

Topic 1: Introduction to Biology

Scientific Method:

- Problem: What does the scientist want to learn more about?
- Make Observations: gathering of information
- Hypothesis: an "educated guess" of an answer to the question
- Procedure: written and carefully followed step-by-step experiment designed to test the hypothesis
- Collect Data: information collected during the experiment
- Organize data (chart/graph): written description of what was noticed during the experiment
- Conclusion: was the hypothesis supported or refuted?

Designing a controlled experiment:

- must have Large sample size and/or several trials
- only change one variable at a time
- Control Group: does not have variable being tested (source of comparison)
- Dependent Variable: what you measure for data
- Independent Variable: causes the effect, the one factor that is different (in experimental group)

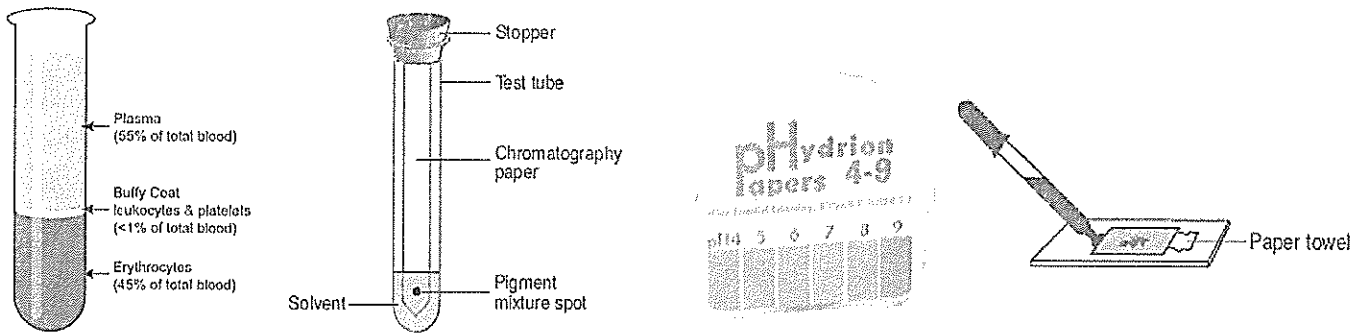
Practice: A TV advertisement claims that a certain brand of cough drop reduces coughing for 8 hours. Describe an investigation that could be used to determine if this claim is valid. In your answer, include at least a description of:

- The treatment to be given to the experimental group
- The treatment to be given to the control group
- The data to be collected
- When the data should be collected
- One observation that would lead to the conclusion that the claim is valid

- The experimental group will be given the cough drops.
- The control group will be given a placebo (sugar pill)
- The data to be collected will be the number of times the individuals cough.
- The data should be collected before and after the the individuals are given the drops.
- If the individuals in the experimental group cough less after taking the cough drops, the claim is valid.

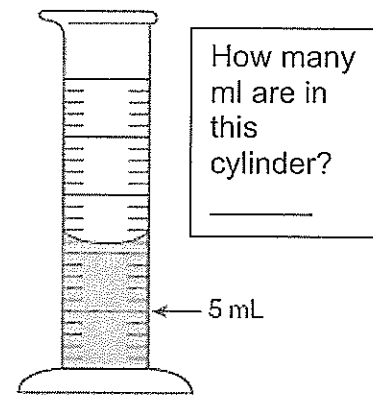
Tools of the Biologist:

Tool	Description
Electrophoresis	Used to separate DNA fragments
Centrifuge	used to separate materials according to different densities
Chromatography	used to separate pigments according to solubility
Indicators	change color in the presence of certain chemicals
Stains	used to make cell structures more visible



Fill in the Chart below:

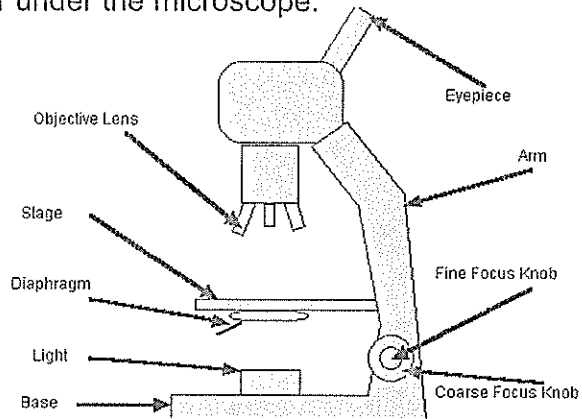
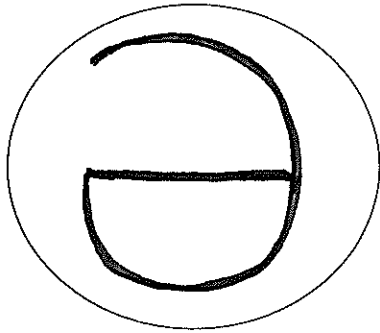
Tool	Unit	Used to measure...
Metric Ruler	cm	Length
Graduated Cylinder	ml	Volume
Thermometer	°C	temperature
Balance / Scale	grams	Mass



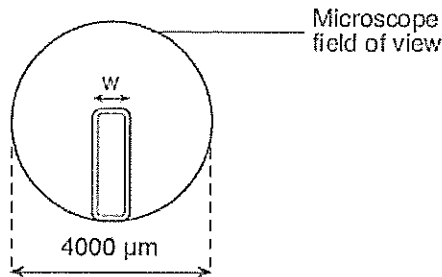
The Compound Light Microscope:

Part	Function
ocular	Lens nearest the eye, usually magnifies 10x
objective	Lenses located closest to specimen, commonly magnify at 4x, 10x, and 40x
stage	Flat surface (platform) on which the slide is placed
diaphragm	Located under the stage, controls the amount of light passing through
Coarse adj.	Used to focus on low power only
Fine adj.	Used to focus on high power

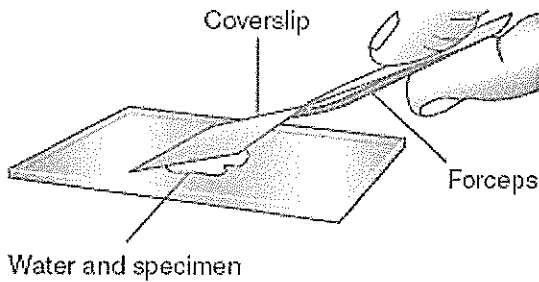
- Objects viewed with the compound microscope will be upside down and backwards.
- Draw the letter "e" as it would appear under the microscope.



- If you move the slide up and to the right, which way will the object in view move?
down and left



Approximately how large is this cell?
800 μm



Briefly describe the steps to follow when preparing a wet mount.
 ① Drop of water and specimen on slide. ② Place one edge of cover-slip on slide and lower down. ③ Add stain to one edge of cover-slip. ④ Place paper towel on opposite edge.

- Briefly describe the steps to follow when observing a specimen through the compound microscope.

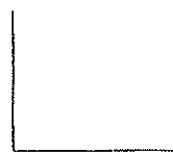
Center the object under low power and focus with course adj.
Switch to high power, add light and focus with fine adj.

Fill in the chart below:

Power	Low	High
Brightness of FOV	Bright	Dark
Size of FOV	Large	Small

Graphing:

1. Identify the variables to be plotted
 - Independent Variable: the variable manipulated by the experimenter
 - plotted on the x-axis (horizontal axis)
 - Dependent Variable: the factor responding to changes in the independent variable
 - plotted on the y-axis (vertical axis)
 - Hypothesis: If (Independent), then (Dependent).
2. Determine the scale of the axes
 - determine each axis individually
 - may easily be determined by taking the largest value to be plotted and dividing by the number of blocks and then rounding up to the nearest convenient number
 - the graph should be spread to occupy the most available space
3. Number and label each axis indicating the appropriate units.
4. Plot each data value on the graph with a point. Surround each point with a circle (or other shape as directed).
5. Draw a line that best fits the data points.
 - do not connect data points to the origin (0,0) unless there is data to support this
6. If asked, provide a title which clearly indicates what the graph is about.



Practice:

A student counted the total number of leaves in a group of duckweed plants (*Lemna gibba*) over a 5-day period. The data collected are shown in the table below.

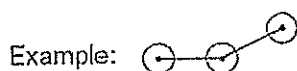
Growth of Duckweed Leaves

Time in Days	Number of Leaves
0	15
1	20
2	25
3	40
4	60
5	80

Directions (39–40): Using the information in the data table, construct a line graph on the grid provided on the next page following the directions below.

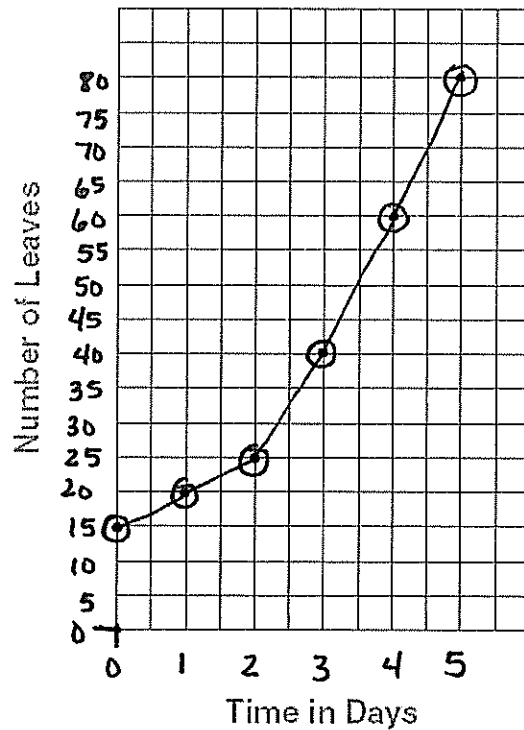
39 Mark an appropriate scale on each labeled axis. [1]

40 Plot the data from the data table. Surround each point with a small circle and connect the points. [1]



39-40

Growth of Duckweed Leaves



41. The time it takes for the number of leaves to increase from 15 to 30 is approximately

- (1) 2.0 days
- (2) 2.3 days
- (3) 2.9 days
- (4) 3.2 days

42. State what would most likely happen to the production of oxygen by duckweed plants if the intensity and duration of exposure to light were increased. [1]

The production of oxygen would increase and then level off (remain constant)

Life Processes:

- Not life functions {
- Metabolism : all life functions working to sustain life
 - Homeostasis : maintaining a stable internal environment in a constantly changing external environment

1. Nutrition : obtain and use nutrients (getting food)

a. Autotrophs : make their own food through the process of photosynthesis (at the chloroplast)

Equation:



b. heterotroph: obtain nutrients from other organisms

2. Respiration : energy making/releasing from organic compounds (at the mitochondria)

Equation:



3. Transport : absorption and distribution of materials through an organism

4. Excretion : removal of metabolic wastes

5. Synthesis : change small molecules to large ones (micromolecules → macromolecules)

6. Regulation : control and coordination (maintain homeostasis)

7. Growth : increase in cell size and/or number

8. Reproduction : production of new individuals

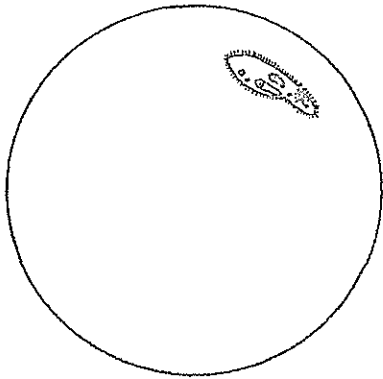


What life function is needed for the survival of the species, but not the survival of the individual? Reproduction

1. Which paragraph describes the correct procedure for preparing a stained wet mount of onion epidermis?
 - 1) Place a piece of onion epidermis on a slide. Add two drops of water and one drop of stain. Cover the slice by dropping a cover slip directly on top of it. Press the coverslip to force air bubbles out. Add one drop of water to one edge of the coverslip, and add one drop of stain to the opposite edge.
 - 2) Add one drop of stain to a piece of onion epidermis. Using forceps, place the epidermis on a slide. Blot the epidermis with a piece of paper towel to remove the excess stain. Drop a coverslip onto the specimen.
 - 3) Place a piece of onion epidermis on a slide. Add one drop of water. Put one edge of a coverslip in the water drop, then slowly lower the opposite edge to the water. Put one drop of stain at one edge of the coverslip. Put a piece of paper towel at the opposite side of the coverslip. Allow the towel to absorb some water so that the stain will move under the coverslip.
 - 4) Add one drop of stain to a slide. Place a piece of onion epidermis on top of the stain. Use a piece of paper towel to absorb the stain. Drop a coverslip on the epidermis to flatten it out. Lift the coverslip and add a drop of water to the epidermis. Replace the coverslip.
2. A biologist would most likely study all the chemical activities of an organism to obtain information about the
 - 1) number of mutations in the organism
 - 2) reproductive cycle of the organism
 - 3) development of the organism
 - 4) metabolism of the organism
3. Which statement best illustrates the life process of growth?
 - 1) A dog consumes a bowl of food.
 - 2) An ameba moves away from bright light.
 - 3) A bean seed germinates.
 - 4) Two monosaccharides are formed from a disaccharide.
4. Two test tubes were filled with a solution of bromthymol blue. A student exhaled through a straw into each tube, and the bromthymol blue turned yellow. An aquatic green plant was placed into each tube, and the tubes were corked. One tube was placed in the dark, and one was placed in direct sunlight. The yellow solution in the tube in sunlight turned blue, while the one in the dark remained yellow. Which statement best explains why the solution in the tube placed in sunlight returned to a blue color?
 - 1) Oxygen was produced by photosynthesis.
 - 2) Oxygen was removed by respiration.
 - 3) Carbon dioxide was removed by photosynthesis.
 - 4) Carbon dioxide was produced by respiration.
5. In the earthworm, digested proteins are converted to new proteins by the process of
 - 1) ingestion
 - 2) digestion
 - 3) transport
 - 4) synthesis
6. When an individual goes without eating for a day, his or her blood sugar level remains about the same throughout the day. This relatively constant condition is maintained by
 - 1) homeostatic control
 - 2) egestion
 - 3) reproduction
 - 4) growth of cells



7. A cell in the field of view of a compound light microscope is shown in the diagram below.



In which direction should the slide be moved to center this cell in the microscopic field?

- 1) to the right and up
 - 2) to the right and down
 - 3) to the left and up
 - 4) to the left and down
8. A student wants to test the hypothesis that a certain aquarium plant absorbs CO_2 . The student placed a sprig of the aquarium plant in a test tube with water and exhaled CO_2 into the water. Which indicator should the student add to the test tube to help him test this hypothesis?
- 1) Benedict's solution
 - 2) iodine solution
 - 3) salt solution
 - 4) bromthymol blue solution
9. Which activity is *not* an example of heterotrophic nutrition?
- 1) An eagle kills and eats a snake.
 - 2) A tapeworm absorbs food in a human intestine.
 - 3) A mushroom decomposes a dead log.
 - 4) An algal cell synthesizes food during photosynthesis.

10. Base your answer on the passage below and on your knowledge of biology.

A student was given a sample of food and asked to determine the types of nutrients present in the sample. The student placed half of the sample in a test tube with Benedict's solution and heated it. The solution turned brick red. When an iodine solution was added to the remaining half of the sample, it turned blue black.

The student can correctly conclude that the food sample contained

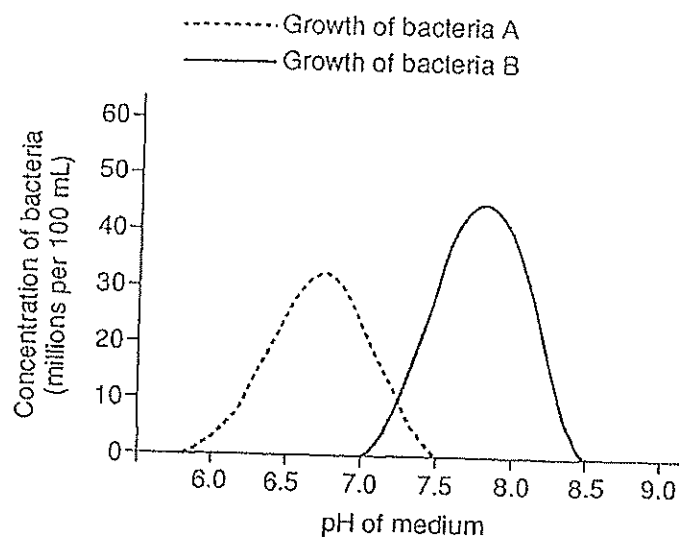
- 1) monosaccharides and polysaccharides
 - 2) polypeptides and fats
 - 3) polysaccharides and lipids
 - 4) monosaccharides and polypeptides
11. Homeostatic regulation of the body is made possible through coordination of all body systems. This coordination is achieved mainly by
- 1) respiratory and reproductive systems
 - 2) skeletal and excretory systems
 - 3) nervous and endocrine systems
 - 4) circulatory and digestive systems
12. During a race, the body temperature of a runner increases. The runner responds by perspiring, which lowers body temperature. This process is an example of
- 1) maintenance of homeostasis
 - 2) an antigen-antibody reaction
 - 3) an acquired characteristic
 - 4) environmental factors affecting phenotype
13. The life function of transport in an organism directly involves those activities used to
- 1) absorb and distribute materials
 - 2) obtain and hydrolyze materials
 - 3) release energy from food
 - 4) produce cellular waste products
14. Which process reduces the concentration of urea in the blood of humans?
- 1) excretion
 - 2) egestion
 - 3) digestion
 - 4) synthesis

15. When heating a solution in a test tube, a student should
- 1) point the test tube in any direction
 - 2) hold the test tube with two fingers
 - 3) cork the test tube
 - 4) wear goggles
16. The life function responsible for the coordination and control of all life activities in an organism is known as
- 1) regulation
 - 2) reproduction
 - 3) excretion
 - 4) nutrition
17. Which substance should be used to determine if a solution is basic?
- 1) methylene blue
 - 2) Benedict's solution
 - 3) Lugol's iodine
 - 4) pH paper
18. The removal of carbon dioxide and nitrogenous wastes from an organism illustrates the life function known as
- 1) regulation
 - 2) nutrition
 - 3) respiration
 - 4) excretion
19. A student prepared a slide of pollen grains from a flower. First the pollen was viewed through the low-power objective lens and then, without moving the slide, viewed through the high-power objective lens of a compound light microscope.

Which statement best describes the relative number and appearance of the pollen grains observed using these two objectives?

- 1) low power: 25 small pollen grains high power: 100 large pollen grains
- 2) low power: 100 small pollen grains high power: 25 large pollen grains
- 3) low power: 25 large pollen grains high power: 100 small pollen grains
- 4) low power: 100 large pollen grains high power: 25 small pollen grains

20. Base your answer to the following question on the graph below and on your knowledge of biology. The graph illustrates the growth curves for two types of bacteria (*A* and *B*) under differing pH values.



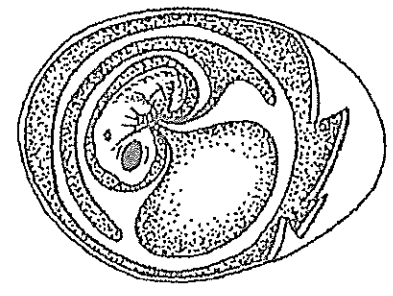
Bacteria *A* grows best in a medium that is

- 1) slightly acidic
- 2) neutral
- 3) slightly basic
- 4) very basic

21. Which activity is an example of the life process known as synthesis?
- 1) An organic compound is broken down and energy is released.
 - 2) Starch is formed by the chemical bonding of glucose molecules.
 - 3) A large molecule is broken down into smaller molecules.
 - 4) Oxygen moves into a cell through the cell membrane.

22. Which life function is primarily involved in the conversion of the energy stored in organic molecules to a form directly usable by a cell?
- 1) absorption
 - 2) circulation
 - 3) digestion
 - 4) respiration

23. The diagram below represents a developing bird egg.



What is the primary function of this egg?

- 1) food supply for predators to preserve predator populations
- 2) adaptation to allow maximum freedom for parent birds
- 3) continuation of the species through reproduction
- 4) preservation of the exact genetic code of the parent birds

24. A glucose-tolerance test was conducted to observe the effect of time on glucose concentration in the blood. An animal was fed 10 milliliters of glucose solution. At five different times after the ingestion of the solution, the blood glucose concentration was determined, and the results were recorded in the data table below.

Data Table

Time After Glucose Ingestion (minutes)	Glucose Concentration in Blood (mg/100 dL)
0	75
30	125
60	110
90	90
120	80
180	70

The change in glucose concentration in the blood between 0 and 30 minutes was probably due to

- 1) the liver releasing glucose into the small intestine
 - ② glucose being absorbed from the digestive system
 - 3) the synthesis of glucose from starch
 - 4) glucose being used for cellular respiration
25. The use of CO_2 and H_2O by a geranium plant to synthesize glucose illustrates the process of
- ① autotrophic nutrition
 - 2) heterotrophic nutrition
 - 3) protein production
 - 4) carbohydrate hydrolysis

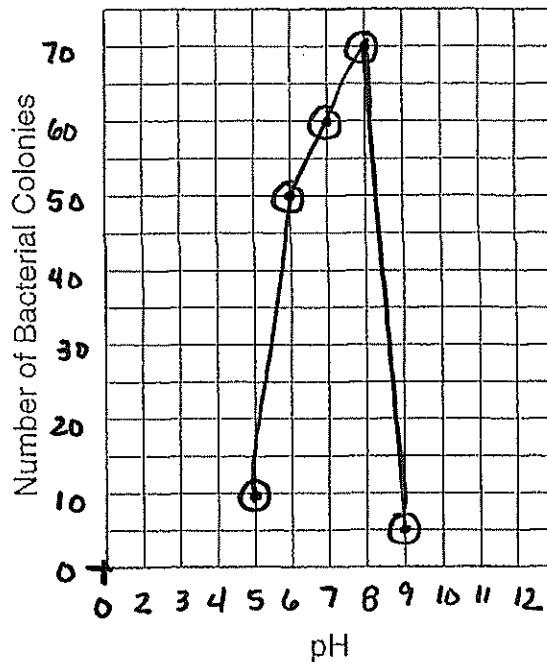
26. Which group of measurement units is correctly arranged in order of increasing size?
- ① micrometer, millimeter, centimeter, meter
 - 2) millimeter, micrometer, centimeter, meter
 - 3) meter, micrometer, centimeter, millimeter
 - 4) micrometer, centimeter, millimeter, meter
27. Which statement most accurately describes the process of respiration?
- 1) It occurs only in plants during daylight hours and usually involves an exchange of gases.
 - 2) It occurs only in plants during daylight hours and involves ingestion of preformed organic molecules.
 - 3) It occurs continuously in the cells of all organisms and involves the synthesis of organic molecules.
 - ④ It occurs continuously in the cells of all organisms and usually involves an exchange of gases.
28. When a duck dives into cold water, the capillaries in its skin constrict and move deeper below the surface of the skin. This reaction is an example of
- ① homeostasis
 - 2) synthesis
 - 3) respiration
 - 4) excretion
29. Nutrition involves those activities by which organisms
- 1) remove cellular waste products
 - ② obtain and process materials needed for other activities
 - 3) exchange gases with their environment
 - 4) absorb and circulate materials
30. Which life process is classified as autotrophic in some organisms and heterotrophic in other organisms?
- 1) hormonal regulation
 - ② nutrition
 - 3) anaerobic respiration
 - 4) transport

Base your answers to questions 31 through 34 on the information and data table below.

One milliliter of a solution containing an even distribution of a species of bacterium was spread on the surface of a nutrient medium in each of five culture dishes. The nutrient medium in each dish was the same, except for pH. The dishes were then incubated at 37°C for 24 hours. The number of bacterial colonies in each dish was then counted, and the results are represented in the data table below.

Data Table

pH of Nutrient Medium	Number of Bacterial Colonies on Nutrient Medium
5	10
6	50
7	60
8	70
9	5



31. Using the information in the data table, construct a line graph on the grid provided. Mark an appropriate scale on each labeled axis.
32. Plot the data for the number of bacterial colonies on the grid. Surround each point with a small circle and connect the points.
33. The limiting factor in this investigation is the
- ① pH of the nutrient medium
 - 2) species of bacterium in each culture dish
 - 3) color of the colonies of bacteria
 - 4) amount of nutrient medium in each culture dish

34. Using one or more complete sentences, state a conclusion that relates the number of colonies of the species of bacterium to pH.

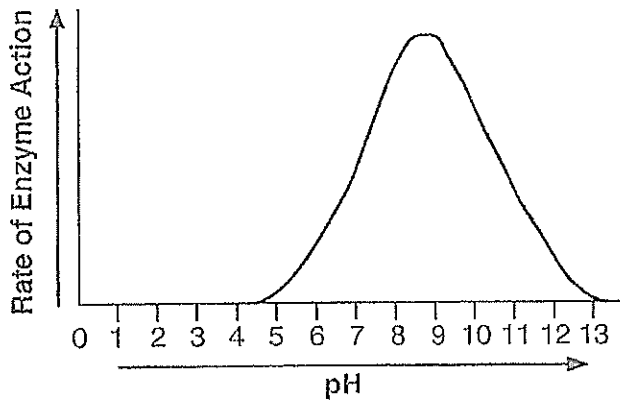
Bacteria growth is optimal at a pH of 8

Bacteria grow best in a slightly basic environment

35. Explain how carbohydrates provide energy for life functions.

Carbohydrates are converted into ATP (cellular energy) during cellular respiration.

36. The effect of pH on a certain enzyme is shown in the graph below.



At what pH would the enzyme be most effective?

- 1) above 10 3) between 5 and 7
② between 8 and 10 4) below 5

37. Many people who are in favor of alternative medicine claim that large doses of vitamin C introduced into a vein speed up the healing of surgical wounds. Describe an experiment to test this hypothesis. Your answer must include at least:

- the difference between the experimental group of subjects and the control group
- two conditions that must be kept constant in both groups
- data that should be collected
- an example of experimental results that would support the hypothesis

- The experimental group will be given Vitamin C
The control group will not get vitamin C.
- Two conditions that must remain constant: Amt. of patients
Time of the experiment
Age of patients
- Data: The healing rate of the wounds
- If the experimental group shows faster healing the claim is valid

38. In desert environments, organisms that cannot maintain a constant internal body temperature, such as snakes and lizards, rarely go out during the hot, sunny daylight hours. They stay in the shade, under rocks, or in burrows during the day. Explain how this behavior helps maintain homeostasis in these organisms.

This behavior helps to regulate their body temperature

39. Base your answer to the following question on the information and data table below.

Two species of fish were subjected to a series of treatments. The number of red blood cells flowing per minute through one capillary in the tail of each fish was counted and the average calculated. The data table below shows the treatments given to each species of fish and the results of the various treatments.

Data Table

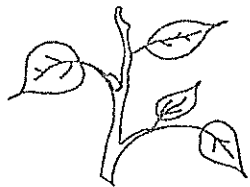
Treatment	Species of Fish	Number of Fish Used	Average Number of Red Blood Cells
Adrenaline added (1:10,000 solution)	Trout	10	35
Adrenaline added (1:1,000 solution)	Trout	10	50
50% alcohol solution added	Trout	5	78
Temperature reduced (25°C to 4°C)	Trout	6	30
Lactic acid added (1:5,000 solution)	Sunfish	6	90
25% alcohol solution added	Sunfish	6	89
Adrenaline added (1:10,000 solution)	Sunfish	6	17
Temperature reduced (25°C to 4°C)	Sunfish	6	14
Temperature increased (15°C to 25°C)	Sunfish	6	22

State *two* errors in this investigation.

- ① Different numbers of fish in the groups
- ② Testing more than one variable

Base your answers to questions 40 and 41 on the information, diagram, and table below.

A student wanted to test the hypothesis that rooting hormones will stimulate the production of new roots at a faster rate than would take place without rooting hormones. Two stem cuttings of equal length, similar to the one shown below, were taken from a rose, a begonia, and a geranium plant. The cut end of one cutting from each plant was dipped into the hormone and then planted in wet sand. The other cutting from each plant was planted in wet sand without dipping it into the hormone. All cuttings were maintained in identical environmental conditions. At the end of 4 weeks, all the cuttings were removed from the sand and the lengths of the roots that had developed were measured. The results are summarized in the data table below.



Plant Cutting	Total Length of Roots in Centimeters	
	Treated with Hormone	Untreated
Begonia	1.50	1.00
Geranium	0.75	0.50
Rose	0.00	0.00

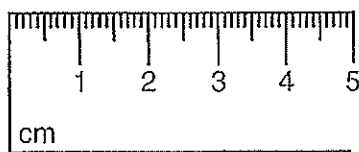
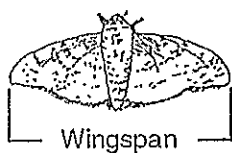
40. Describe *one* way the student could make the experiment more valid.

The experiment will be more valid with larger sample sizes (use more plants in each group)

41. What purpose did the untreated cuttings serve in this experiment?

The untreated cuttings served as the control group

42. A peppered moth and part of a metric ruler are represented in the diagram below.



Row	Body Length:Wingspan
(1)	1:1
(2)	2:1
(3)	1:2
(4)	2:2

Which row in the chart above best represents the ratio of body length to wingspan of the peppered moth?

- 1) 1
- 2) 2
- 3) 3
- 4) 4