

Scientific Method, Graphing and Measurement

- Which safety precaution is recommended when a liquid is being heated in a test tube?
 - When holding the test tube, keep fingers closest to the open end of the tube.
 - Direct the flame of the burner into the open end of the test tube.
 - Stopper the test tube with a rubber stopper.
 - Wear goggles and a laboratory apron.
- When heating a solution in a test tube, a student should
 - point the test tube in any direction
 - hold the test tube with two fingers
 - cork the test tube
 - wear goggles
- The directions for a laboratory activity call for 50 milliliters (ml) of solution *A*. A student accidentally takes 55 ml from the stock bottle. What should the student do with the extra 5 ml of solution *A*?
 - Return the extra 5 ml to the stock bottle and replace the cap.
 - Pour the extra 5 ml down the drain and rinse the sink with cold water.
 - Dilute the extra 5 ml with 100 ml of water and pour it down the drain.
 - Set the extra 5 ml aside in a labeled beaker and ask the teacher for advice.
- Chlorophyll can be removed from leaves by boiling them in alcohol, a flammable solvent. In addition to wearing safety goggles, which is the safest procedure to follow?
 - A stoppered test tube of leaves and alcohol should be held over a Bunsen burner.
 - A stoppered test tube of leaves and alcohol should be placed into a beaker of alcohol on a tripod over a Bunsen burner.
 - A beaker of leaves and alcohol should be placed on a tripod over a Bunsen burner.
 - A beaker of leaves and alcohol should be placed into a larger beaker of water and heated on a hot plate.
- Which statement represents an unsafe procedure for heating a nutrient solution in a flask?
 - heat the solution at the lowest temperature possible on a hot plate
 - stopper the flask tightly to prevent evaporation of the solution
 - use a Bunsen burner to heat the solution
 - stir the solution while it is heating
- A scientist is planning to carry out an experiment on the effect of heat on the function of a certain enzyme. Which would *not* be an appropriate first step?
 - doing research in a library
 - having discussions with other scientists
 - completing a data table of expected results
 - using what is already known about the enzyme
- A student conducted an original, well-designed experiment, carefully following proper scientific procedure. In order for the conclusions to become generally accepted, the experiment must
 - contain several experimental variables
 - be repeated to verify the reliability of the data
 - support the original hypothesis
 - be conducted by a scientist

8. Base your answer to the following question on "the investigation described below and on your knowledge of biology.

Twelve bean plants were used to study the effect of nutrients on the rate of plant growth. All the plants used in this investigation were initially the same height. Starting on day 1, six of the bean plants (Group A) were given 30 milliliters of distilled water every day for seven consecutive days. Starting on the same day, the other six bean plants (Group B) were given 30 milliliters of distilled water containing 0.1 gram of fertilizer every day for seven consecutive days. The average daily change in height of the plants in each group is shown in the data table below.

DATA TABLE

Day	Average Daily Increase in Plant Height (mm)	
	Group A	Group B
1	0	0
2	2	4
3	1	3
4	3	5
5	2	5
6	2	4
7	1	4

Based on the data in the table, if all the bean plants were 70 millimeters tall on day 1, the average height of the bean plants in group B on day 7 would be

- A) 75 mm B) 81 mm C) 95 mm D) 100 mm

9. A student hypothesized that lettuce seeds would not germinate (begin to grow) unless they were covered with soil. The student planted 10 lettuce seeds under a layer of soil and scattered 10 lettuce seeds on top of the soil. The data collected are shown in the table below.

Data Table

Seed Treatment	Number of Seeds Germinated
Planted under soil	9
Scattered on top of soil	8

To improve the reliability of these results, the student should

- A) conclude that darkness is necessary for lettuce seed germination
B) conclude that light is necessary for lettuce seed germination
C) revise the hypothesis
D) repeat the experiment using a larger sample size

10. Why do scientists consider any hypothesis valuable?

- A) A hypothesis requires no further investigation.
B) A hypothesis may lead to further investigation even if it is disproved by the experiment.
C) A hypothesis requires no further investigation if it is proved by the experiment.
D) A hypothesis can be used to explain a conclusion even if it is disproved by the experiment.

11. The analysis of data gathered during a particular experiment is necessary in order to

- A) formulate a hypothesis for that experiment
B) develop a research plan for that experiment
C) design a control for that experiment
D) draw a valid conclusion for that experiment

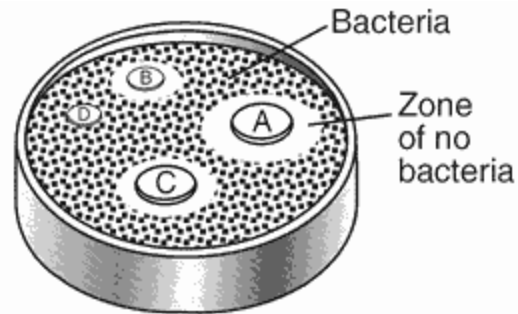
12. A biologist in a laboratory reports a new discovery based on experimental results. If the experimental results are valid, biologists in other laboratories should be able to

- A) repeat the same experiment with a different variable and obtain the same results
- B) perform the same experiment and obtain different results
- C) repeat the same experiment and obtain the same results
- D) perform the same experiment under different experimental conditions and obtain the same results

13. A biologist formulates a hypothesis, performs experiments to test his hypothesis, makes careful observations, and keeps accurate records of his findings. In order to complete this process, the biologist should

- A) adjust the data to support the hypothesis
- B) eliminate data that do not support the hypothesis
- C) write a research paper explaining his theories before performing his experiments, in order to gain funding sources
- D) evaluate the findings and, if necessary, alter the hypothesis based on his findings, and test the new hypothesis

14. An experiment was carried out to determine which mouthwash was most effective against bacteria commonly found in the mouth. Four paper discs were each dipped into a different brand of mouthwash. The discs were then placed onto the surface of a culture plate that contained food, moisture, and bacteria commonly found in the mouth. The diagram below shows the growth of bacteria on the plate after 24 hours.



Which change in procedure would have improved the experiment?

- A) using a smaller plate with less food and moisture
 - B) using bacteria from many habitats other than the mouth
 - C) using the same size paper discs for each mouthwash
 - D) using the same type of mouthwash on each disc
15. A study was conducted using two groups of 10 plants of the same species. During the study, the plants were placed in identical environmental conditions. The plants in one group were given a growth solution every 3 days. The heights of the plants in both groups were recorded at the beginning of the study and at the end of a 3-week period. The data showed that the plants given the growth solution grew faster than those not given the solution.

When other researchers conduct this study to test the accuracy of the results, they should

- A) give growth solution to both groups
- B) make sure the conditions are identical to those in the first study
- C) give an increased amount of light to both groups of plants
- D) double the amount of growth solution given to the first group

16. Which statement best describes a scientific theory?

- A) It is a collection of data designed to provide support for a prediction.
- B) It is an educated guess that can be tested by experimentation.
- C) It is a scientific fact that no longer requires any evidence to support it.
- D) It is a general statement that is supported by many scientific observations.

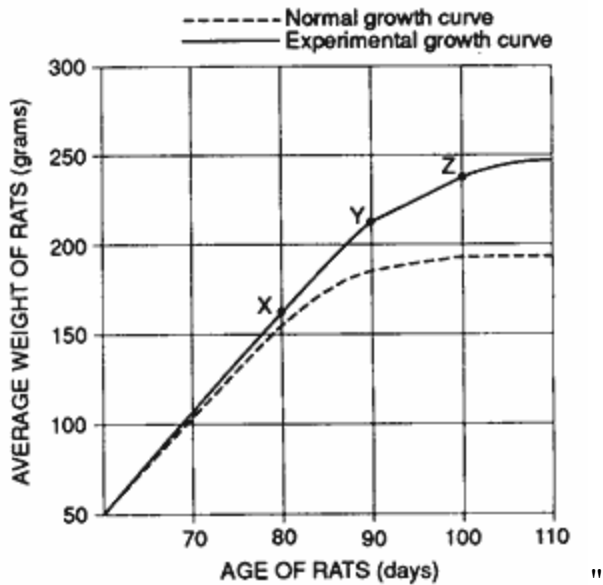
17. A student added 10 mL of a yeast suspension and 10 mL of 30°C water to each of two test tubes. Five grams of sugar was then added to one of the test tubes. Both test tubes were gently swirled to mix the contents, and then the test tubes were placed in a warm water bath for 15 minutes. The student made observations of any bubbles that formed in the test tubes and recorded the data in a table.

This experiment was most likely carried out to investigate the

- A) effect of sugar on a metabolic activity of yeast
 - B) effect of temperature on a metabolic activity of yeast
 - C) solubility of yeast in water at 30°C
 - D) solubility of sugar in a yeast suspension
-

18. Base your answer to the following question on "the graph below and on your knowledge of biology.

The graph below illustrates the results of an investigation using newborn rats. The dashed line curve shows the normal growth rate of rats, based on previous investigations. The solid-line curve shows the growth rate of 50 rats that were fed a normal diet containing nutrients *A* and *B* until they reached an age of 80 days (point *X*). At point *X*, the amounts of nutrients *A* and *B* were increased. At point *Y*, nutrient *A* was returned to the normal amount. At point *Z*, nutrient *B* was returned to the normal amount.



If the investigation had continued as described except that at point *Z* nutrient *B* was not returned to the normal amount, the most reasonable conclusion that could be drawn from the data presented is that the rats would probably have

- A) lived for 30 to 60 additional days and then died
- B) remained at about twice the weight of normally developed rats
- C) continued to gain weight
- D) become mentally and sexually immature adults

19. For many years, scientists were uncertain about the function of repeated base sequences in DNA that did not code for proteins. Recently, investigations of plants indicated that the greater the number of specific repeated base sequences a plant species contains, the larger the plant will be. The Atlantic Giant pumpkin, which can reach a weight of almost 1,000 pounds, was found to contain a large number of these repeated DNA sequences. Similar findings were observed in other large plants. Which statement is *not* valid based on this information?

- A) The Atlantic Giant pumpkin contains many repeated DNA sequences.
- B) Scientists have only recently begun to understand the function of repeated DNA sequences.
- C) Some regions of a DNA molecule code for proteins.
- D) The findings reported for plants must also be true for animals.

20. A student wanted to determine the effect of specific amino acids on growth in humans. The student weighed several genetically identical mice and placed them in separate cages. The mice were raised under identical conditions, except that some were given additional amounts of selected amino acids. After 4 weeks, the mice were all weighed and evaluated. A limitation of this investigation is that

- A) mouse research data are not necessarily valid for humans
- B) mice do not need amino acids in their diets
- C) amino acids are toxic to mice
- D) the student did not use a control

21. A student hypothesized that lettuce seeds would not sprout (germinate) unless they were exposed to darkness. The student planted 10 lettuce seeds under a layer of soil and scattered 10 lettuce seeds on top of the soil. The data collected are shown in the table below.

Data Table

Seed Treatment	Number of Seeds Germinated
Planted under soil	9
Scattered on top of soil	8

One way to improve the validity of these results would be to

- A) conclude that darkness is necessary for lettuce seed germination
- B) conclude that light is necessary for lettuce seed germination
- C) revise the hypothesis
- D) repeat the experiment

22. Recently, scientists noted that stained chromosomes from rapidly dividing cells, such as human cancer cells, contain numerous dark, dotlike structures. Chromosomes from older human cells that have stopped dividing have very few, if any, dotlike structures. The best generalization regarding these dotlike structures is that they

- A) will always be present in cells that are dividing
- B) may increase the rate of mitosis in human cells
- C) definitely affect the rate of division in all cells
- D) can cure all genetic disorders

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23. Base your answer to the following question on the information below and on your knowledge of biology.

An experiment was designed to determine if chlorophyll is responsible for the growth of corn seedlings toward light. In the experiment, equal numbers of albino corn seedlings and green corn seedlings were grown at a temperature of 24°C. All other environmental conditions were the same for both groups of seedlings. The results of the experiment showed that both the albino seedlings and the green seedlings bent toward light.

Which hypothesis is being tested in this experiment?

- A) Albino corn seedlings grow as fast as green corn seedlings.
 - B) Chlorophyll is needed for corn seedlings to grow toward light.
 - C) Differences in genotypes produce variations in corn phenotypes.
 - D) Light is required for germination of corn.
24. A mineral supplement designed to prevent the flu was given to two groups of people during a scientific study. Dosages of the supplement were measured in milligrams per day, as shown in the table below.

Supplement Dosages

Group	Dosage (mg/day)
A	100
B	200

After 10 weeks, neither group reported a case of the flu. Which procedure would have made the outcome of this study more valid?

- A) test only one group with 200mg of the supplement
 - B) test the supplement on both groups for 5 weeks instead of 10 weeks
 - C) test a third group that receives 150mg of the supplement
 - D) test a third group that does not receive the supplement
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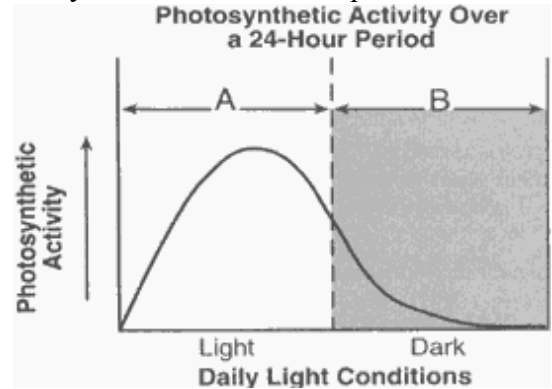
25. To test the effect of hormones on plant growth, six potted plant seedlings of the same species were measured and then sprayed with auxin (a growth hormone). After four weeks of growth under ideal conditions, the plants were measured again. To set up a proper control for this experiment, the investigator should

- A) spray the same plants with different amounts of auxin
- B) spray auxin on six plant seedlings of the same species and grow them in the dark for four weeks
- C) wash the auxin off three of the plants after two weeks
- D) grow another six plant seedlings of the same species under the same conditions, spraying them with distilled water only

26. The development of an experimental research plan should *not* include a

- A) list of safety precautions for the experiment
- B) list of equipment needed for conducting the experiment
- C) procedure for the use of technologies needed for the experiment
- D) conclusion based on data expected to be collected in the experiment

27. The graph below shows photosynthetic activity in an ecosystem over a 24-hour period.



When should data for a study on respiration in this ecosystem be collected?

- A) interval A, from only the producers in the ecosystem
 - B) intervals A and B, from only the consumers in the ecosystem
 - C) intervals A and B, from both the producers and consumers in the ecosystem
 - D) interval A only, from abiotic but not biotic components of the ecosystem
28. The first trial of a controlled experiment allows a scientist to isolate and test
- A) a logical conclusion
 - B) a variety of information
 - C) a single variable
 - D) several variables

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29. Base your answer to the following question on information and data table below and on your knowledge of biology.

Five students design an experiment to answer the question: "How is heart rate affected by running?" Two chairs were set up at different ends of a large room. The pulse rate of each student was taken at rest just before running. Each of the five students ran between the chairs a different number of times. Their pulse rates were taken after running and the results are shown in the table below.

Effect of Running on Heart Rate

Student	Number of Times the Student Ran Between the Chairs	Pulse Rate After Running (beats/min)
A	2	88
B	4	96
C	6	104
D	8	112
E	10	120

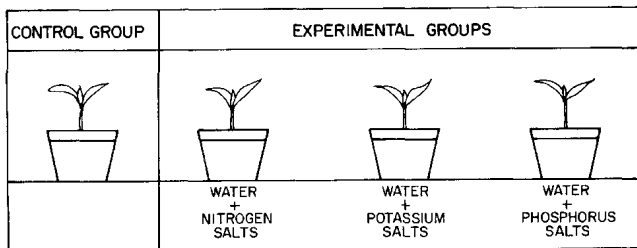
- If a control group is *not* included in an experiment, it would be difficult to
- A) formulate a hypothesis for the experiment
 - B) make observations about the experimental group
 - C) record data in a data table
 - D) draw a valid conclusion
30. An experiment was carried out to determine whether drinking caffeinated soda increases pulse rate. The pulse rates of two groups of people at rest were measured. Group *A* was then given caffeinated soda and group *B* was given caffeine-free soda. One hour after drinking the soda, the pulse rates were measured. The participants in the experiment were all the same age, and they were all given the same amount of soda.

What is the dependent variable in this experiment?

- A) type of soda given to each group
 - B) amount of soda given to each group
 - C) pulse rate of each group
 - D) age of participants in each group
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31. Base your answer to the following question on the information and diagrams below and on your knowledge of biology.

An experiment was performed to determine the effect of different mineral salts on plant growth. Forty pots containing identical plants were divided into four equal groups and placed in a well-lighted greenhouse. Each pot contained a nonmineral potting medium and one plant. Materials were then added to each experimental group of pots as shown



What was added to the control group of pots?

- A) water, only
 - B) nitrogen salts, only
 - C) potassium salts, only
 - D) potassium and phosphorus salts
32. One hundred laboratory rats were used in a controlled study to determine the effect of aspirin on the frequency of heart attacks. Fifty rats were each given a daily injection containing 5.0 milligrams of aspirin for a period of 1 year. On a daily basis each of the other 50 rats would most likely receive an
- A) oral dose of 100 mg of aspirin
 - B) injection of 5.0 mg of water
 - C) injection of 100 mg of aspirin
 - D) oral dose of 50 mg of water
33. An investigation was designed to determine the effect of ultraviolet light on mold spore growth. Two groups of mold spores were grown under identical conditions, except one group was exposed only to ultraviolet light, while the other group was grown in total darkness. In this investigation, the group of mold spores grown without receiving any ultraviolet light is known as the
- A) control
 - B) hypothesis
 - C) dependent variable
 - D) limiting factor

34. Base your answer to the following question on the information below and on your knowledge of biology.

An experiment was carried out to answer the question "Does the pH of water affect the growth of radish plants?" Two groups of ten radish plants were set up. One group was watered with water having a pH of 3.0, and the other group was watered with water having a pH of 7.0. Both groups of plants received the same amount and intensity of light, the same amount of water, and they were grown in the same type of soil. The heights of the radish plants were measured every 2 days for a period of 2 weeks.

What was the dependent variable in this experiment?

- A) heights of the plants
- B) pH of the water
- C) temperature of the water
- D) type of soil

35. A new drug for the treatment of asthma is tested on 100 people. The people are evenly divided into two groups. One group is given the drug, and the other group is given a glucose pill. The group that is given the glucose pill serves as the

- A) experimental group
- B) limiting factor
- C) control
- D) indicator

Base your answers to questions 36 and 37 on the information and data table below and on your knowledge of biology.

In an experiment using chicken eggs, 100 fertilized eggs were injected with a saline (salt) solution containing vitamin B during day 1 of their incubation period. At the same time, a second group of 100 fertilized eggs was injected with plain saline solution. All the chicks that hatched on the 21st day were weighed and measured at hatching. The results are recorded in the data table below.

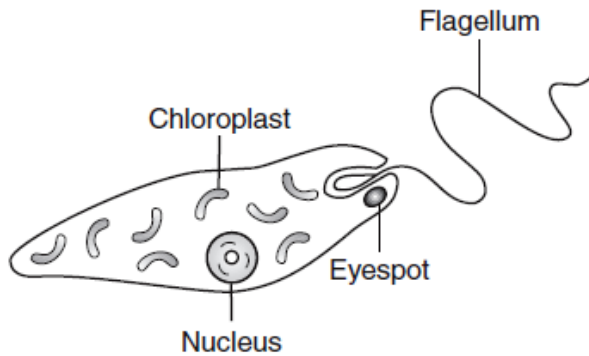
Data Table

Treatment	Number of Eggs Hatched on the 21st Day	Average Weight of Chicks at Hatching (g)	Average Leg Length at Hatching (cm)
Vitamin B Injection	91	50	3.2
Saline Injection	65	35	1.5

36. The purpose of injecting the second group of eggs with plain saline solution is to
- A) produce disease-resistant chicks
 - B) provide a control for the experiment
 - C) encourage the growth of larger eggs
 - D) increase the number of fertilized eggs
37. According to the data in the table, one effect of injecting vitamin B into chicken eggs is that it
- A) changes the amount of yolk stored in the egg
 - B) produces larger eggs
 - C) increases the number of eggs hatching on the 21st day
 - D) increases the incubation period

38. Base your answer to the following question on the information below and on your knowledge of biology.

Euglena are single-celled organisms that live in ponds. All euglena have chloroplasts and can make their own food. They can also take in food from the environment. The diagram below represents a euglena.



An experiment was set up to determine the effect of nitrates, a pollutant, on the number of chloroplasts present in euglena. Five tanks were set up, each with euglena and a different concentration of nitrate solution: 0%, 0.5%, 1.0%, 1.5%, and 2.0%.

The tanks were placed in a sunny location where each tank received the same amount of light. Which statement is a possible hypothesis for this experiment that could be supported by the results of this experiment?

- A) If the average number of chloroplasts in euglena decreases, will less nitrate be needed in each tank?
- B) If the nitrate concentration is increased, then the euglena will have a lower average number of chloroplasts.
- C) If the number of euglena in a tank increases, will more nitrates be produced?
- D) If the nitrate concentration is decreased, then more light will reduce the average number of chloroplasts in euglena.

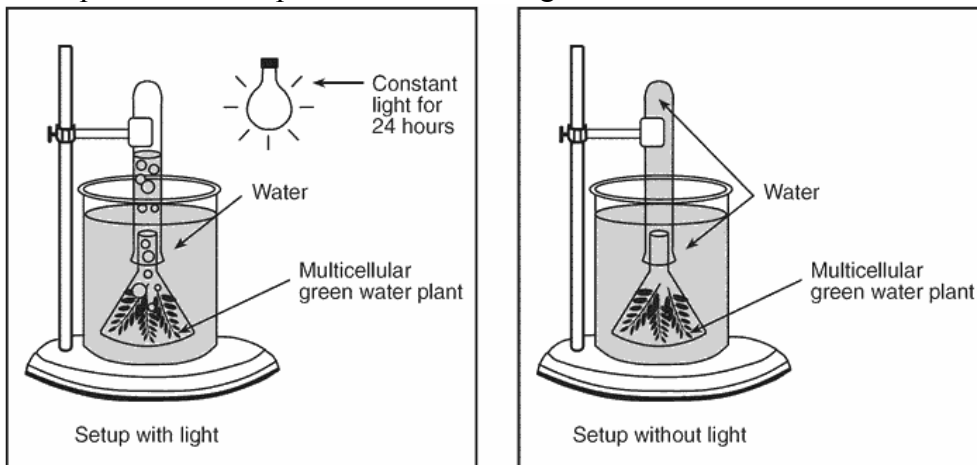
39. Which statement best describes a hypothesis?

- A) A hypothesis is the process of making careful observations.
 - B) The conclusion drawn from the results of an experiment is part of a hypothesis.
 - C) A hypothesis serves as a basis for determining what data to collect when designing an experiment.
 - D) The facts collected from an experiment are written in the form of a hypothesis.
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40. In an experiment, DNA from dead pathogenic bacteria was transferred into living bacteria that do not cause disease. These altered bacteria were then injected into healthy mice. These mice died of the same disease caused by the original pathogens. Based on this information, which statement would be a valid conclusion?

- A) DNA is present only in living organisms.
- B) DNA functions only in the original organism of which it was a part.
- C) DNA changes the organism receiving the injection into the original organism.
- D) DNA from a dead organism can become active in another organism.

41. An experimental setup is shown in the diagram below.



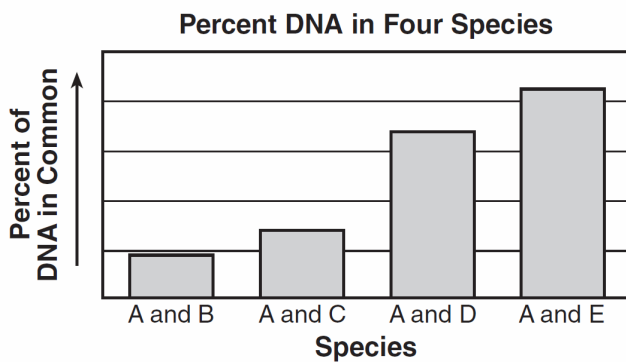
Which hypothesis would most likely be tested using this setup?

- A) Green water plants release a gas in the presence of light.
- B) Roots of water plants absorb minerals in the absence of light.
- C) Green plants need light for cell division.
- D) Plants grow best in the absence of light.

42. As part of an investigation, 10 bean seedlings in one setup were grown in the dark, while 10 seedlings in another setup were grown in sunlight. All other growth conditions were kept the same in both setups. The seedlings grown in the dark were white with long, slender stems. These seedlings eventually died. The seedlings grown in the sunlight were green and healthy. Which hypothesis was most likely being tested in this investigation?

- A) Plants grown in the dark cannot perform the process of respiration.
- B) Sunlight is necessary for the normal growth of bean plants.
- C) Light is necessary for the germination of bean seeds.
- D) Light is necessary for proper mineral absorption by plants.

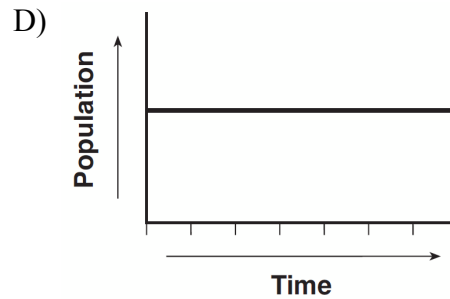
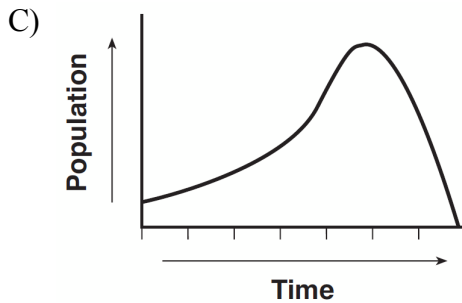
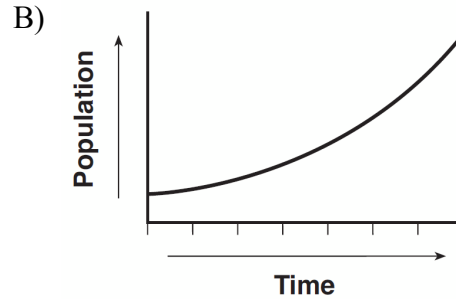
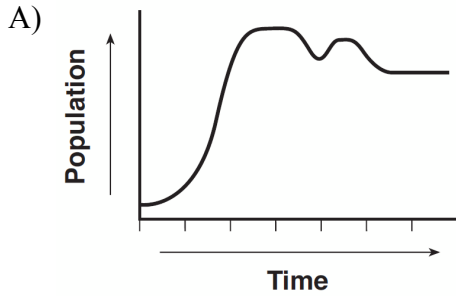
43. The percent of DNA that species *A* has in common with species *B*, *C*, *D*, and *E* are shown in the graph below.



Which statement is a valid conclusion that can be drawn from this graph?

- A) Species *A* is closely related to species *B*, but is not related to species *E*.
- B) Fewer mutations have occurred in species *B* and *C* than in species *A*.
- C) Species *A* and *E* have the greatest similarity in protein structure.
- D) Environment influences the rate of evolution.

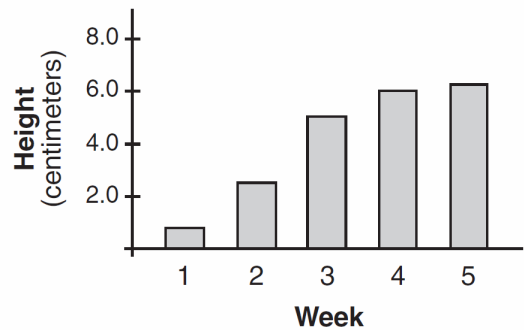
44. Which graph best shows changes in a population of yeast that develops in a test tube and completely consumes a limited supply of food?



45. Worms that had been invaded by bacteria were eaten by a species of bird. Many of these birds died as a result. The most likely explanation for this is that the

- A) bacteria interfered with normal life functions of the birds
- B) disease that killed the birds was inherited
- C) gene alterations in the bacterial cells killed the birds
- D) birds produced antigens in response to the bacteria

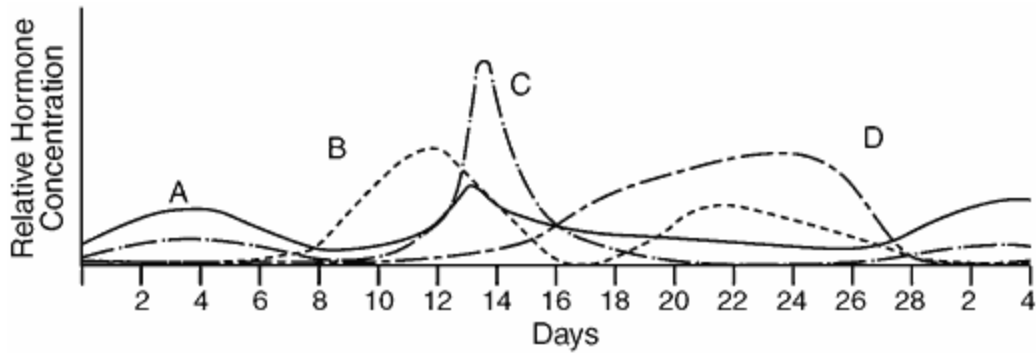
46. The bar graph below shows the height of a plant at the end of each week of a five-week growth period.



Which statement represents a valid conclusion based on the information in the graph?

- A) The plant was given water during the first three weeks, only.
- B) The plant will grow faster during the sixth week than it did during the fifth week.
- C) The plant grew fastest during the first three weeks, and then it grew slower.
- D) The plant grew slowest during the first three weeks, and then it grew faster.

47. The graph below shows the different concentrations of female reproductive hormones *A*, *B*, *C*, and *D* over a 28-day cycle.



Although the data used to make this graph was originally entered in a data table, most scientists prefer to see the information in the form of a graph because

- A) the information in a graph is more accurate than the information in a data table
- B) it is easier to see relationships between variables in a graph than in a data table
- C) it is possible to put more information in a graph than in a data table
- D) only graphs can be used to predict future trends

48. Base your answer to the following question on the information below and on your knowledge of biology.

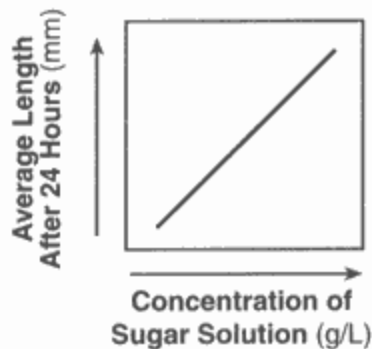
Students cut 20 rod-shaped pieces of potato of the same diameter and length. Five pieces of potato were placed into each of four beakers containing different concentrations of sugar solutions. Each potato piece was measured again after 24 hours. The table below shows the results of their experiment.

Change in Length

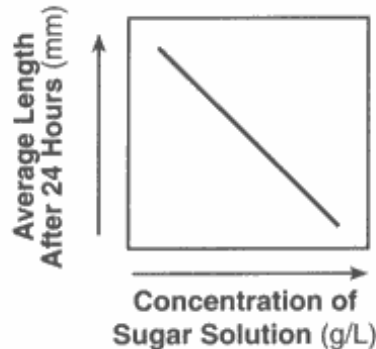
Concentration of Sugar Solution (grams per liter)	Original Length of Potato Pieces (mm)	Average Length After 24 Hours (mm)
0	50.0	52.0
5	50.0	44.0
8	50.0	43.5
10	50.0	42.5

Which graph best represents the information in the data table above?

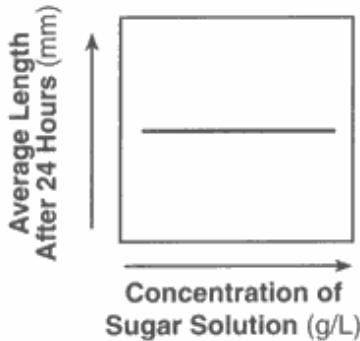
A)



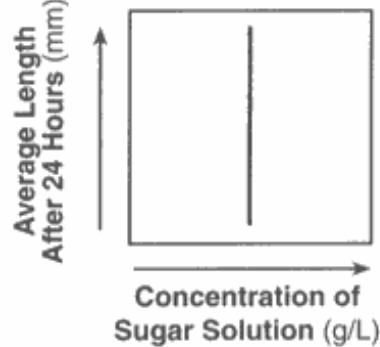
B)



C)

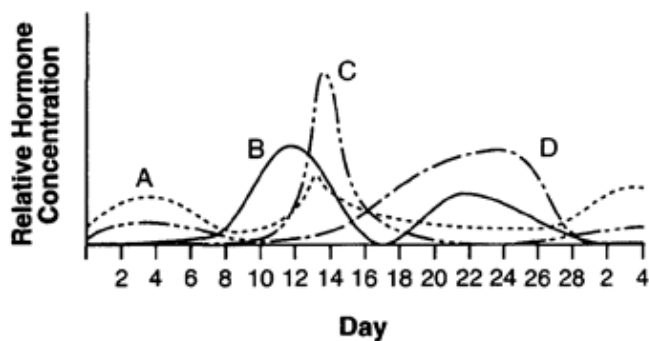


D)



49. Conclusions based on an experiment are most likely to be accepted when
- A) they are consistent with experimental data and observations
 - B) they are derived from investigations having many experimental variables
 - C) scientists agree that only one hypothesis has been tested
 - D) hypotheses are based on one experimental design

50. The graph below shows the relative concentrations of certain hormones in the blood during the human female reproductive cycle.



Which hormone has the lowest concentration on which day?

- A) hormone *A* on day 4
 - B) hormone *B* on day 2
 - C) hormone *C* on day 12
 - D) hormone *D* on day 20
51. Students collected data about the capacities of their lungs by inflating balloons with a single breath. They measured the circumference of the balloons in centimeters. Each student completed three trials and calculated the average.

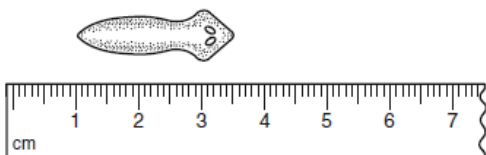
Balloon Circumference (cm)

Student	Trial 1	Trial 2	Trial 3	Average
1	66.0	66.5	68.5	67.0
2	67.5	64.0	70.5	67.3
3	60.3	60.5	60.5	61.0
4	55.0	58.0	59.0	57.3

Which student miscalculated her average?

- A) student 1
- B) student 2
- C) student 3
- D) student 4

-
52. Scientists in the United States, Europe, and Africa have now suggested that the hippopotamus is a relative of the whale. Earlier studies placed the hippo as a close relative of wild pigs, but recent studies have discovered stronger evidence for the connection to whales. This information suggests that
- A) genetic engineering was involved in the earlier theories
 - B) structural evidence is the best evolutionary factor to consider
 - C) natural selection does not occur in hippopotamuses
 - D) scientific explanations can change with new evidence.
53. Which group of measurement units is correctly arranged in order of increasing size?
- A) micrometer, millimeter, centimeter, meter
 - B) millimeter, micrometer, centimeter, meter
 - C) meter, micrometer, centimeter, millimeter
 - D) micrometer, centimeter, millimeter, meter
54. A transparent metric ruler is placed on the stage of a microscope and observed under low power. The diameter of the field of vision was found to be 2 millimeters. How many micrometers is the diameter?
- A) 10
 - B) 200
 - C) 1,000
 - D) 2,000
55. A laboratory procedure calls for heating 50 milliliters of a liquid sugar solution to 60°C. Which piece of laboratory equipment will *not* be needed?
- A) protective eyewear
 - B) ruler
 - C) thermometer
 - D) graduated cylinder
56. The diagram below represents the measurement of a biological specimen.



What is the approximate length of the specimen in millimeters?

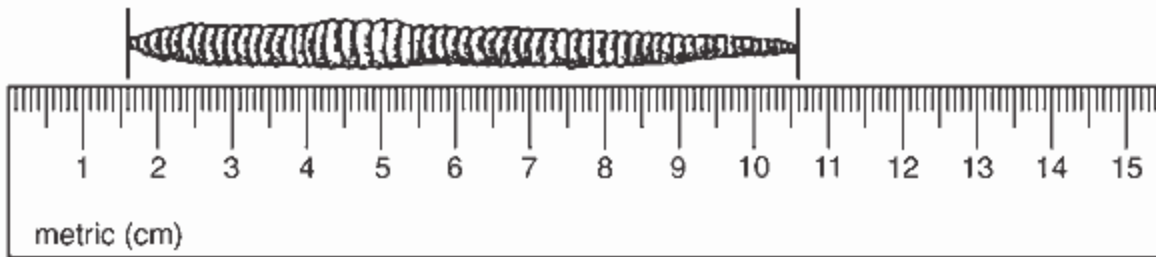
- A) 25 mm
 - B) 30 mm
 - C) 35 mm
 - D) 40 mm
-

57. A diagram of the actual size of a peppered moth wingspan is shown below.

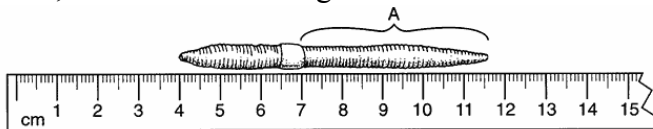


An estimated length of the wingspan could be

- A) 3 centimeters B) 3 grams
C) 3 milliliters D) 3 kilometers
58. What is the approximate length of the earthworm shown in the diagram below?



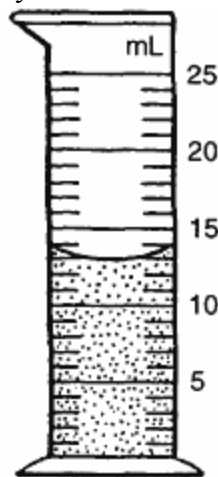
- A) 9 mm B) 90 mm C) 10.6 cm D) 106 cm
59. A student measured an earthworm using a metric ruler, as shown in the diagram below.



What is the length of section *A*?

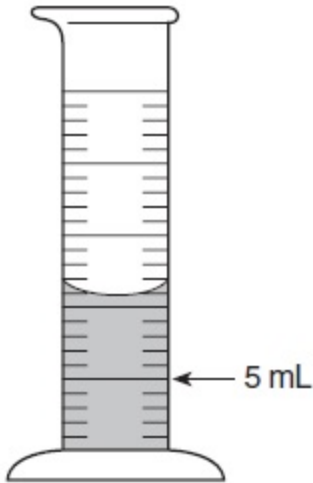
- A) 7.6 cm B) 11.6 cm
C) 46 mm D) 23 mm

60. What is the volume of water in the graduated cylinder shown below?



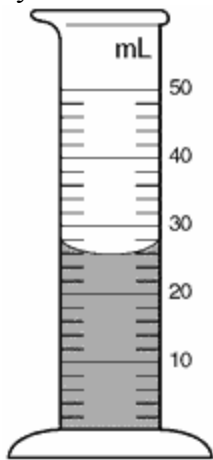
- A) 10.3 mL B) 13.0 mL
C) 13.5 mL D) 14.0 mL

61. How much water should be removed from the graduated cylinder shown below to leave 5 milliliters of water in the cylinder?



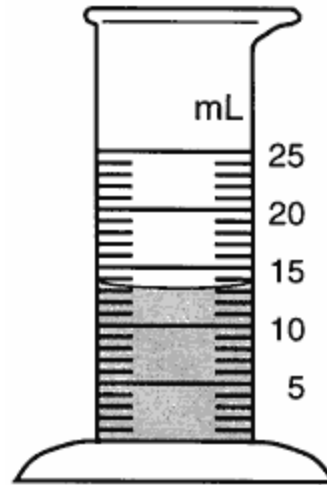
- A) 6 mL
- B) 7 mL
- C) 11 mL
- D) 12 mL

62. What is the volume of the liquid in the graduated cylinder shown below?



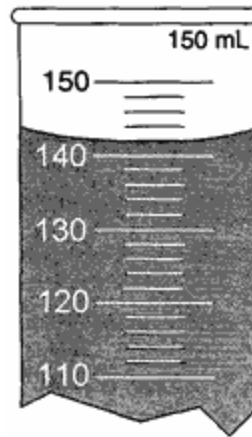
- A) 23 mL
- B) 26 mL
- C) 27 mL
- D) 28 mL

63. A student needs 20 milliliters of water for an experiment. How much additional water must the student add to the graduated cylinder shown below to reach 20 milliliters?



- A) 6.0 ml
- B) 6.5 ml
- C) 7.0 ml
- D) 13.0 ml

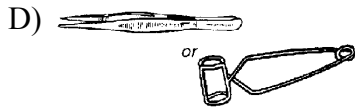
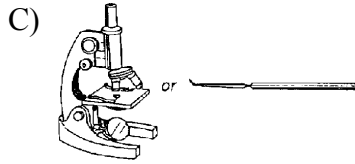
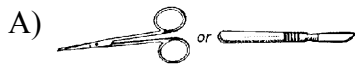
64. A chicken bone was placed in a graduated cylinder containing 100 milliliters of water. The diagram below illustrates the new level of water.



What is the volume of the chicken bone?

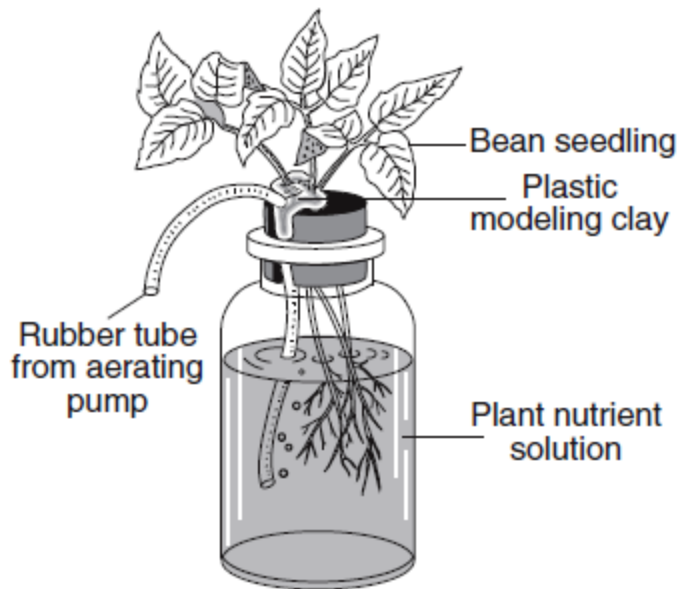
- A) 41 mL
- B) 42 mL
- C) 141 mL
- D) 142 mL

65. Which piece of laboratory equipment should a student use to remove the legs of a preserved grasshopper for further study?



Base your answers to questions **66** through **70** on the information and diagram below and on your knowledge of biology.

The presence of air is believed to be important for root growth in bean plants. The apparatus available to conduct an investigation is shown below. There are enough bottles and other materials to have multiple setups. Air (for aeration) can be bubbled into the bottle through the rubber tube.



Source: Biology Handbook, SED 1960

Design an experiment to test the effect of aeration on the growth of roots of bean seedlings. In your answer, be sure to:

66. State *one* hypothesis the experiment would test.

67. Describe how the control group will be treated differently from the experimental group.

68. Identify the dependent variable in the experiment.

69. State *one* reason why many setups should be used in both the experimental and control groups.

70. State *one* reason why several different kinds of seedlings were *not* tested in this experiment.

Base your answers to questions **71** through **75** on the passage below.

Some poinsettia plants have green leaves that turn red. A garden club decided to study the color change of poinsettia plants. Knowing that poinsettias change color during the short daylight periods of winter, they decided to investigate the effect of different daylight lengths on color change.

Design a controlled experiment using three experimental groups that could be used to determine if the number of hours of daylight has an effect on the color change of poinsettias.

71. State *one* way the three experimental groups would differ.

72. Identify *two* factors that must be kept the same in all three groups.

73. Identify the dependent variable in the experiment.

74. Describe experimental results that would support your hypothesis.

75. State *one* hypothesis the experiment would test.

Base your answers to questions 76 through 78 on the information below, and on your knowledge of biology.

A Study of Antibacterial Cleansers

An experiment was designed to test the effectiveness of three antibacterial hand-cleansing solutions against bacteria present on hands. Swabs were used to take one sample each from the unwashed hands of ten test subjects. Each swab was then rubbed across the surface of bacterial growth medium in a separate petri dish. The dishes were placed in an incubator to allow bacterial colonies to develop.

Ten other test subjects treated their hands with an antibacterial hand-cleansing solution, then had their hands swabbed, and ten more petri dishes were set up and incubated in the same way as the first set of dishes.

The process was repeated again with ten more test subjects for a second hand cleanser, and again for a third group with a third hand cleanser.

The results from the incubated petri dishes were averaged. The averages are shown in the data table below.

Effectiveness of Antibacterial Cleansers

Treatment Before Swabbing	Average Number of Bacterial Colonies
none	30
antibacterial hand-cleansing solution 1	12
antibacterial hand-cleansing solution 2	13
antibacterial hand-cleansing solution 3	11

76. Based on the data provided, what could the researchers conclude regarding the effectiveness of the antibacterial hand-cleansing solutions tested?

77. Explain why the researchers used data from ten trials and averaged them, rather than data from a single trial.

78. What was the purpose of testing unwashed hands?

Base your answers to questions **79** through **82** on the information below and on your knowledge of biology.

Scientists have been experimenting with different forms of alternate energy to help reduce the amount of fossil fuels that are burned. They studied yeast, which convert plant materials into ethanol, a form of alcohol that can be used in automobiles. These experiments were carried out at room temperature. The scientists wondered whether more ethanol would be produced at different temperature.

Design an experiment to determine the effect of temperature on ethanol production by yeast.

79. State *one* hypothesis the experiment would test

80. Identify *two* factors that must be kept the same in both the experimental and control groups

81. State how the control group would be treated differently from the experimental group

82. Identify the independent variable in the experiment

83. Base your answer to the following question on the information below and on your knowledge of biology.

Help for Aging Memories

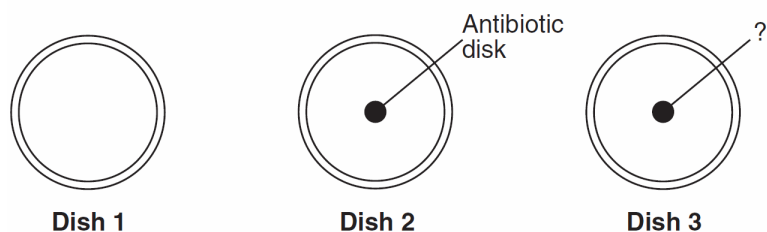
As aging occurs, the ability to form memories begins to decrease. Research has shown that an increase in the production of a certain molecule, BDNF, seems to restore the processes involved in storing memories. BDNF is found in the central nervous system and seems to be important in maintaining nerve cell health. Researchers are testing a new drug that seems to increase the production of BDNF.

Design an experiment to test the effectiveness of the new drug to increase the production of BDNF in the brains of rats. In your answer be sure to:

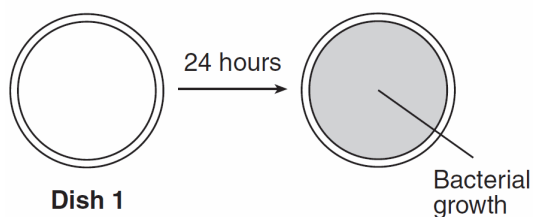
- state the hypothesis your experiment will test
- describe how the control group will be treated differently from the experimental group
- identify *two* factors that must be kept the same in both the experimental and control groups.
- identify the dependent variable in your experiment.

Base your answers to questions 84 and 85 on the information below and on your knowledge of biology.

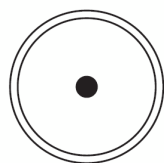
A researcher wanted to test the effectiveness of a new antibiotic on *Streptococcus pyrogenes*, the species of bacteria that causes strep throat. Bacteria were added to dish 1, dish 2, and dish 3. A disk soaked in the new antibiotic was then placed in dish 2. Dish 3 was set up as the control. The dishes are shown in the diagram below.



84. All three dishes were placed in an incubator at 37°C for 24 hours. The results for dish 1 are shown below.



Complete the diagram of dish 2 below to represent an example of experimental results that would support your hypothesis. Explain how your diagram supports your hypothesis.



Dish 2 after 24 hours

85. State *one* appropriate hypothesis for this experiment.

Base your answers to questions **86** through **90** on the information below and on your knowledge of biology.

Poison ivy is a weed that grows in New York State. It synthesizes an oil, urushiol, that causes skin rashes. Researchers have found that if poison ivy grows in an environment that contains an increased concentration of carbon dioxide, the plants grow larger, faster, and produce more urushiol. Because carbon dioxide levels in the atmosphere are rising, poison ivy might become a hazard to people who work or vacation outdoors.

86. State the hypothesis the experiment would test

87. State *one* way the control group should be treated differently from the experimental group

88. Identify *one* safety precaution that should be taken during the experiment and explain why it is necessary

89. Describe the type of data to be collected

90. Identify *two* conditions that should be kept the same in both the control and the experimental groups

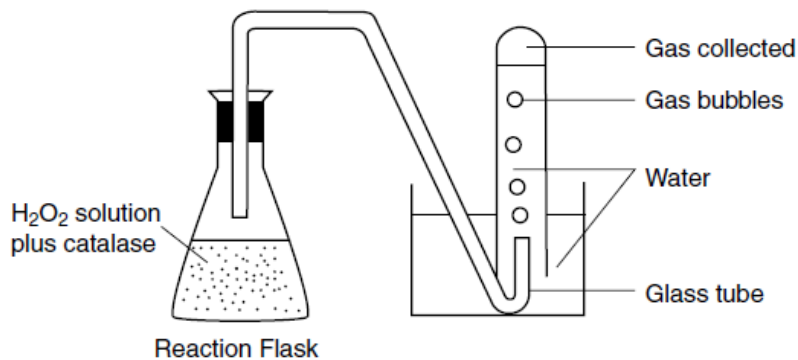
91. Base your answer to the following question on the information and data table below and on your knowledge of biology.

Hydrogen peroxide (H_2O_2), a byproduct of cellular metabolism, is broken down by the enzyme catalase which is produced by nearly all organisms. When catalase is added to hydrogen peroxide, a reaction occurs that produces bubbles of oxygen gas (O_2) and water (H_2O).



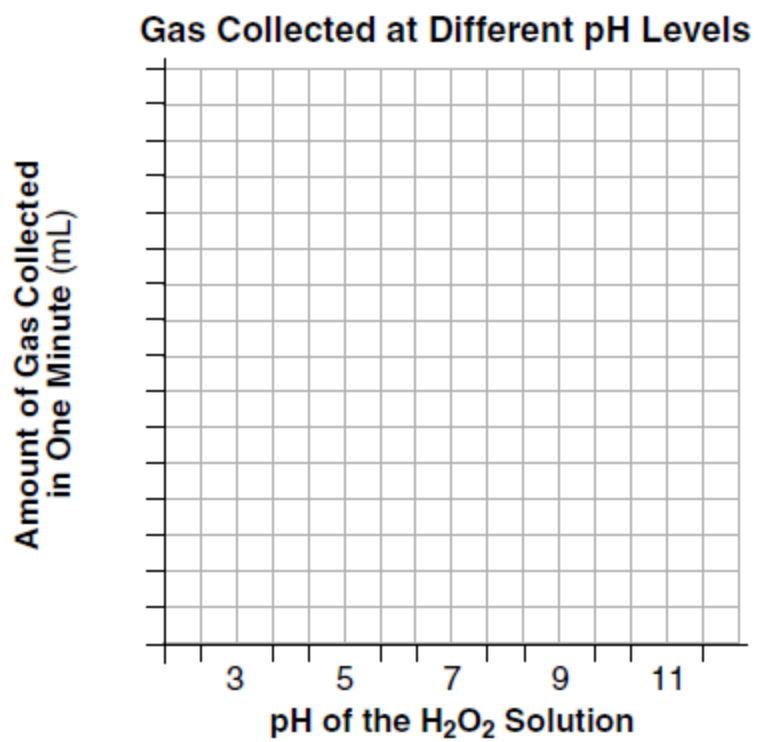
The laboratory setup represented below was used to investigate the effect of pH on the breakdown of H_2O_2 . Five setups were made with H_2O_2 solutions, each at a different pH level.

Catalase was added to the solution in the first setup and the reaction proceeded for one minute and the amount of gas produced by the reaction was recorded on the data table. This exact procedure was repeated with the other four setups containing different H_2O_2 solutions.



Gas Collected in Reactions at Different pH Levels	
pH	Gas Collected in One Minute (mL)
3	2
5	5
7	11
9	9
11	6

Construct vertical bars to represent the data. Shade in each bar.



-
92. Base your answer to the following question on the information and drawing below and on your knowledge of biology. The drawing represents a salamander. Salamanders are small amphibians that live in a variety of environments.

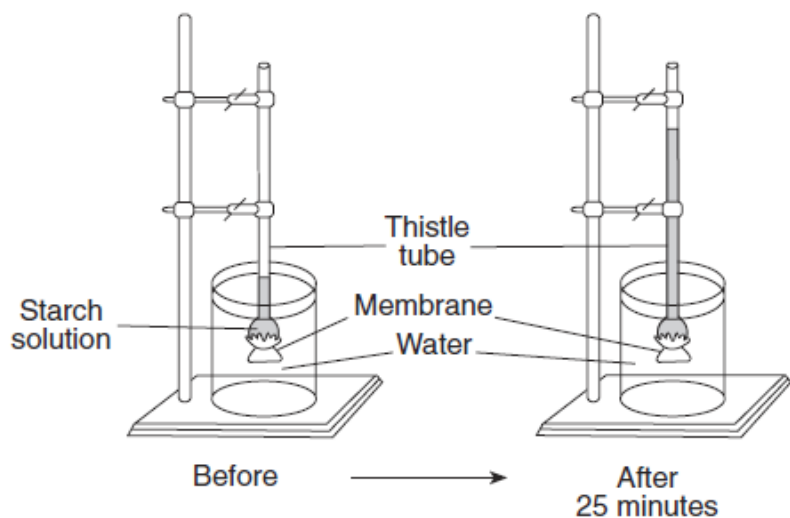
Two species of salamander inhabit an island. The habitat on each side of the island is different. One side tends to be wet; the other side tends to be dry. Researchers want to know if the salamanders will survive equally well on either side of the island. Species *A* lives on the wet side of the island, while Species *B* lives on the dry side of the island. Researchers develop two artificial habitats, one that simulates conditions on the wet side and one that simulates conditions on the dry side.



Researchers put three salamanders of each species in each of the two different artificial environments. Why would other scientists question the validity of the conclusions based on this setup?

Base your answers to questions 93 and 94 on the information, diagram, and table below and on your knowledge of biology.

A concentrated starch solution was placed in a thistle tube with a semi-permeable membrane covering the wide opening. It was then placed in a beaker of water. The height of the solution in the tube was measured every 5 minutes for 25 minutes. The setup and the data collected are shown below.



Height of Liquid in Thistle Tube

Time (min)	Height (cm)
0	2
5	3
10	6
15	8
20	10
25	11

93. Plot the data for height on the grid. Connect the points and surround each point with a small circle.

94. Mark an appropriate scale, without any breaks in the data, on each labeled axis.

Base your answers to questions 95 through 97 on the information below and on your knowledge of biology .

Scientists will often grow bacteria in prepared petri dishes. In some experiments, the petri dish will also contain paper disks soaked in a particular antibiotic. The area where the bacteria do not grow is called the zone of inhibition, or ZOI. The diameter of the ZOI indicates the effectiveness of the antibiotic.

The ZOI data collected by one scientist while trying to determine which disk (*A, B, C, or D*) is most effective at killing *Streptococcus* bacteria are: Disk *D*-9 mm, Disk *B*-8 mm, Disk *C*-0 mm.

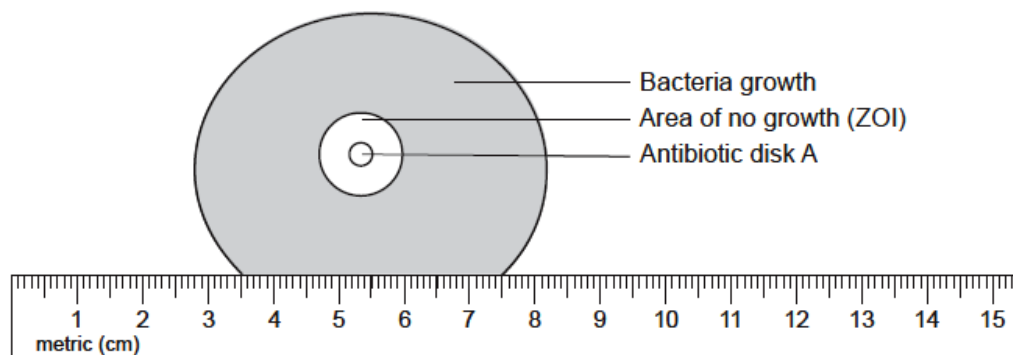
95. Insert the appropriate heading (with units) for the second column in the data table below and record the data from this investigation.

Disk	
A	
	0
D	

96. Which disk is most likely the control for this experiment? Support your answer.

Disk: _____

97. Using the metric ruler represented below, determine the diameter in millimeters (mm) of the **ZOI** for antibiotic disk *A* shown below.



ZOI Disk A _____ mm

Base your answers to questions **98** and **99** on the information below and on your knowledge of biology.

Five groups of corn seeds, each containing 275 seeds, were soaked for 1 hour in different concentrations of gibberellic acid, a plant growth hormone. After 1 hour, the seeds were rinsed in tap water and drained of all excess water. The seeds were then placed on paper towels and kept moist for 7 days. After 7 days, the growing stems were cut and weighed to determine the increase in growth. Then, the percent increase in growth compared to the growth of a group of untreated seeds was calculated. The results were recorded and are shown in the data table below.

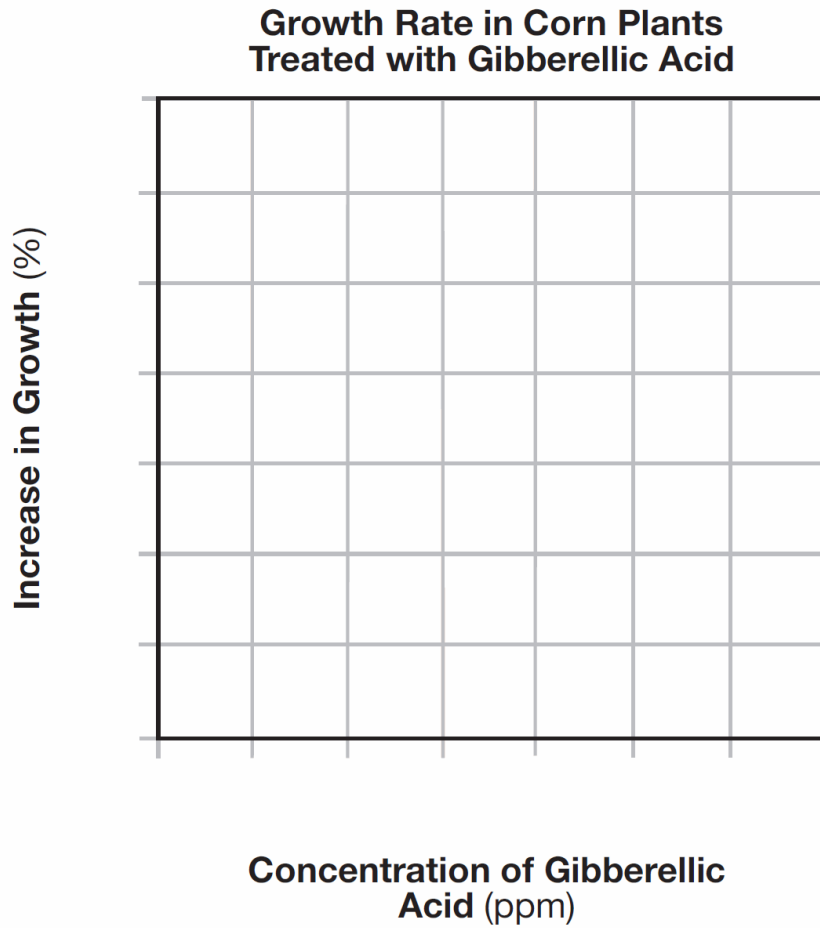
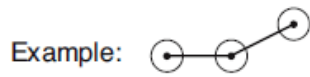
Growth Rate in Corn Plants Treated with Gibberellic Acid

Concentration of Gibberellic Acid in Parts per Million (ppm)	Increase in Growth * (%)
225	15
300	30
400	23
500	15
600	6

* percent increase in growth compared to the growth of untreated seeds

Source: Adaped from www.super-grow.biz/GibberellicAcid.jsp

98. Plot the data from the table on the grid on the next page. Surround each point with a small circle and connect the points.



99. Mark an appropriate scale, without any breaks, on each labeled axis on the grid on the next page.

Answer Key

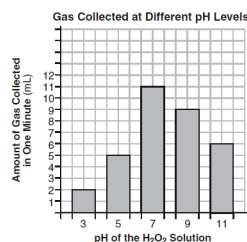
Scientific Method, Measurement and Graphing Regents Review

1. D
 2. D
 3. D
 4. D
 5. B
 6. C
 7. B
 8. C
 9. D
 10. B
 11. D
 12. C
 13. D
 14. C
 15. B
 16. D
 17. A
 18. C
 19. D
 20. A
 21. D
 22. B
 23. B
 24. D
 25. D
 26. D
 27. C
 28. C
 29. D
 30. C
 31. A
 32. B
 33. A
 34. A
 35. C
 36. B
 37. C
 38. B
 39. C
 40. D
 41. A
 42. B
 43. C
 44. C
 45. A
 46. C
 47. B
 48. B
 49. A
 50. B
 51. C
 52. D
 53. A
 54. D
 55. B
 56. A
 57. A
 58. B
 59. C
 60. B
 61. A
 62. B
 63. C
 64. B
 65. A
 66. — Roots of bean plant seedlings grown in aerated nutrient solution will grow faster than roots of seedlings grown without aeration of the nutrient solution. — Bubbling air into the nutrient solution will lead to more root growth. — If air is bubbled into the nutrient solution, then the roots will grow more rapidly. — Air is important for root growth in bean plants.
 67. — The control group will have no aeration. — No air will be pumped through the rubber tube.
 68. — number of roots — length of roots — rate of root growth
 69. — Many setups provide more data for drawing a valid conclusion. — so your conclusion will be valid
 70. — This experiment was done to test the presence of air on root growth in bean seedlings only. — There should be only one variable.
 71. — One group gets less than 10 hours of daylight, one more than 12 hours of daylight, and one 11 hours of daylight. — exposure to different lengths of daylight
 72. — temperature, —amount of water/fertilizer, — soil condition, — age/size of plants
 73. — leaf color, — whether or not color changes
 74. — The hypothesis would be supported if only the plants exposed to less than 10 hours of daylight change color and those exposed to more hours of daylight do not change color. — All of the plants changed color/none of the plants changed color.
 75. — If plants are exposed to fewer than 11 hours of daylight, then they will change color. — The number of hours of daylight will have no effect on color change.
-

Answer Key

Scientific Method, Measurement and Graphing Regents Review

76. — Solution 3 is the most effective antibacterial hand-cleansing solution of those tested. — Solution 2 is the least effective antibacterial hand-cleansing solution of those tested. — Solutions 1, 2, and 3 are all more effective at killing bacteria than no treatment. — All of them are equally effective. — None of them were 100% effective.
77. — Data from single trials are most likely to include error. — to make the experiment- /conclusion more valid, — Averaging data makes the conclusion more valid. — to make the experiment conclusion more reliable
78. — to have a group for comparison, — to use the unwashed group as a control, — to see what would happen without the treatment, — the control
79. – Increasing the temperature will increase the rate of ethanol production. – Decreasing the temperature will increase the rate of ethanol production. – Temperature affects the rate of ethanol production.
80. – amount of yeast used – amount of plant material used – type of plant material used – species of yeast used
81. – The control group will be kept at room temperature, while the experimental group will be kept at a higher temperature. – The control group would be kept at room temperature.
82. Identifying the independent variable in the experiment as temperature.
83. (essay)
84. Allow 1 credit for completing the diagram to represent an example of experimental results that would support the student's hypothesis in question 59 *and* supporting the answer.
85. - This antibiotic will have no effect on the growth of this bacterium. - The new antibiotic will slow down bacterial growth. - The antibiotic will kill the bacteria.
86. – If poison ivy grows in a place with a higher than normal concentration of carbon dioxide, then it will grow taller. – In high concentrations of carbon dioxide, poison ivy will grow faster. – Large concentrations of carbon dioxide will cause poison ivy to produce more urushiol. – Different concentrations of carbon dioxide will affect the growth rate of poison ivy plants.
87. – The experienced group would be exposed to a higher than normal concentration of carbon dioxide. The control group would be exposed to the same level as before (normal level). – The control group would have plants growing at normal carbon dioxide level. – The experimental group would have plants growing at a higher carbon dioxide level.
88. – Wear gloves to avoid exposure to the oil (urushiol). – Wear goggles to protect your eyes from the oil. – Avoid direct contact with poison ivy to avoid getting a rash.
89. – heights of plants – average number of plant leaves – total mass of plants – size of leaves on the plants – amount of urushiol produced
90. – The soil should be the same. – amount of water is the same – same species of plant used – The length of exposure to daylight should be the same. – the initial size of plants

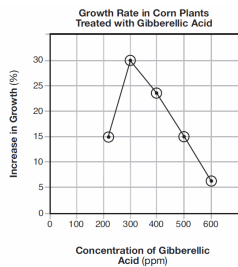


Answer Key

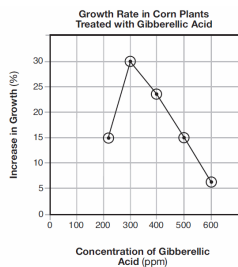
Scientific Method, Measurement and Graphing Regents Review

92. — The sample size is small. — The environment is artificial. — The salamanders are not in their natural habitat. — The experiment was not repeated.

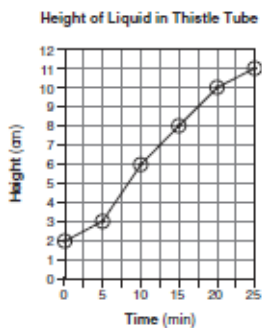
98.



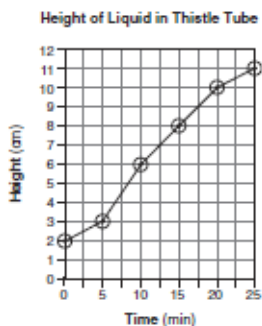
99.



93.



94.



95.

Disk	Measurement of ZOI (mm) or ZOI (mm) or Diameter (mm)
A	13 (+/-2mm)
B	8
C	0
D	9

96. — C
— no ZOI, — did not kill bacteria so probably contains no antibiotics

97. 13mm (+/- 2mm).

Answer Key

Scientific Method, Measurement and Graphing Regents Review

- 83.
- stating the hypothesis the experiment will test.
— Rats that are given the drug will show an increase in BDNF in their brains.— The drug affects memory formation in rats.
 - describing how the control group will be treated differently from the experimental group.
— The control group will not get the drug; the experimental group will.— The control group will get a placebo.
 - identifying *two* factors that must be kept the same in both the experimental and control groups.
— Both groups should have the same number of rats. — rats of the same age — kept in same conditions
— given the same food
 - identifying the dependent variable in the experiment.
— amount of BDNF found in their nerve tissue— ability to form/store memories
-