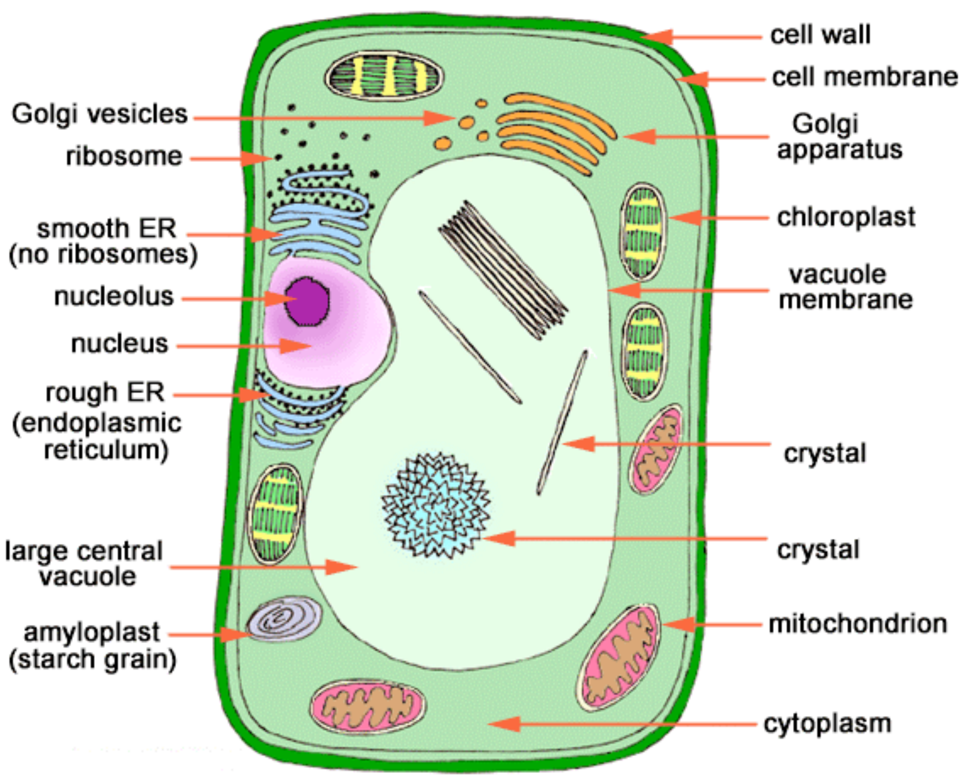
Cells are often referred to as small chemical factories. Factories have components which for specific functions. For each of the factory components listed, indicate which cell organelles perform this function in the plant and animal cell. Functions may involve more than one organelle.

Function	Plant Cell Organelle/Structure	Animal Cell Organelle/Structure
Support		
Controls material entering and leaving		
Internal transport system		
Powerhouse		
Control center		
Production of key products		
Packaging center for shipment of products		
Shipment of materials out of cell		
Storage of liquids and solids		
Recycling center		
Convert light energy to chemical energy		
Allows new cell factories to be produced		

MICROBE MISSION – PRACTICE ACTIVITIES

CELL ORGANELLE/STRUCTURES AND THEIR FUNCTIONS





MICROBE MISSION – PRACTICE ACTIVITIES

CELL ORGANELLE/STRUCTURES AND THEIR FUNCTIONS

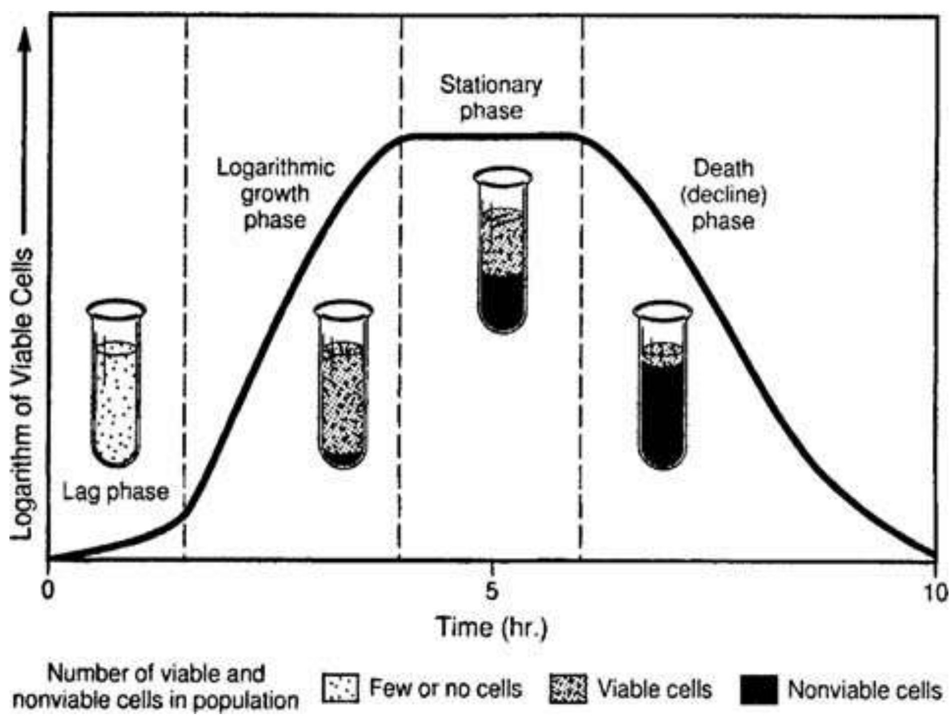
Use the organelles for the Plant and Animal Cell diagrams for answering the questions.

Cells are often referred to as small chemical factories. Factories have components which for specific functions. For each of the factory components listed, indicate which cell organelles perform this function in the plant and animal cell. Functions may involve more than one organelle.

Function	Plant Cell Organelle/Structure	Animal Cell Organelle/Structure
Support	**Cell wall**	**Cytoskeleton – microfilaments Microtubules – cell membrane**
Controls material entering and leaving	**Cell membrane, pores**	**Cell membrane, pores**
Internal transport system	**Endoplasmic reticulum**	**Endoplasmic reticulum**
Powerhouse	**Mitochondria**	**Mitochondria**
Control center	**Nucleus** **Organelle DNA for mitochondria & chloroplast**	**Nucleus** **Organelle DNA for mitochondria**
Production of key products	**Ribosomes, chloroplasts** **Endoplasmic reticulum**	**Ribosomes** **Endoplasmic reticulum**
Packaging center for shipment of products	**Golgi apparatus** **Endoplasmic reticulum**	**Golgi Apparatus** **Endoplasmic reticulum**
Shipment of materials out of cell	**Golgi apparatus , Vesicles**	**Golgi apparatus , Vesicles**
Storage of liquids and solids	**Chromoplasts, plastids, Vacuoles**	**Vacuole and vesicles**
Recycling center	**Lysosomes (but rare) and Perixosomes**	**Lysosomes and Perixosomes**
Convert light energy to chemical energy	**Chloroplasts**	
Allows new cell factories to be produced	**Nuclear DNA and Cell Wall**	**Nuclear DNA and Centrioles**

MICROBE MISSION – PRACTICE ACTIVITIES

MICROBIAL GROWTH CURVE:



1. What is the independent variable for this growth graph? In what units is it measured?

2. What is the dependent variable for this growth graph? In what units is it measured?

3. What is a viable cell?

4. What is a nonviable cell?

5. What is happening to the microbes during the lag phase?

6. What is happening during the logarithmic growth phase?

7. What is happening during the stationary phase?

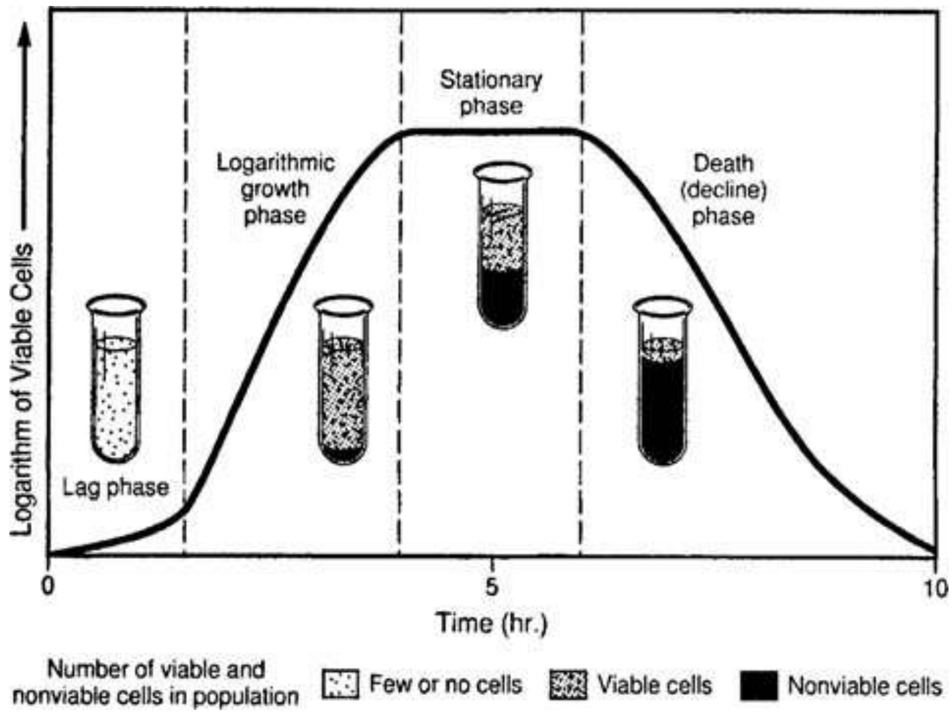
8. What is happening during the death phase?

9. What environmental factors could cause the death of these microbes?

10. If a colony of 100 bacteria doubles in number every half hour, how many bacteria will be present after 5 hours?

MICROBE MISSION – PRACTICE ACTIVITIES

MICROBIAL GROWTH CURVE:



1. What is the independent variable for this growth graph? In what units is it measured?
   Time in Seconds
2. What is the dependent variable for this growth graph? In what units is it measured?
   Cells – logarithm of number of cells
3. What is a viable cell?
   Living cells
4. What is a nonviable cell?
   Dead cells
5. What is happening to the microbes during the lag phase?
   Producing materials needed to reproduce
6. What is happening during the logarithmic growth phase?
   Rapid growth – number double each generation
7. What is happening during the stationary phase?
   Same number of cells dies as are being produced
8. What is happening during the death phase?
   Rapid death of cells
9. What environmental factors could cause the death of these microbes?
   Food supply limited, pollution of environment by wastes
10. If a colony of 100 bacteria doubles in number every half hour, how many bacteria will be present after 5 hours? **102,400**

MICROBE MISSION – PRACTICE ACTIVITIES

TEMPERATURE AND MICROBES:

On the basis of preferred temperature ranges, microbes are classified as psychrophiles (cold-living), mesophiles (moderate-temperature-loving), and thermophiles (heat-loving).

- **Psychrophiles** can grow at 0° C but optimum is about 15° C.
- **Psychrotrophs** can grow at 0° C also but optimum is 20 - 30° C – important in food spoilage.
- **Mesophiles** grow best at moderate around 37° C – many pathogens fall in this category.
- **Thermophiles** have a growth optimum at around 60° C.
- **Hyperthermophiles** have growth optima of 80° C or higher (Archaea).

Use the information provided above to help in answering the questions.

1. What is the **most specific unit** on the Easy Temp probe?

2. Use the Easy temp probe to determine the **temperature of Solutions A.** Record it here.

3. Use the Easy temp probe to determine the **temperature of Solutions B.** Record it here.

4. Which **type of microbes** would prefer to grow in the **temperature of Solution A?**

5. Which **type of microbes** would prefer to grow in the **temperature of Solution B**?

6. Which **types of microbes** could grow on food **in your refrigerator**?

7. Which **type of microbes** could grow in **very high temperatures**?

8. Which type of microbes could grow at **human body temperature**? **(~ 37 degrees C)**

MICROBE MISSION – PRACTICE ACTIVITIES

TEMPERATURE AND MICROBES:

Using the Easy Temp Probe

Note: Steps 1-3 have been done for you.

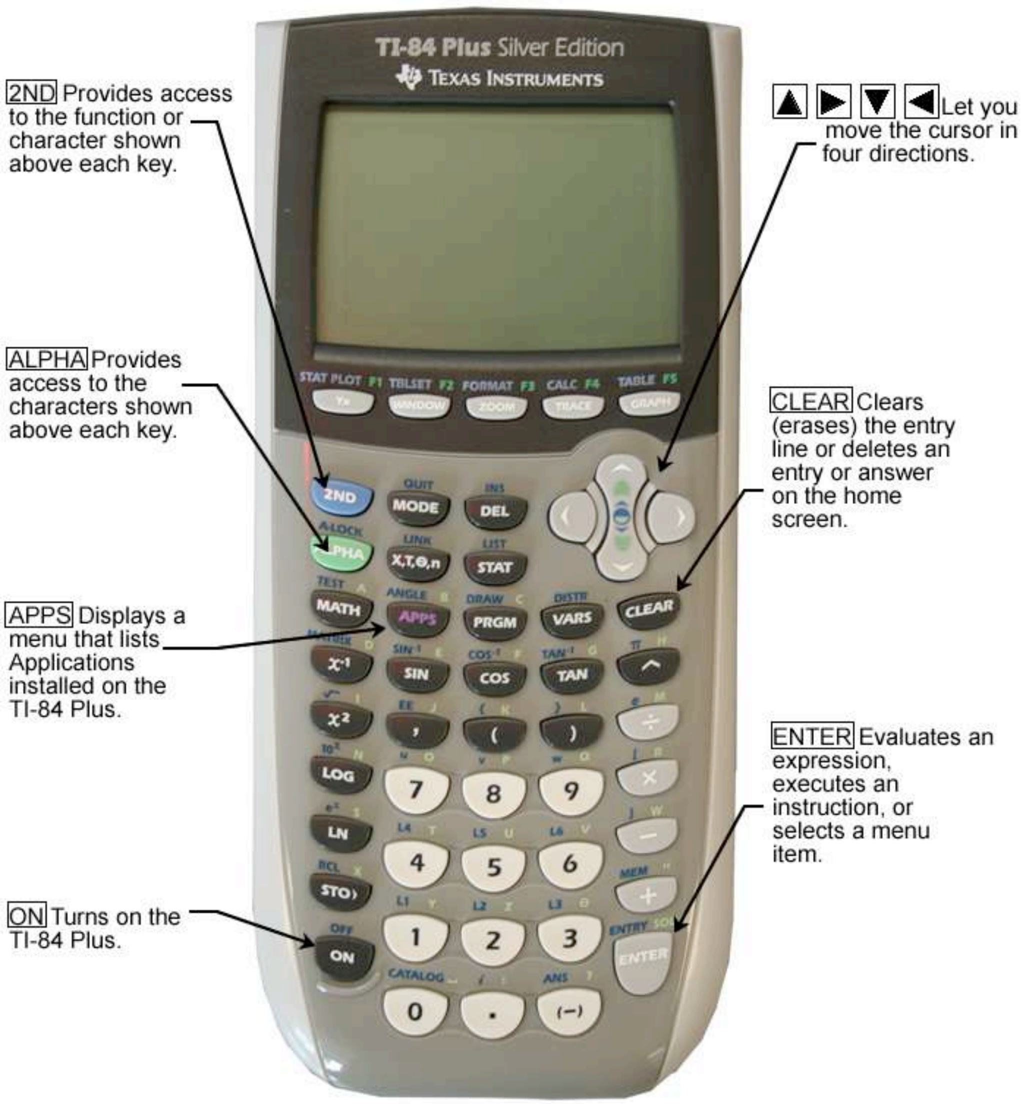
1. Turn the TI-84 Plus calculator on, and display the home screen (a flashing dark square in upper right corner). If another application is open select **Quit** and/or **Clear** to get the home screen.

2. Connect the EasyTemp sensor to the calculator. After a few seconds, the EasyData main screen is displayed. The screen shows the current EasyData mode and the current sensor reading.

3. Select **File** and then the option **New.**

4. Measure the temperature of the lab.

- Watch the temperature until the temperature levels off.
- Record the highest temperature to the nearest 0.1 oC.



MICROBE MISSION – PRACTICE ACTIVITIES

TEMPERATURE AND MICROBES:

On the basis of preferred temperature ranges, microbes are classified as psychrophiles (cold-living), mesophiles (moderate-temperature-loving), and thermophiles (heat-loving).

- **Psychrophiles** can grow at 0° C but optimum is about 15° C.
- **Psychrotrophs** can grow at 0° C also but optimum is 20 - 30° C – important in food spoilage.
- **Mesophiles** grow best at moderate around 37° C – many pathogens fall in this category.
- **Thermophiles** have a growth optimum at around 60° C.
- **Hyperthermophiles** have growth optima of 80° C or higher (Archaea).

Use the information provided above to help in answering the questions.

Note: answers will depend upon what solutions are used. Sample data is given.

9. What is the **most specific unit** on the Easy Temp probe?

   0.1 degrees Celcius

10. Use the Easy temp probe to determine the temperature of **Solutions A**.

    Record it here. 24.3 degrees Celcius

11. Use the Easy temp probe to determine the temperature of **Solutions B.**

    Record it here. 12.8 degrees Celcius

12. Which **type of microbes** would prefer to grow in the temperature of **Solution A?**

    Psychrotrophs

13. Which **type of microbes** would prefer to grow in the temperature of **Solution B?**

    Psychrophiles

14. Which **types of microbes** could grow on food **in your refrigerator**?

    Psychrotrophs

15. Which **type of microbes** could grow in **very high temperatures**?

    Hyperthermophiles

16. Which **type of microbes** could grow at **human body temperature**? (~ 37 degrees C)

    Mesophiles

pH AND MICROBES

Most bacteria grow best at a pH of 6.5 - 7.5 (neutral or near neutral). Most bacteria do not grow at all below a pH of about 4 but a few acidophiles do tolerate acidity.
Molds and yeasts prefer a pH of 5 - 6, but tend to grow at least some over a wide range of pH.

Acid foods such as pickles and sauerkraut usually do not undergo bacterial spoilage. Alkalinity could also be used to preserve food, but high pH tends to make foods bitter and slimy, so this method of preservation is not desirable.

1. What pH is neutral?
2. What range of pH is acidic? Which is the most acidic?
3. What range of pH is basic? Which is most basic?
4. What is the most specific unit that the pH probe can determine?
5. Using the pH probe, determine the pH of solution A. Which type of microbes might grow in this solution?

For each of the three foods, identify foods with fall in the range of each of the foods tested.

6. From the pH of Common Foods, which foods would be best for growing molds?
7. From the pH of Common Foods, on which acidic foods would bacteria probably not grow?
8. From the pH of Common Foods, which foods are closest to being neutral?
9. From the pH of Common Foods, which food is the most basic?
10. How many times **fewer** hydrogen ions are in a pH of 7 than a pH of 4.

pH of Common Foods

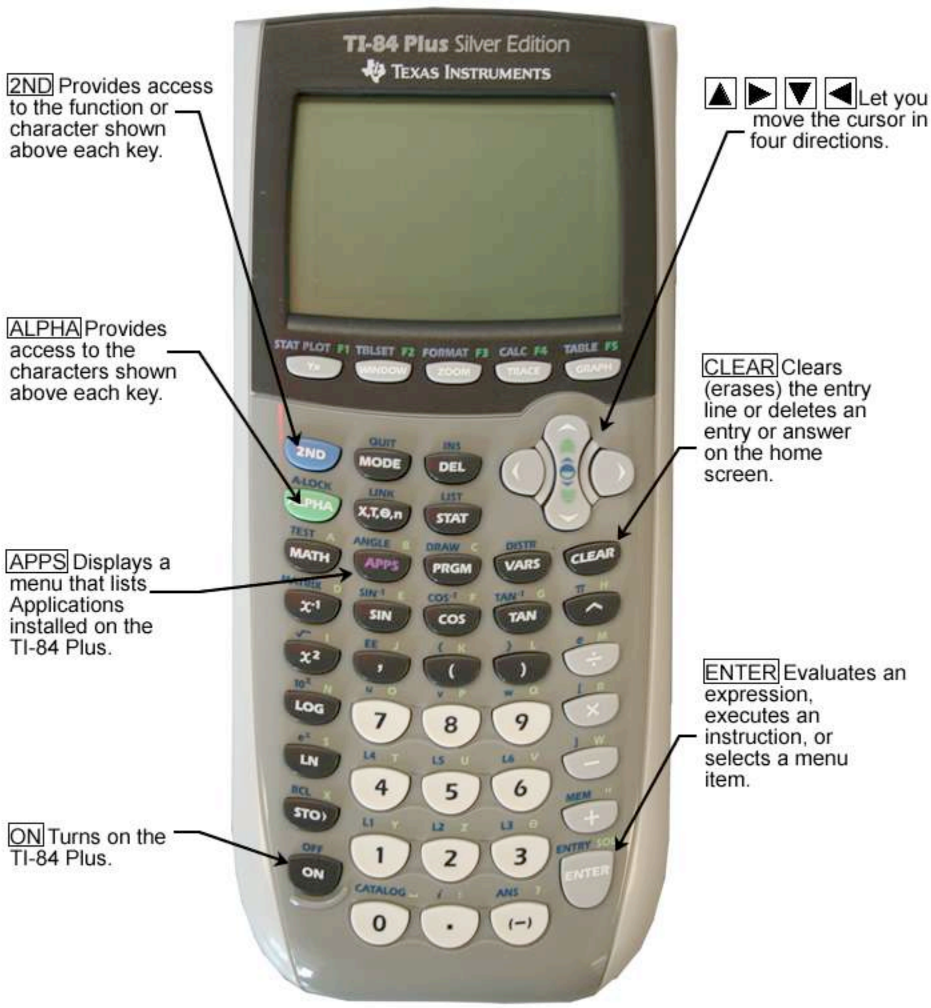
Common Foods	pH
Apple Juice	3.3 - 3.5
Baking Soda	8.0 - 8.2
Beef	5.3 - 6.2
Chicken	5.5 - 6.4
Cheese	5.0 - 6.1
Chocolate - Dutch	7.0 - 8.0
Colas	2.3 - 3.2
Distilled Water	7.0
Eggs	7.6 - 8.0
Ginger Ale	2.0 - 3.0
Hot Dogs	6.2 - 6.3
Kidney Beans	5.2 - 5.4
Limewater	12.0 - 12.4
Milk	6.6 - 6.8
Orange Juice	3.0 - 4.0
Potatoes - white	5.4 - 6.3
Soda Crackers	7.5 - 8.5
Tomato Juice	4.2 - 4.5
White Bread	5.0 - 6.0
Yogurt	3.8 - 4.2

pH AND MICROBES:

Using the pH probe

Note: Steps 1-6 have been done for you.

1. Before each use of the pH Sensor, you need to rinse the tip of the sensor thoroughly with distilled water. Raise the pH Sensor from the sensor soaking solution and set the solution aside. Use a wash bottle filled with distilled water to thoroughly rinse the pH Sensor. Catch the rinse water in the second beaker or cup. **Important:** Do not let the pH Sensor dry out. Place it in the **holding beaker** with 100 mL of distilled water. The tip of the sensor is made of glass—it is fragile. Handle with care!
2. Turn on the calculator. Connect the pH Sensor to EasyLink interface and the EasyLink to the calculator. (With EasyLink the calculator will automatically launch EasyData and detect the sensor.)
3. Set up the data-collection mode.
4. Start the EasyData application, if it is not already running.
5. Select from the Main screen, and then select **New** to reset the application.
6. Select from the Main screen, and then select **Events with Entry**.
7. Place the pH sensor in **beaker A** and determine the pH of the solution.
8. Rinse the pH sensor with distilled water and place it back in the **holding beaker** of distilled water.



pH AND MICROBES

Most bacteria grow best at a pH of 6.5 - 7.5 (neutral or near neutral). Most bacteria do not grow at all below a pH of about 4 but a few acidophiles do tolerate acidity.
Molds and yeasts prefer a pH of 5 - 6, but tend to grow at least some over a wide range of pH.

Acid foods such as pickles and sauerkraut usually do not undergo bacterial spoilage. Alkalinity could also be used to preserve food, but high pH tends to make foods bitter and slimy, so this method of preservation is not desirable. ***Note: Some answers will depend upon which solutions are used. Sample data is given.***

1. What pH is neutral? **pH of 7**

2. What range of pH is acidic? Which is the most acidic?
1 to 7 **1**

3. What range of pH is basic? Which is most basic?
7 to 14 **14**

4. What is the most specific unit that the pH probe can determine?
0.01

5. Using the pH probe, determine the pH of solution A. Which type of microbes might grow in this solution?
Solution A is cola – its pH is 2.3. (it will erode human teeth)
Acid loving bacteria

For each of the three foods, identify foods with fall in the range of each of the foods tested.

6. From the pH of Common Foods, which foods would be best for growing molds?
Beef, chicken, cheese, kidney beans, white bread (note – mold is used to tenderize meat and flavor cheese)

7. From the pH of Common Foods, on which acidic foods would bacteria probably not grow?
Apple juice, colas, ginger ale, orange juice, yogurt (special bacteria cultures are found in yogurt)

8. From the pH of Common Foods, which foods are closest to being neutral?
Distilled water is neutral, others close are milk or chocolate

9. From the pH of Common Foods, which food is the most basic?
Limewater

10. How many times **fewer** hydrogen ions are in a pH of 7 than a pH of 4.
1000 or 10^3

MICROBE MISSION – PRACTICE ACTIVITIES

YEAST AND BALLOONS

Saccharomyces cerevisiae, is commonly known as baker's yeast. Yeast is a tiny single- celled fungus: Just one gram holds about 25 billion cells.

Materials:

• 1 packet of active dry yeast
• 1 cup very warm water (105° F–115° F)
• 2 tablespoons sugar
• a large rubber balloon
• a small (1-pint to 1-liter) empty water bottle or large test tube

Procedure:

1. Stretch out the balloon by blowing it up repeatedly, and then lay it aside.

2. Add the packet of yeast and the sugar to the cup of warm water and stir.

3. Once the yeast and sugar have dissolved, pour the mixture into the bottle. You'll notice the water bubbling as the yeast produces carbon dioxide.

4. Attach the balloon to the mouth of the bottle, and set both aside.

5. After several minutes, you'll notice the balloon standing upright. If you don't see anything happen, keep waiting. Eventually, the balloon will inflate.

Explanation of what is happening:

1. What process is being carried out by the yeast to produce the gas being collected in the balloon? Is is aerobic or is it anaerobic?

2. What gas is being produced by the yeast and collected in the balloon?

3. What other waster product is being produced by the yeast during this process and is being collected in the bottle or test tube?

4. What must be provided for the yeast in order for them to carry out this process?

5. What does the yeast gain from this process?

6. What commercial processes utilize yeast to produce this gas?

7. What commercial processes utilize the other waste product from this process? The one you named in # 3.

MICROBE MISSION – PRACTICE ACTIVITIES

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Procedure:

1. Stretch out the balloon by blowing it up repeatedly, and then lay it aside.

2. Add the packet of yeast and the sugar to the cup of warm water and stir.

3. Once the yeast and sugar have dissolved, pour the mixture into the bottle. You'll notice the water bubbling as the yeast produces carbon dioxide.

4. Attach the balloon to the mouth of the bottle, and set both aside.

5. After several minutes, you'll notice the balloon standing upright. If you don't see anything happen, keep waiting. Eventually, the balloon will inflate.

Explanation of what is happening:

2. What process is being carried out by the yeast to produce the gas being collected in the balloon? Is is aerobic or is it anaerobic? **Alcoholic fermentation – anaerobic**

2. What gas is being produced by the yeast and collected in the balloon?
   Carbon dioxide
3. What other waster product is being produced by the yeast during this process and is being collected in the bottle or test tube?
   Alcohol
4. What must be provided for the yeast in order for them to carry out this process?
   Sugar and water
5. What does the yeast gain from this process?
   Energy (ATP)
6. What commercial processes utilize yeast to produce this gas?
   Baking – carbon dioxide is used to make dough rise
7. What commercial processes utilize the other waste product from this process? The one you named in # 3.
   Brewing – the alcohol is collecting in beer and wine production

MICROBE MISSION – PRACTICE ACTIVITIES

MICROBES AND FOOD

Microbes play a key role in Food Production as well as Food Spoilage and Decomposition of Food.

Below are a list of common foods and beverages. For each food indicate how microbes are involved – are the involved in the production of the food, are they a risk to rapid food spoilage, or are they involved in both? Some foods have multiple components – if so, analyze the components. When the lab is done, feel free to eat the specimens.

Single Items:

Tea

Yogurt

Chocolate

Bread

Sauerkraut

Beer

Sour Cream

Wine

Pickles

Multiple component items:

Chips and Sour Cream

Cheeseburger

Nachos and Cheese

Chocolate Milk

Pizza

MICROBE MISSION – PRACTICE ACTIVITIES
MICROBES AND FOOD

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Below are a list of common foods and beverages. For each food indicate how microbes are involved – are the involved in the production of the food, are they a risk to rapid food spoilage, or are they involved in both? Some foods have multiple components – if so, analyze the components. When the lab is done, feel free to eat the specimens.

<u>Single Items:</u>

Tea - microbes are used in production

Yogurt - microbes are used in production – good bacteria in culture help our digestion

Chocolate - microbes are used in production

Bread – microbes are used in production – yeast fermentation – carbon dioxide bubbles make the dough rise

Sauerkraut - microbes are used in production – controlled fermentation of cabbage

Beer - microbes are used in production – yeast fermentation for alcohol

Sour Cream - microbes are used in production

Wine - microbes are used in production – yeast fermentation for alcohol

Pickles - microbes are used in production – controlled fermentation of cucumbers

<u>Multiple component items:</u>

Chips and Sour Cream - microbes are used in production of sour cream – chips are for eating with sour cream

Cheeseburger - microbes are used in production of cheese and pickles; hamburger is Microbes can contaminate hamburger if not processed safely.

Nachos and Cheese - microbes are used in production and nachos are for eating with cheese

Chocolate Milk - microbes are used in production of chocolate and can cause milk to spoil

Pizza – microbes are used in production of cheese, used to make dough rise, mushrooms on the pizza are microbes

Fresh fruit as strawberries, raspberries – mold grows and damage fresh fruits especially if fruit is bruised. Fresh fruit that is not bruised is good dipped in chocolate

Enjoy yourself as you eat the specimens!

MICROBE MISSION – PRACTICE ACTIVITIES

DISEASE CAUSING MICROBES

Use the key to the right to identify the type of microbe which causes each of the following diseases.

Key:

A. virus
B. bacteria
C. protozoan
D. fungus

1. Athlete's foot
2. chicken pox
3. Ebola Hemorrhagic Fever
4. botulism
5. influenza
6. mumps
7. ringworm
8. syphilis
9. tetanus
10. common cold
11. shingles
12. dental caries (tooth decay)
13. typhus
14. Legionnaire's disease
15. malaria
16. tuberculosis
17. herpes
18. cholera
19. measles
20. rabies
21. thrush
22. Pertussis (whooping cough)
23. AIDS/HIV disease
24. strep throat
25. Rocky Mountain Spotted Fever

MICROBE MISSION – PRACTICE ACTIVITIES

DISEASE CAUSING MICROBES

Use the key to the right to identify the type of microbe which causes each of the following diseases.

Key:
A. virus
B. bacteria
C. protozoan
D. fungus

1. Athlete's foot	**D. fungus**
2. chicken pox	**A. virus**
3. Ebola Hemorrhagic Fever	**A. virus**
4. botulism	**B. bacteria**
5. influenza	**A. virus**
6. mumps	**A. virus**
7. ringworm	**D. fungus**
8. syphilis	**B. bacteria**
9. tetanus	**B. bacteria**
10. common cold	**A. virus**
11. shingles	**A. virus**
12. Dental Caries (tooth decay)	**B. bacteria**
13. typhus	**B. bacteria**
14. Legionnaire's disease	**B. bacteria**
15. Malaria	**C. protozoan**
16. tuberculosis	**B. bacteria**
17. herpes	**A. virus**
18. cholera	**B. bacteria**
19. measles	**A. virus**
20. rabies	**A. virus**
21. thrush	**D. fungus**
22. Pertussis (whooping cough)	**B. bacteria**
23. AIDS/HIV disease	**A. virus**
24. strep throat	**B. bacteria**
25. Rocky Mountain Spotted Fever	**B. bacteria**