CELL BIOLOGY – 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.

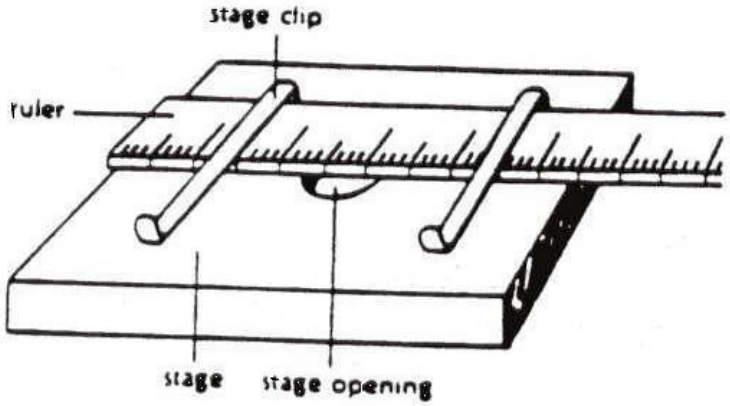
4. Find the number 5 on the ruler. Draw how it looks when viewing ruler on the stage and how it looks when viewed using the ocular. How do the two images compare?

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?



CELL BIOLOGY –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.

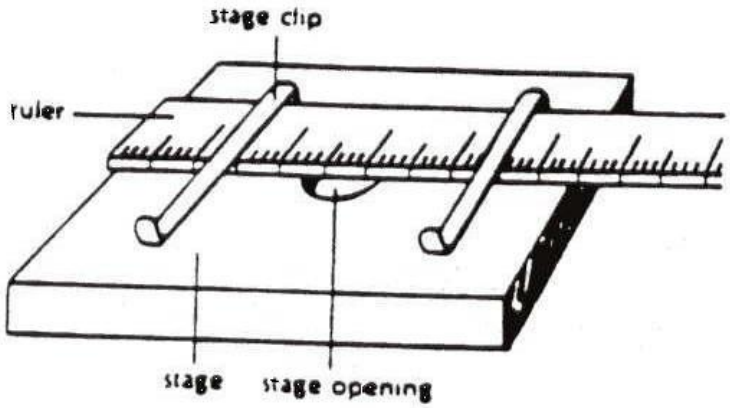
Depends upon microscope usually about 3 mm or 3000 mcm

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



PROPERTIES OF MICROSCOPY

Use the microscope, slide of "**JF**", **mm ruler** and **photo of onion cells** to assist you in answering the questions.

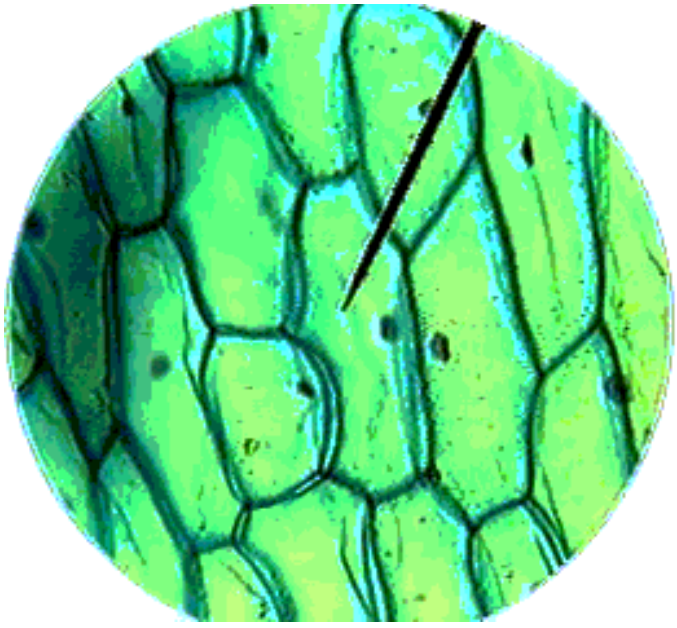
1. A slide with the letters "**JF**" is positioned in the normal reading position on the stage. Show how the "**JF**" will appear when viewed

2. If the diameter of the low (10X) power field of view **is 1.6 millimeters**. What would be the diameter of the **high (40X) power** field in **millimeters? in micrometers?**
***(Hint: remember the diameter ratios for the fields of view*)**

3. Assume that the onion cells photo was taken under the high power field of microscope from question 4. What is the length of an onion cell indicated by the pointer in **micrometers**?

4. How many cells are visible in this high power (40 X) field of view?

5. How many cells should be visible in low power (10X) field of view?



Stained Onion Cells under High Power

PROPERTIES OF MICROSCOPY

Use the microscope, slide of "**JF**", **mm ruler** and **photo of onion cells** to assist you in answering the questions.

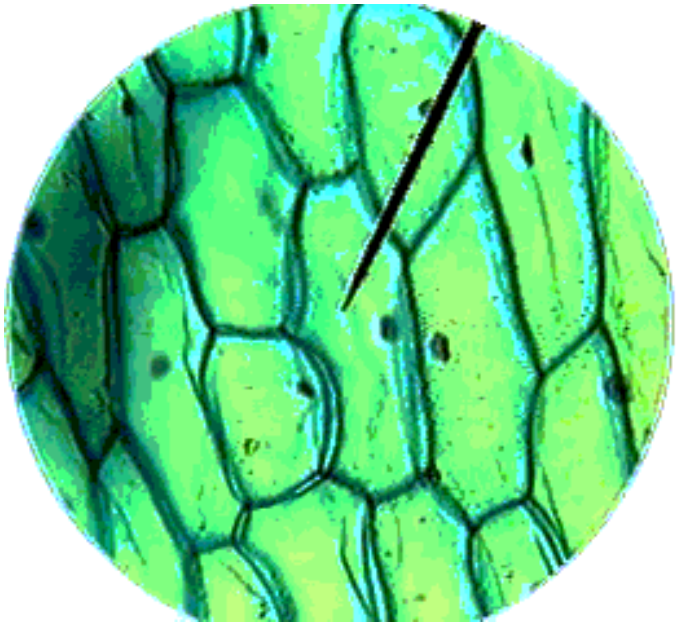
1. A slide with the letters "**JF**" is positioned in the normal reading position on the stage. Show how the "**JF**" will appear when viewed
It will be inverted and reversed

2. If the diameter of the low (10X) power field of view **is 1.6 millimeters**. What would be the diameter of the **high (40X) power** field in **millimeters? in micrometers?**
***(Hint: remember the diameter ratios for the fields of view*)**
.4 mm 400 mcm

3. Assume that the onion cells photo was taken under the high power field of microscope from question 4. What is the length of an onion cell indicated by the pointer in **micrometers**?
about 200 mcm

4. How many cells are visible in this high power (40 X) field of view?
20 cells

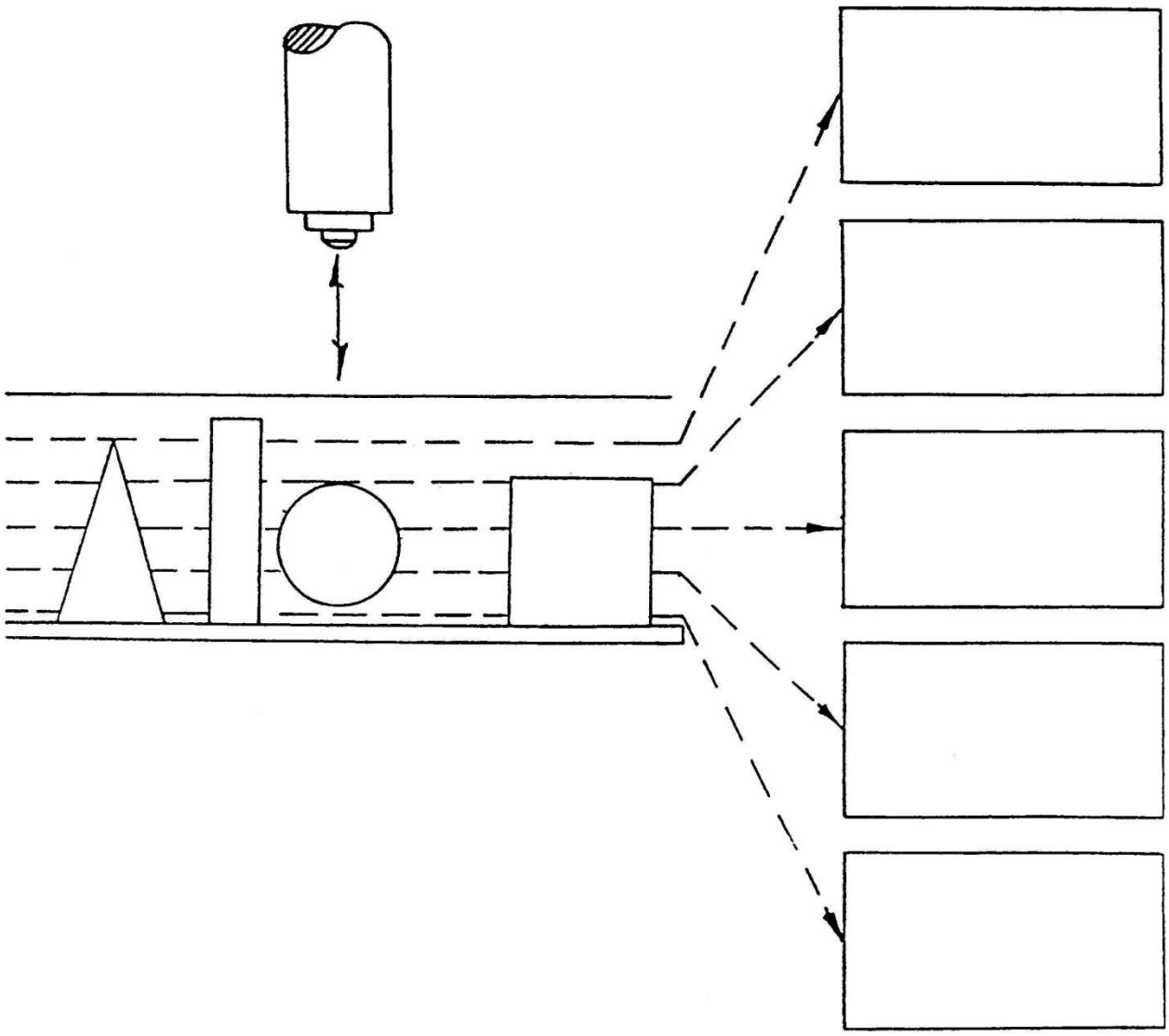
5. How many cells should be visible in low power (10X) field of view?
20 cells X 16 = 320 cells



Stained Onion Cells under High Power

MICROSCOPE - 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.



How can you determine the actual depth of an object with the microscope?

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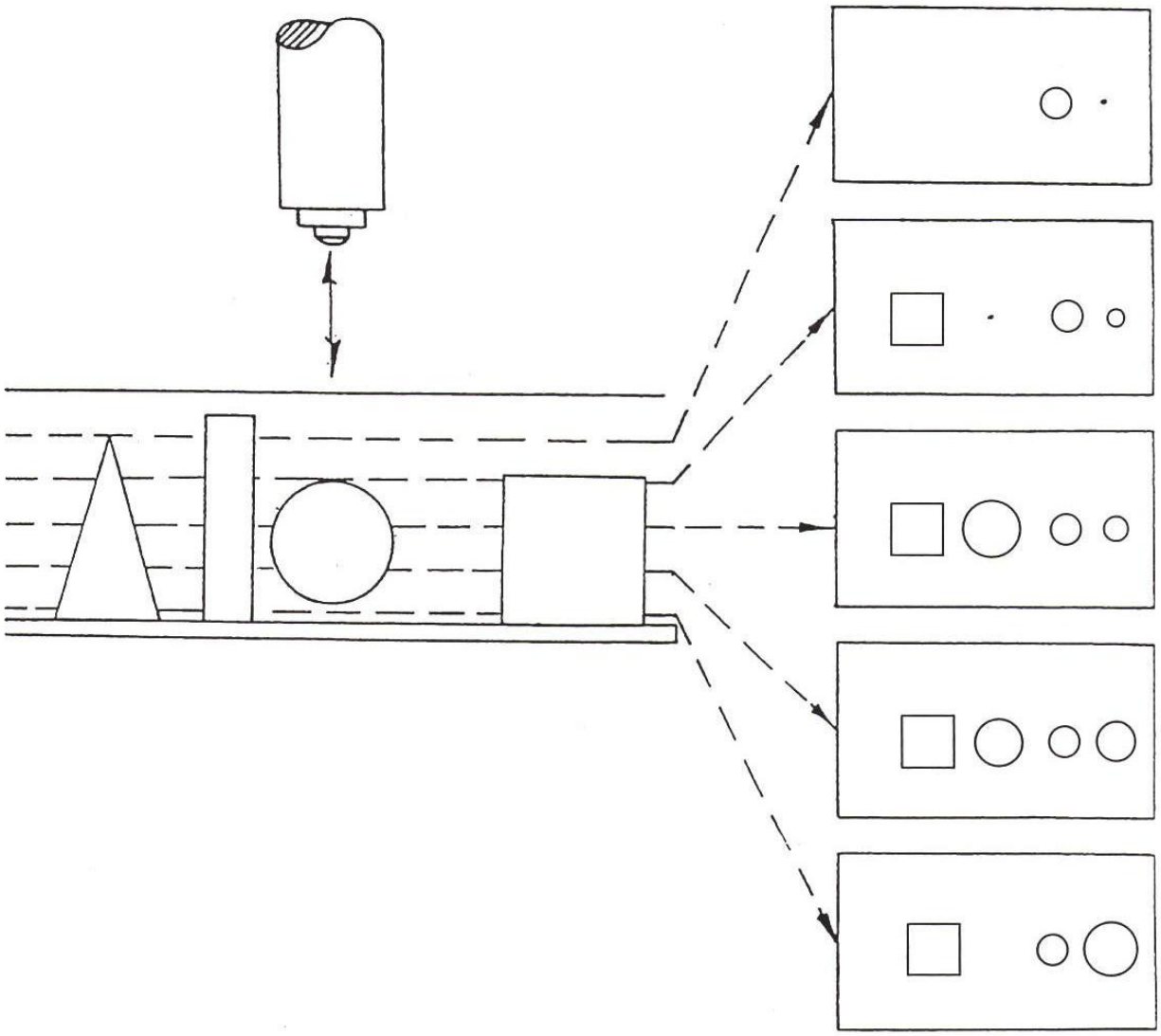
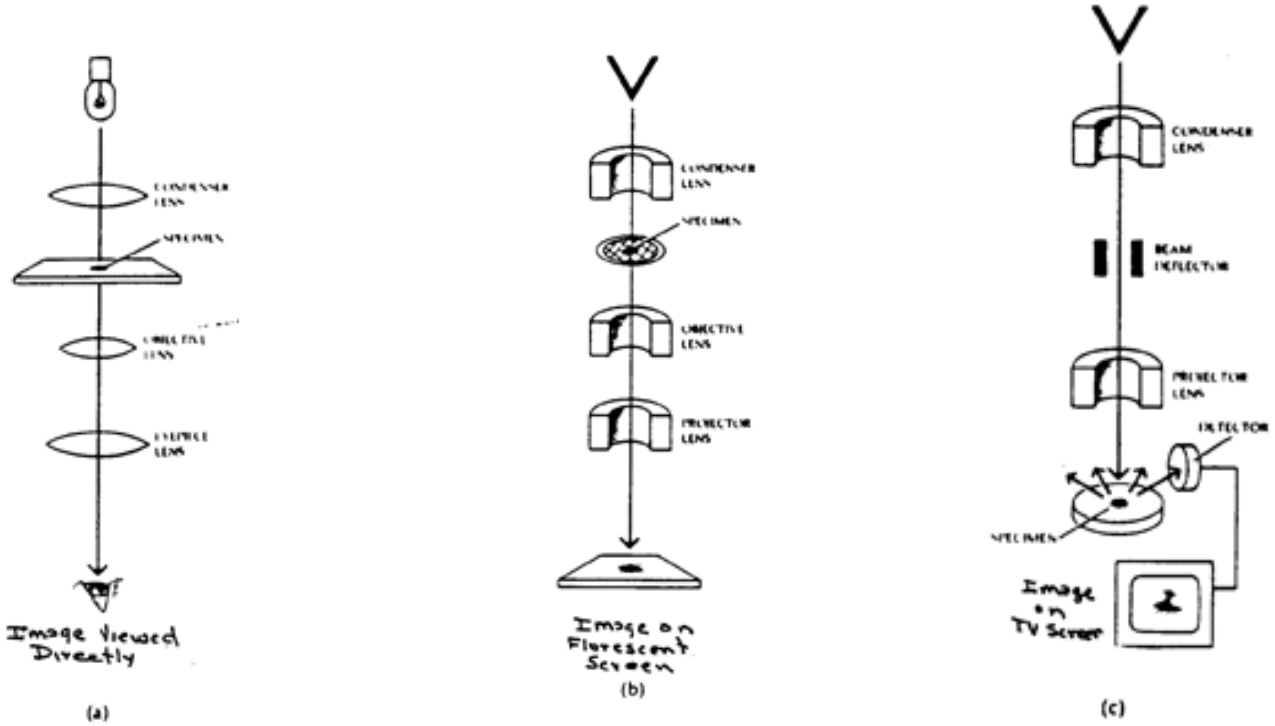


How can you determine the actual depth of an object with the microscope?

There are graduations on the fine adjustment knob that can be used to determine the distance as you focus through the object.

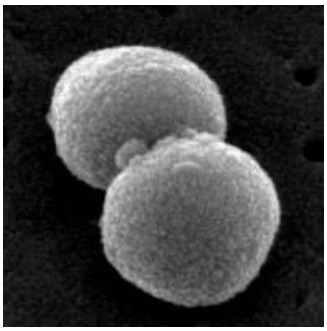
TYPES OF MICROSCOPE IMAGES



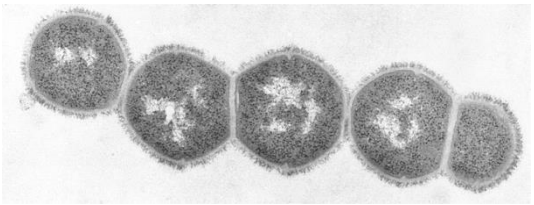
Types of Microscopes:

1. Give the letter of the diagram which illustrates the operation of a transmission electron microscope. How should the image appear?
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



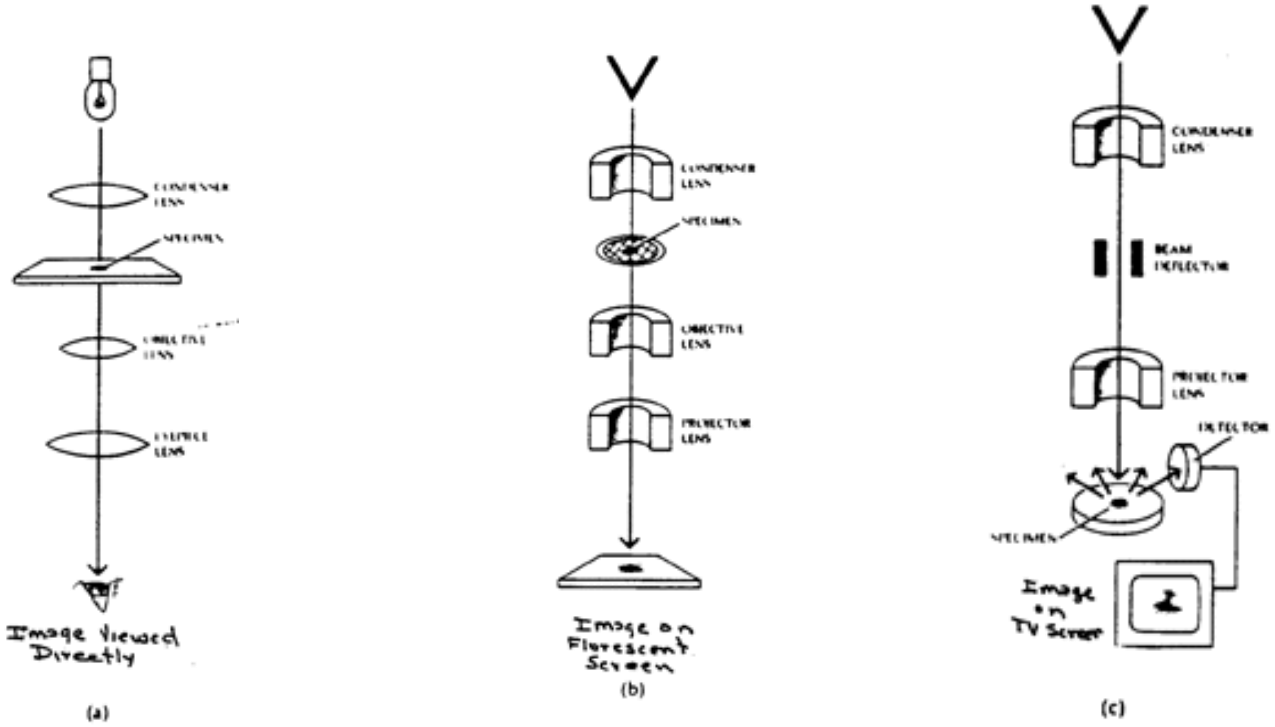
C



D

E

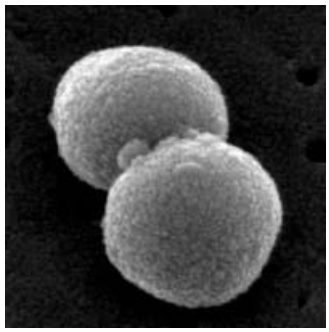
TYPES OF MICROSCOPE IMAGES



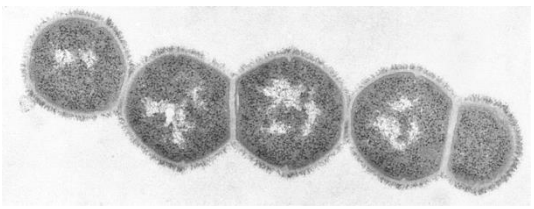
Types of Microscopes:

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



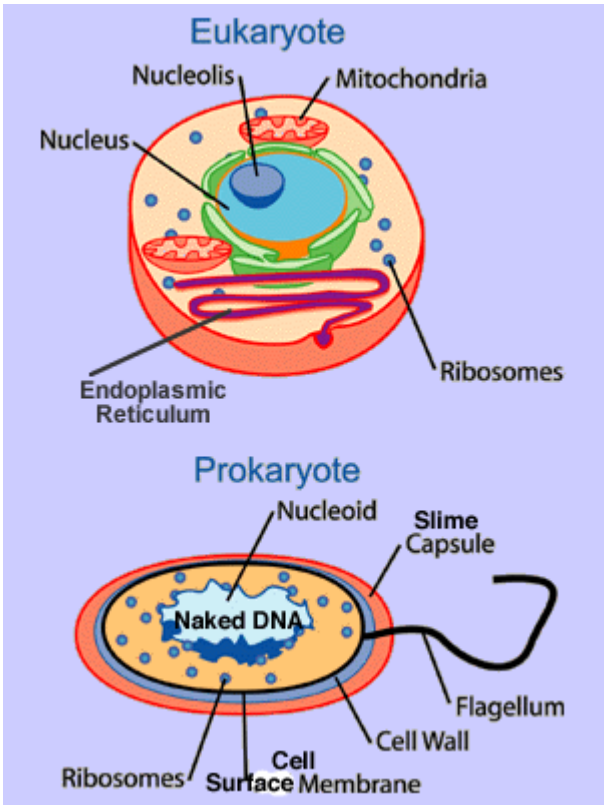
C



D

E

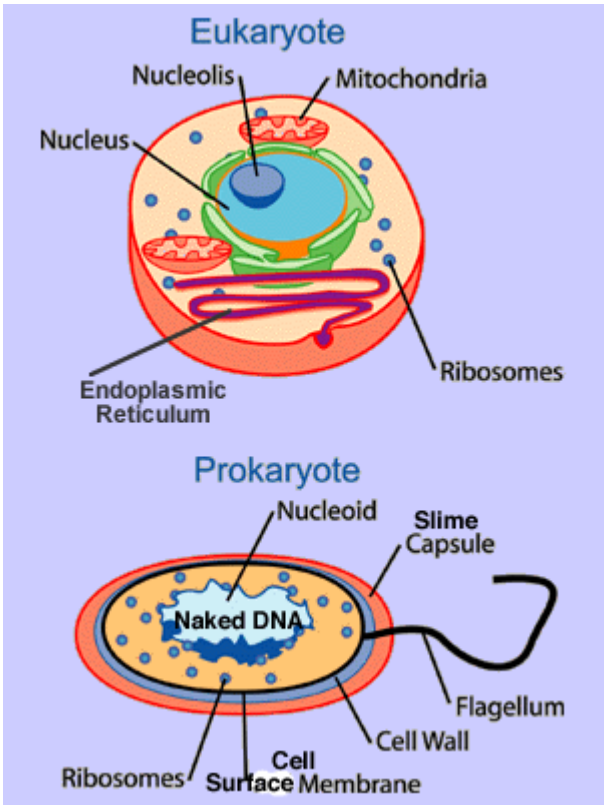
PROKARYOTIC VS EUKARYOTIC CELLS



Compare the prokaryotic and eukaryotic cells**.**

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

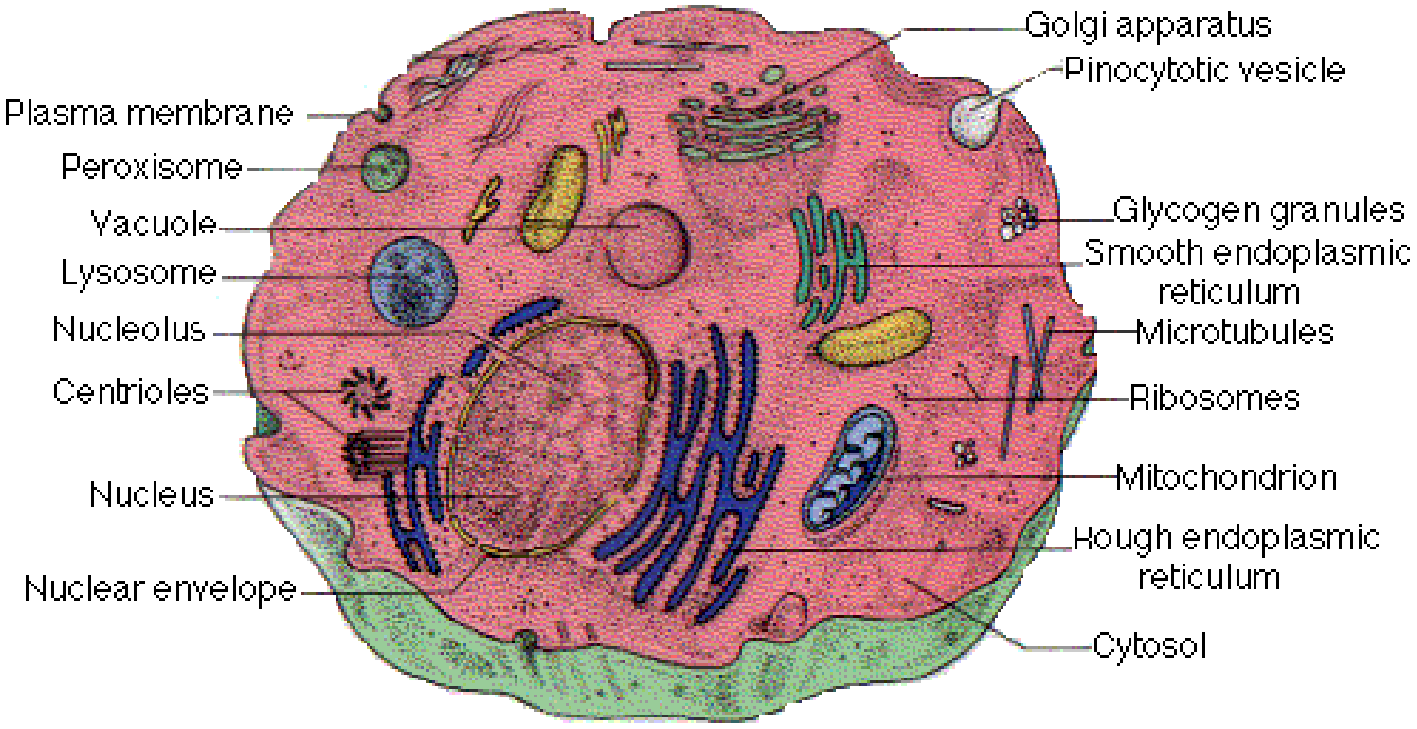
PROKARYOTIC VS EUKARYOTIC CELLS

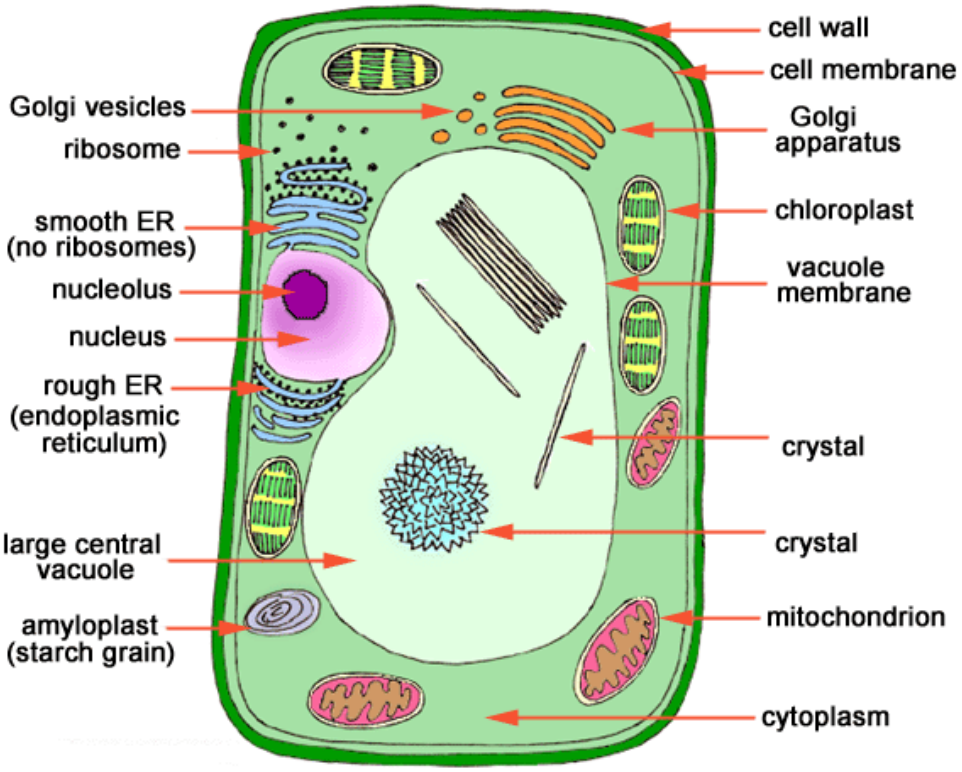


Compare the prokaryotic and eukaryotic cells**.**

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

CELL ORGANELLE/STRUCTURES AND THEIR FUNCTIONS





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		

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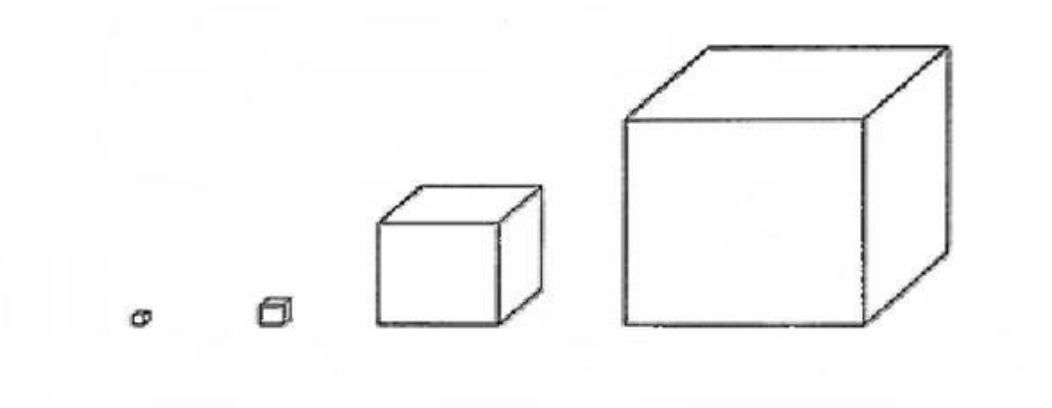
Function	Plant Cell Organelle/Structure	Animal Cell Organelle/Structure
Support	**Cell wall**	**Cytoskeleton – microfilaments** **Microtubules – cell membrane**
Controls material entering and leaving	**Cell membrane, pores**	**Cell membrane, pores**
Internal transport system	**Endoplasmic reticulum**	**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**

SURFACE AREA TO VOLUME RATIO



.05 mm **0.1 mm** **0.5 mm** **1.0 mm**

Surface area of a cube = length x width x number of surfaces

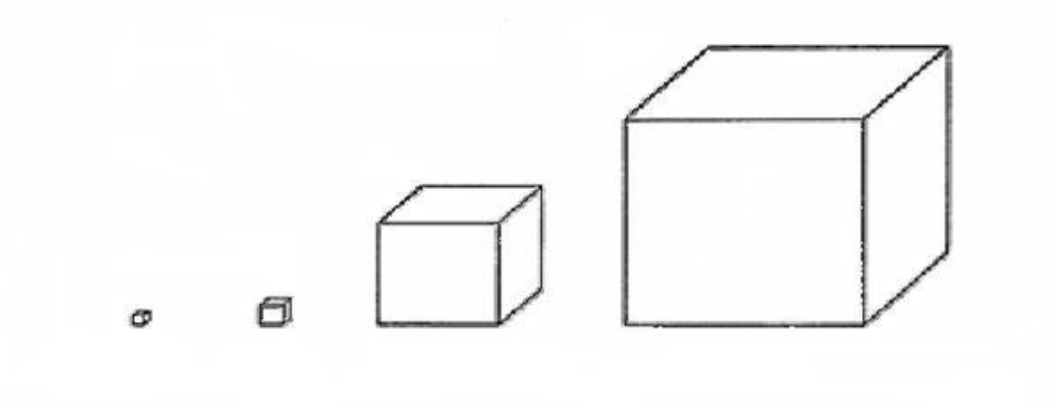
Volume of a cube = length x width x height

Materials: containers of Play Doh

1. Determine the surface area and volume of the 1.0 mm cube. What is the surface area to volume ratio?
2. Determine the surface area and volume of the 0.5 mm cube. What is the surface area to volume ratio?
3. Determine the surface area and volume of the 0.1 mm cube. What is the surface area to volume ratio?
4. Determine the surface area and volume of the 0.05 mm cube. What is the surface area to volume ratio?
5. Which cell would have the greatest surface area to volume ratio?
6. Which cell would probably have the slowest metabolic rate? Why?

7. Use the Play Doh to form models of cell shapes that would increase the surface area to volume ratio. What types of cell in organisms have adapted to these types of shapes?

SURFACE AREA TO VOLUME RATIO



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3. Determine the surface area and volume of the 0.1 mm cube. What is the surface area to volume ratio?

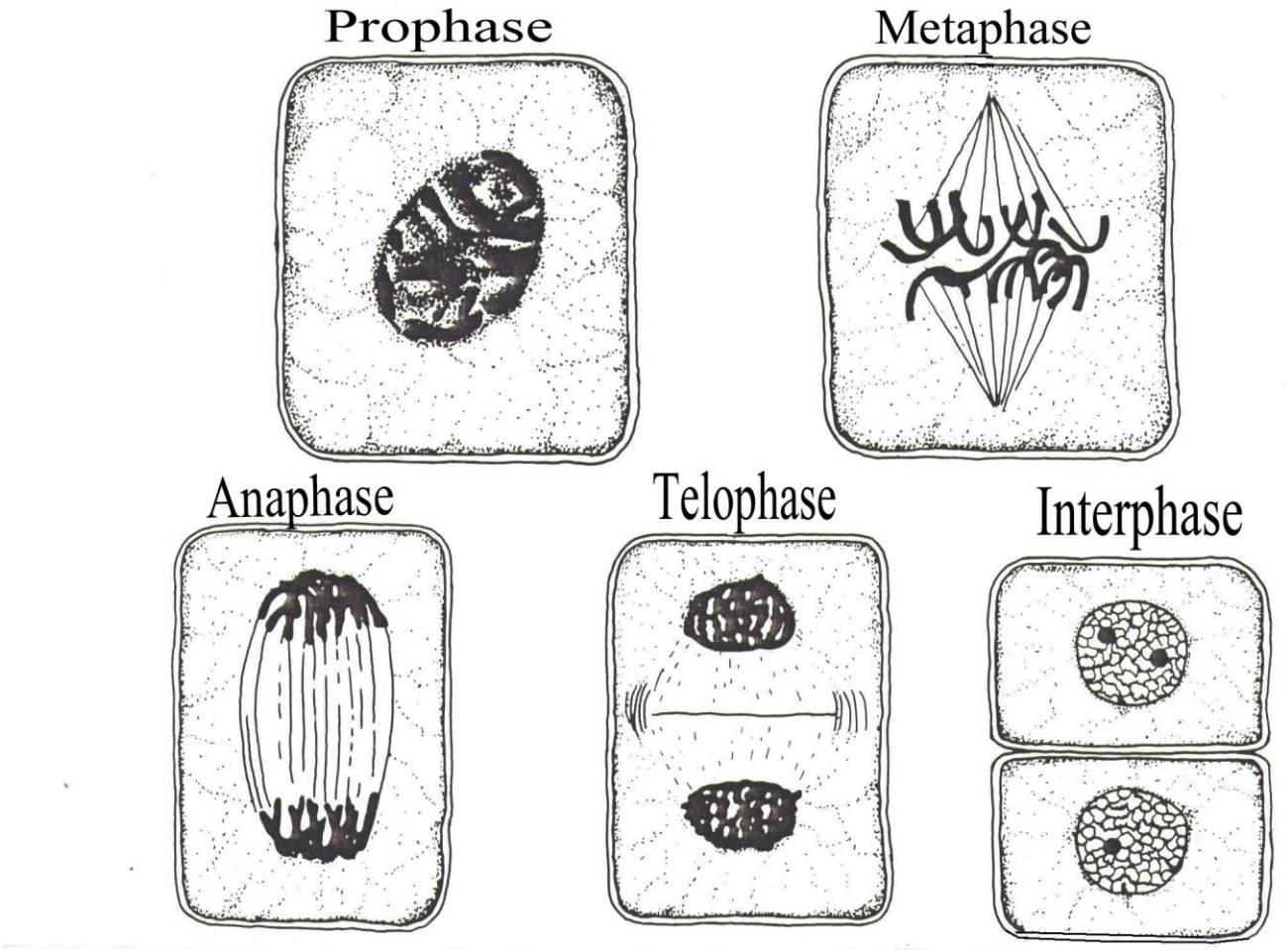
4. Determine the surface area and volume of the 0.05 mm cube. What is the surface area to volume ratio?

5. Which cell would have the greatest surface area to volume ratio?
   0.5 mm more surface area to supply volume of the cell
6. Which cell would probably have the slowest metabolic rate? Why?
   1.0 mm not enough surface area to supply volume of cytoplasm
7. Use the Play Doh to form models of cell shapes that would increase the surface area to volume ratio. What types of cell in organisms have adapted to these types of shapes?

Muscle cells, nerve cells, surface skin cells (pancake shaped), columnar cells

CELL CYCLE EXPERIMENT

Phases of Mitosis



Number of Onion cells in each phase

Phase	Area 1	Area 2	Area 3	Total number Per phase
Prophase	15	12	20	47
Metaphase	6	5	7	18
Anaphase	3	1	2	6
Telophase	4	2	3	9
Interphase	90	80	85	255
	Total number of cells			335

CELL CYCLE EXPERIMENT

Examine the background information, diagrams, and data table for the **Experiment dealing with Mitosis of Onion cells** and answer the questions.

Background: A scientist wanted to determine how much time it takes for each phase of mitosis. He knew that it takes 12 hours or 720 minutes for onion cells to complete a cell cycle. He examined slides of onion cells during the cell cycle and counted the number of cell in each area that were in each phase.

To calculate the time per phase he used the following formula.

$$\text{Time for a phase} = \frac{\text{number of cells in a phase}}{\text{total number of cells}} \times 720 \text{ minutes}$$

1. What is the **independent variable** and **how is it determined**?

2. What is the **dependent variable** and **how is it determined**?

3. What was the time for **Interphase? Prophase?** (Round off to the nearest minute)

4. What was the time for **Metaphase, Anaphase and Telophase** combined? (Round off to the nearest minute)

5. What is the weakness of the scientist's assumption for determining the time per phase?

6. What normally occurs during Interphase? Explain what happens during the G1, S, and G2 parts of Interphase? cell?

7. How would the time in each phase be changed by a cancerous cell.

8. How would the time in each phase be changed by a mature nerve or muscle cell?

9. What types of things limit the size a cell can grow?

10. How have cells modified their shape to make them more efficient? Draw them.

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To calculate the time per phase he used the following formula.

$$\text{Time for a phase} = \frac{\text{number of cells in a phase}}{\text{total number of cells}} \times 720 \text{ minutes}$$

1. What is the **independent variable** and **how is it determined**?
   cells per phase **count the number**

2. What is the **dependent variable** and **how is it determined**?
   time per phase **calculate using the formula**

3. What was the time for **Interphase? Prophase?**
   (Round off to the nearest minute)
   548 min **101 min**

4. What was the time for **Metaphase, Anaphase and Telophase** combined? (Round off to the nearest minute)
   71 min

5. What is the weakness of the scientist's assumption for determining the time per phase? **It is a continuous process and hard to divide into phases**

6. What normally occurs during Interphase? Explain what happens during the G1, S, and G2 parts of Interphase? cell?
   G1 – normal cell activities and growth
   S – synthesis of new DNA
   G2 – production of material for mitosis as spindle

7. How would the time in each phase be changed by a cancerous cell.
   greatly reduced time in G1

8. How would the time in each phase be changed by a mature nerve or muscle cell?
   greatly increased time in G1 – stop reproducing

9. What types of things limit the size a cell can grow?
   Surface area to volume ratio, ability of nucleus to control cell activity, type of cell activity that is predominant

10. How have cells modified their shape to make them more efficient? Draw them.
    Muscle cells, nerve cells, surface skin cells (pancake shaped), columnar cells

CHEMICAL ANALYSIS

The pH paper and the pH probe were used to determine the pH of 4 different solutions. Below are the results.

	pH paper	pH Probe
Solution A -	3	3.4
Solution B -	6	6.4
Solution C -	8	8.3
Solution D -	2	2.3

Use the data and the pH of common items in answering the questions.

1. Which of the common items might **Solution A** be?
   Which of the common items might **Solution B** be?

2. Which of the common items might **Solution C** be?
   Which of the common items might **Solution D** be?

3. What is the advantage of using the probe over using the pH paper?

4. Which Solutions (A-D) are **basic**? Which Solutions (A-D) are **acidic**?

5. How many times more hydrogen ions are present in a solution with a pH of 2 than a solution with a pH of 5?

Now determine the pH of the solution provided using the pH paper and/or the pH probe. Record your results.

USING THE pH PROBE:

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 beaker or cup with 100 mL of tap 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 File from the Main screen, and then select **New** to reset the application.
6. Select Setup from the Main screen, and then select **Events with Entry**.

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Solution C -	8	8.3
Solution D -	2	2.3

Use the data and the pH of common items in answering the questions.

1. Which of the common items might **Solution A** be? **soft drink**
   Which of the common items might **Solution B** be? **milk**

2. Which of the common items might **Solution C** be? **baking soda**
   Which of the common items might **Solution D** be? **vinegar**

3. What is the advantage of using the probe over using the pH paper?
   more accurate reading and no color interference

4. Which Solutions (A-D) are **basic**? Which Solutions (A-D) are **acidic**?
   C is basic **A,B, D are acidic**

5. How many times more hydrogen ions are present in a solution with a pH of 2 than a solution with a pH of 5? **1000**

Now determine the pH of the solution provided using the pH paper and/or the pH probe. Record your results. (pH depends upon the solution chosen)

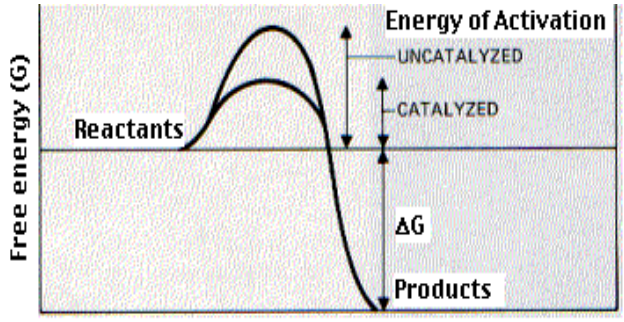
USING THE pH PROBE:

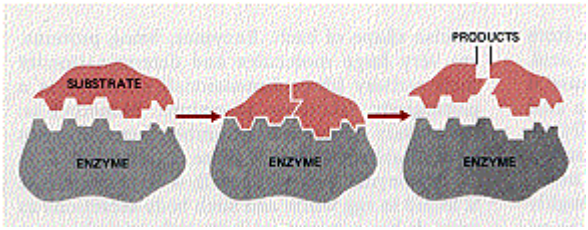
1. Before each use of the pH Sensor, you need to rinse the tip of the sensor thoroughly with distilled water. Raise the pH Sensor from the sensor soaking solution and set the solution aside. Use a wash bottle filled with distilled water to thoroughly rinse the pH Sensor. Catch the rinse water in the second beaker or cup. Important: Do not let the pH Sensor dry out. Place it in the beaker or cup with 100 mL of tap 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 [File] from the Main screen, and then select **New** to reset the application.
6. Select [Setup] from the Main screen, and then select **Events with Entry**.

pH of Common Items

pH	Common Items
1.0	battery acid
2.0	lemon juice
2.2	vinegar
3.0	apples
3.5	soft drink
4.0	wine
4.5	tomatoes
5.6	unpolluted rainwater
6.6	milk
7.0	pure water
7.4	human blood
8.3	baking soda solution
8.4	sea water
10.5	milk of magnesia
11.0	household ammonia
12.4	lime
13.0	lye

ENZYMES AND ACTIVATION ENERGY





Name the structure being described or provide the requested information.

1. List the characteristics of enzymes.

2. What is energy of activation?

3. What chemical acts as the storage battery for cells and provides activation energy for chemical reactions?

4. How do enzymes affect energy of activation? (increase or decrease)

5. The names of enzymes end with what suffix? What enzyme would work with the sugar lactose?

6. Write the chemical equation for reactions using enzymes.

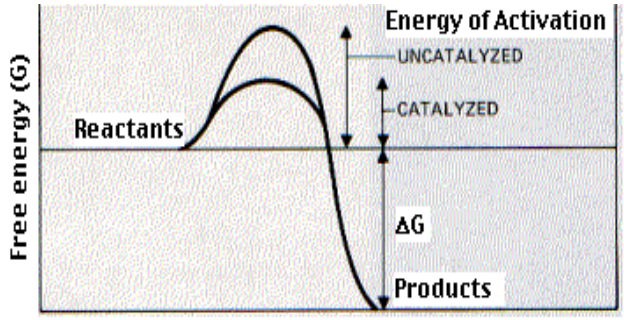
7. What type of chemical reaction is being shown in the graph above? How do you know?

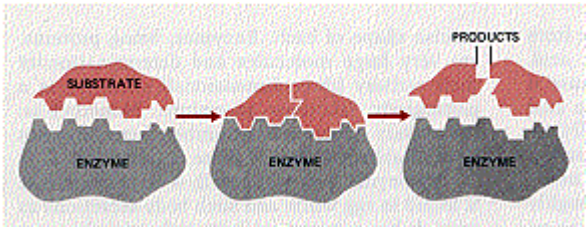
8. What type of chemical is an enzyme?

9. What role do vitamins and minerals have in the operation of enzymes?

10. Why are enzymes so important for chemical reactions taking place within living cells.

ENZYMES AND ACTIVATION ENERGY





Name the structure being described or provide the requested information.

1. List the characteristics of enzymes.
   made of protein, catalysts, very specific, not used or changed in the reaction, are reusable
2. What is energy of activation?
   energy needed to start a reaction
3. What chemical acts as the storage battery for cells and provides activation energy for chemical reactions?
   ATP
4. How do enzymes affect energy of activation? (increase or decrease) **decrease**

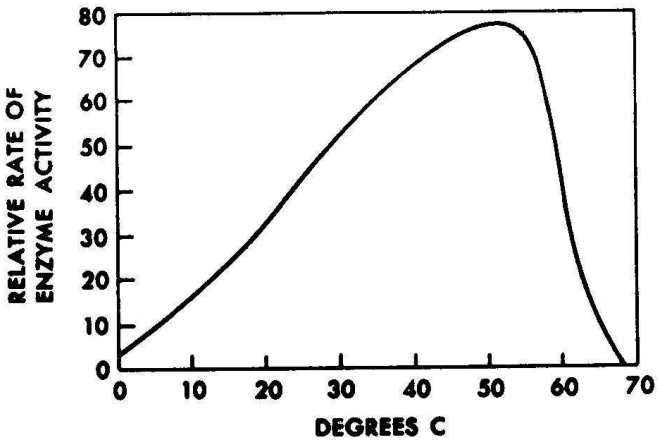
5. The names of enzymes end with what suffix? What enzyme would work with the sugar lactose? "**ase"** **lactase**

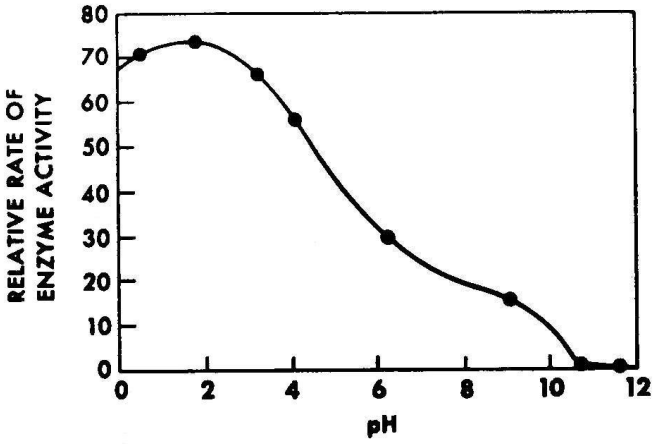
6. Write the chemical equation for reactions using enzymes.
   S + E _--> ES --> EP --> E + P
7. What type of chemical reaction is being shown in the graph above? How do you know?
   exothermic-releases energy - reactants have more energy than products
8. What type of chemical is an enzyme?
   Protein

9. What role do vitamins and minerals have in the operation of enzymes? **Cofactors – act as non-protein parts of** enzymes

10. Why are enzymes so important for chemical reactions taking place within living cells.
    They allow reactions to go on at lower temperatures with less activation energy.

ENZYMES





Examine the Graph on the Effect of Temperature on Enzyme Action.

1. What is the independent variable? How is it measured?

2. What is the dependent variable? How is it measured?

3. At what temperature does the enzyme work best?

4. At what temperature does the enzyme lose its effectiveness?

5. What happened to cause the enzyme to become ineffective?

Examine the Graph on Activity of an enzyme in different pH levels.

6. What is the independent variable? How is it measured?

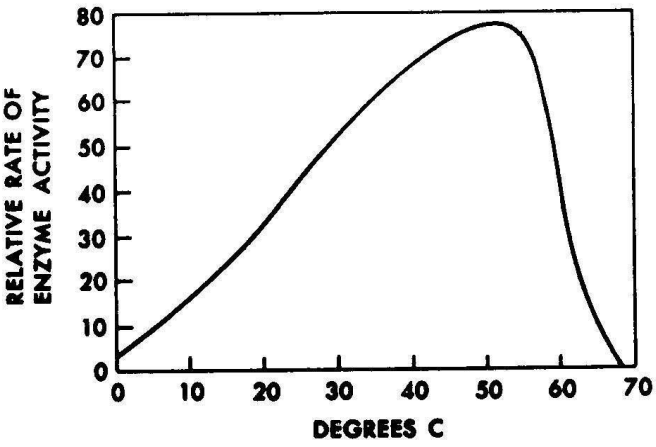
7. What is the dependent variable? How is it measured?

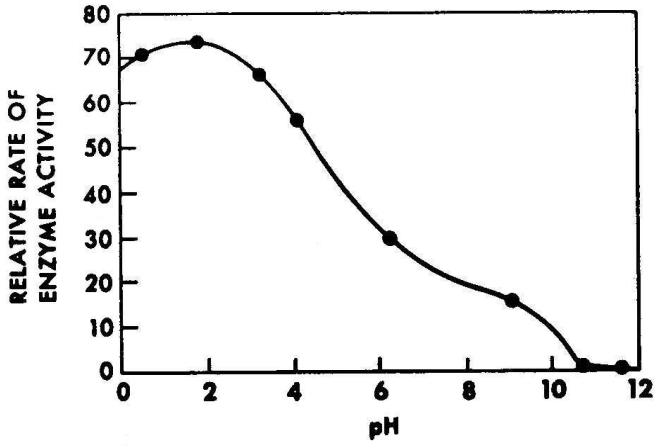
8. At what pH does the enzyme work best? Where might you expect to find pepsin in the body?

9. At what pH does the enzyme lose its effectiveness?

10. Would all enzymes have the same effectiveness at this pH as this enzyme? Why or why not?

ENZYMES





Examine the Graph on the Effect of Temperature on Enzyme Action.

1. What is the independent variable? How is it measured?
   temperature degrees Celcius

2. What is the dependent variable? How is it measured?
   rate of enzyme action relative rate

3. At what temperature does the enzyme work best?
   about 50 degrees Celcius

4. At what temperature does the enzyme lose its effectiveness?
   about 55 degrees Celcius

5. What happened to cause the enzyme to become ineffective?
   heat denatures the protein of the enzyme

Examine the Graph on Activity of an enzyme in different pH levels.

6. What is the independent variable? How is it measured?
   pH **pH scale units**

7. What is the dependent variable? How is it measured?
   rate of enzyme action relative rate

8. At what pH does the enzyme work best? Where might you expect to find pepsin in the body?
   pH of 2

9. At what pH does the enzyme lose its effectiveness?
   Gradual loss of effectiveness from pH of 3 to pH of 10

10. Would all enzymes have the same effectiveness at this pH as this enzyme? Why or why not?
    No, different enzymes are made up of different amino acids which are affected differently by pH

OSMOSIS LAB

Materials: 4 plastic bottles containing the following solutions.
Bottle A has 15% table salt
Bottle B has 10 % table salt
Bottle C has 5 % table salt
Bottle D has tap water
4 small carrots about the same size
electronic balance to determine mass of carrot pieces

Carrot place in solution	Initial mass	Mass after 24 hours	Change in mass	Observations -firmness
15% table salt				
10 % table salt				
5 % table salt				
tap water				

Using the electronic balance, determine the mass of the carrots from each solution and record it on the data table.

1. Measure four small carrot pieces about the same size.
2. Using the electronic balance, measure the initial mass of each piece of carrot and place it in the corresponding salt solution. Record the initial mass on the data table.
3. Let the container set for 24 hours.
4. Using the electronic balance, determine the mass of each carrot piece after 24 hours.
5. Record your observations about the firmness of each carrot piece.

ANALYSIS OF THE RESULTS

1. Which solution caused the greatest gain in mass of the carrot?
   Which is this solution (hypertonic, hypotonic, or isotonic) in relation to the carrot cells?
   What % weight gain did the carrot have?

2. Which solution caused the greatest loss in mass of the carrot?
   Which is this solution (hypertonic, hypotonic, or isotonic) in relation to the carrot cells?
   What % weight gain did the carrot have?

3. In which solution did the carrot become the firmest? What in the cell of the carrot promotes this firmness?

4. Which solution was closest to being isotonic in relation to the carrot cells? Why?

5. What hint might this experiment give you about getting firm vegetables to become firm again?

OSMOSIS LAB

Materials: 4 plastic bottles containing the following solutions.
Bottle A has 15% table salt
Bottle B has 10 % table salt
Bottle C has 5 % table salt
Bottle D has tap water
4 small carrots about the same size
electronic balance to determine mass of carrot pieces

Data will vary

Carrot place in solution	Initial mass	Mass after 24 hours	Change in mass	Observations -firmness
15% table salt				**Very mushy**
10 % table salt				**Mushy**
5 % table salt				**Slightly firm**
tap water				**Very firm**

Using the electronic balance, determine the mass of the carrots from each solution and record it on the data table.

1. Measure four small carrot pieces about the same size.
2. Using the electronic balance, measure the initial mass of each piece of carrot and place it in the corresponding salt solution. Record the initial mass on the data table.
3. Let the container set for 24 hours.
4. Using the electronic balance, determine the mass of each carrot piece after 24 hours.
5. Record your observations about the firmness of each carrot piece.

ANALYSIS OF THE RESULTS

1. Which solution caused the greatest gain in mass of the carrot? **tap water**
   Which is this solution (hypertonic, hypotonic, or isotonic) in relation to the carrot cells? **hypotonic**
   What % weight gain did the carrot have?

2. Which solution caused the greatest loss in mass of the carrot? **15 % salt**
   Which is this solution (hypertonic, hypotonic, or isotonic) in relation to the carrot cells? **hypertonic**
   What % weight gain did the carrot have?

3. In which solution did the carrot become the firmest? What in the cell of the carrot promotes this firmness? **tap water turgor pressure from water in vacuole pressuring against cell wall**

4. Which solution was closest to being isotonic in relation to the carrot cells? Why?
   5 % salt - nearest to normal salt content of cells

5. What hint might this experiment give you about getting firm vegetables to become firm again?
   Soak in cold distilled or tap water - explains mister in the grocery stores

ESSENTIAL AMINO ACIDS

Essential Amino Acids

To grow bones, hair, and fingernails, your body must make new protein. You can make all but eight of the twenty-two amino acids you need to build protein. These eight must come from food. Protein synthesis occurs when all twenty-two amino acids are present in the correct proportions. If there is too little of even a single amino acid, protein building falls to a low level.

The letter ratings in the table show, report card-style, how well several foods compare to egg protein, considered to be an almost perfect source of protein, as sources of four key amino acids likely to be deficient in the human diet: tryptophan, isoleucine, lysine, and the sulfur-containing amino acids. The cost listed is for one day's protein allowance.

Amino Acid Rating – Legumes

1/4 - 1/3 cup dry	Tryp	Iso.	Lys.	SC.	Cost
Peas	C	B	A+	D	$.34
Kidney Beans	C	B	A+	D	.78
Chick Peas	C	B	A+	C	.80
Lima Beans	C	B	A+	C	.61
Tofu	A	B	A	C	.31
Lentils	C	B	A+	D	.84
Navy Beans	C	B	A+	D	.80

Amino Acid Rating – Grains & Cereals

1/4 - 1/3 cup dry	Tryp.	Iso.	Lys.	SC.	Cost
Wheat	B	C	C	B	$.30
Rye	C	C	C	B	.35
Barley	A	C	C	B	.35
Millet	A+	C	C	B	.99
Spaghetti	B	B	C	C	1.11
Oatmeal	B	C	C	B	.35
Rice, brown	B	C	C	B	.74

Use the **Data Table** in answering the questions.

1. This study is grading plant protein compared to what animal substance? Why was this animal substance chosen?

2. For which amino acids do legumes have the poorest ratings?

3. In the grains and cereals, which of the amino acids have the poorest ratings?

4. Which plant has a good overall rating for the 4 amino acids **and** a low cost?

5. How could a vegetarian use **these** foods to insure enough of the essential amino acids

ESSENTIAL AMINO ACIDS

Use the **Data Table** in answering the questions.

Essential Amino Acids

To grow bones, hair, and fingernails, your body must make new protein. You can make all but eight of the twenty-two amino acids you need to build protein. These eight must come from food. Protein synthesis occurs when all twenty-two amino acids are present in the correct proportions. If there is too little of even a single amino acid, protein building falls to a low level.

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Amino Acid Rating – Grains & Cereals

1/4 - 1/3 cup dry	Tryp.	Iso.	Lys.	SC.	Cost
Wheat	B	C	C	B	$.30
Rye	C	C	C	B	.35
Barley	A	C	C	B	.35
Millet	A+	C	C	B	.99
Spaghetti	B	B	C	C	1.11
Oatmeal	B	C	C	B	.35
Rice, brown	B	C	C	B	.74

1. This study is grading plant protein compared to what animal substance? Why was this animal substance chosen?
   egg protein almost perfect source of protein

2. For which amino acids do legumes have the poorest ratings?
   SC – sulfur containing protein

3. In the grains and cereals, which of the amino acids have the poorest ratings?
   Lysine

4. Which plant has a good overall rating for the 4 amino acids **and** a low cost? **Tofu**

5. How could a vegetarian use **these** foods to insure enough of the essential amino acids
   Combine legumes with grains and cereals

CHEMICAL REACTIONS

Materials: TI 84 Plus calculator with Easy Data Application,
EasyTemp sensor, Alka-seltzer tables,
Styrofoam cup, water. large syringe or a graduated cylinder with a capacity of 50 mL

1. Turn on your TI-84 Plus graphing calculator and make sure that it is on the home screen. Plug the EasyTemp probe into the USB port of the graphing calculator. The EasyData program will automatically start and the Main screen will be displayed. Set scale to read 0.01 ^{o} C.

2. Select [File] and then select **New** to reset the program.

3. Use the large syringe to measure and add 50.0 mL of water to the Styrofoam cup.

4. Carefully remove an Alka-seltzer© tablet from its packaging.

5. Hold the temperature sensor and the cup so that the tip of the temperature sensor is in the water but not touching the side or bottom of the cup.

6. Select [Start] to start collecting data, wait 5 seconds and then add the Alka-seltzer© tablet to the water in the cup. Notice the temperature rise or fall.

7. Slowly stir the solution until the data collection reaches its highest or lowest point. Record the highest or lowest temperature after the reaction to the nearest 0.01 ^{o} C. at the end of the reaction.

8. A graph of temperature *vs*. time will be displayed on the calculator screen. To determine the maximum and minimum values, use the ▶ and ◀ keys to examine the data points along the curve. As you move the cursor, the time (X) and temperature (Y) values of each data point are displayed above the graph.

9. On the Main screen, select [Quit] (press the GRAPH key). Select [OK] (press the GRAPH key) to exit EasyData and return to the main screen.

10. Shut off the calculator and remove the probe.

11. Empty contents of cup into labeled waste container and rinse and dry the cup.

DATA ANALYSIS:

1. Did the temperature of the water increase or did it decrease as a result of the reaction? What was the temperature change in ^{0} Celcius?

2. Which was this reaction endothermic (used energy) or exothermic (released energy)? Why?

3. The specific heat of water is 1.000 cal/g ^{0}C.
Calculate the amount of energy (cal) released or absorbed during the course of this reaction.

4. What type of experiments can you develop to test endothermic and exothermic reactions?

CHEMICAL REACTIONS

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4. Carefully remove an Alka-seltzer© tablet from its packaging.

5. Hold the temperature sensor and the cup so that the tip of the temperature sensor is in the water but not touching the side or bottom of the cup.

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9. On the Main screen, select [Quit] (press the GRAPH key). Select [OK] (press the GRAPH key) to exit EasyData and return to the main screen.

10. Shut off the calculator and remove the probe.

11. Empty contents of cup into labeled waste container and rinse and dry the cup.

DATA ANALYSIS:

1. Did the temperature of the water increase or did it decrease as a result of the reaction? What was the temperature change in ^{0} Celcius? **about -2 degrees**
decreased

2. Which was this reaction endothermic (used energy) or exothermic (released energy)? Why?
endothermic – it used energy so temperature dropped

3. The specific heat of water is 1.000 cal/g ^{0}C.
Calculate the amount of energy (cal) released or absorbed during the course of this reaction.
Energy was absorbed – about 26 calories

4. What type of experiments can you develop to test endothermic and exothermic reactions?
Endothermic as oxidation reactions that use energy

Exothermic which give off heat

FOOD LABEL ANALYSIS - Note: there are 3 single serve cans per container

Nutrition Facts

Serving Size 1 can drained (68g)
Servings Per Container 3

Amount Per Serving

Calories 90 Calories from Fat 15

	% Daily Value*
Total Fat 1.5g	2%
Saturated Fat 0g	0%
Cholesterol 30mg	10%
Sodium 220mg	9%
Total Carbohydrate 0g	0%
Dietary Fiber 0g	0%
Sugars 0g	
Protein 20g	38%

Not a significant source of Vitamin A, Vitamin C, Calcium and Iron.

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

INGREDIENTS: WHITE CHICKEN, WATER, AND SALT
VALLEY FRESH INC. P.O. BOX 339, TURLOCK, CA 95381

VALLEY FRESH CHICKEN SALAD

1 Can (3oz.) VALLEY FRESH CHUNK WHITE CHICKEN, drained
2 Tbs. Diced Celery
2 Tbs. Sliced Green Onion
2 Tbs. Mayonnaise
¼ tsp. Prepared Mustard
Dash Garlic Powder, Dash Onion Powder
Combine ingredients.
Serve immediately or cover and chill. Serves 2.

FOOD LABEL ANALYSIS

Use the data from the food label in answering the following questions?

Round off answers to the nearest whole number.

1. How many **calories** are in a single serving of this chicken?
2. What **percent** of these calories come from fat?
3. How many **grams** are in a single serving of this chicken?
4. How many **grams** of **protein** are in a single serving of chicken?
5. What **percent** of a **single serving** of chicken is **protein**?
6. What **percent** of a **single serving** of chicken is **total carbohydrate**?
7. The **% daily value** is based upon a diet of how many **calories**?
8. One serving of this food provides what **percent daily value** of **protein**?
9. How many calories are in a gram of fat? How does this compare to the calories in a gram of protein or carbohydrate?
10. Using the **number of grams** of protein in one serving of this food and the **% daily value** of protein, determine the number of **grams** of protein you should have each day.

Application Questions:

1. What percent of a single serving is neither protein, fat, nor carbohydrate?
2. What type of substance is this and why is it so important to cells?
3. Into what building blocks will the proteins be broken during digestion?
4. Into what building blocks will the fats be broken during digestion?
5. Into what building blocks will the carbohydrates be broken during digestion?

FOOD LABEL ANALYSIS

Use the data from the food label in answering the following questions?

Round off answers to the nearest whole number.

1. How many **calories** are in a single serving of this chicken? **90 cal**

2. What **percent** of these calories come from fat?
15/90 x 100% = 17%

3. How many **grams** are in a single serving of this chicken?
68 g

4. How many **grams** of **protein** are in a single serving of chicken?
20 g

5. What **percent** of a **single serving** of chicken is **protein**?
29 %

6. What **percent** of a **single serving** of chicken is **total carbohydrate**?
0 %

7. The **% daily value** is based upon a diet of how many **calories**?
2000 calories

8. One serving of this food provides what **percent daily value** of **protein**?
38 %

9. How many calories are in a gram of fat? How does this compare to the calories in a gram of protein or carbohydrate?
9 g compared to 4 g

10. Using the **number of grams** of protein in one serving of this food and the **% daily value** of protein, determine the number of **grams** of protein you should have each day.
53 g per day

Application Questions:

1. What percent of a single serving is neither protein, fat, nor carbohydrate?
32 % percent will be much higher in fruits and vegetables

2. What type of substance is this and why is it so important to cells?
Water – much of the mass of food is actually water – it is necessary for life functions to occur

3. Into what building blocks will the proteins be broken during digestion?
amino acids

4. Into what building blocks will the fats be broken during digestion?
glycerol and fatty acids

5. Into what building blocks will the carbohydrates be broken during digestion?
Simple sugars