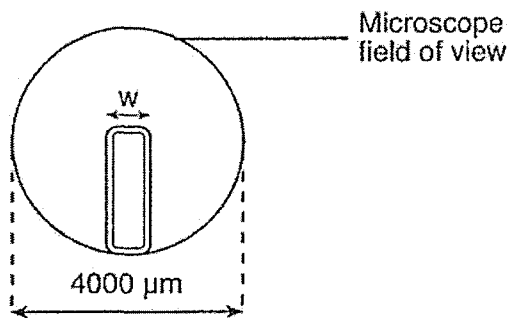


Name:

Topic One:
Scientific Method, Experimental Design and Lab Tools

1. A plant cell in a microscopic field of view is represented below.



The width (w) of this plant cell is closest to

- | | |
|----------------------|-----------------------|
| 1) 200 μm | 3) 1200 μm |
| 2) 800 μm | 4) 1600 μm |
2. The development of an experimental research plan should *not* include a
- 1) list of safety precautions for the experiment
 - 2) list of equipment needed for conducting the experiment
 - 3) procedure for the use of technologies needed for the experiment
 - 4) conclusion based on data expected to be collected in the experiment
3. In 1910, Thomas Morgan discovered a certain pattern of inheritance in fruit flies known as sex linkage. This discovery extended the ideas of inheritance that Gregor Mendel had discovered while working with garden peas in 1865. Which principle of scientific inquiry does this illustrate?
- 1) A control group must be part of a valid experiment.
 - 2) Scientific explanations can be modified as new evidence is found.
 - 3) The same experiment must be repeated many times to validate the results.
 - 4) Values can be used to make ethical decisions about scientific discovery.

4. Which statement most accurately describes scientific inquiry?
- 1) It ignores information from other sources.
 - 2) It does not allow scientists to judge the reliability of their sources.
 - 3) It should never involve ethical decisions about the application of scientific knowledge.
 - 4) It may lead to explanations that combine data with what people already know about their surroundings.
5. Which statement best describes a scientific theory?
- 1) It is a collection of data designed to provide support for a prediction.
 - 2) It is an educated guess that can be tested by experimentation.
 - 3) It is a scientific fact that no longer requires any evidence to support it.
 - 4) It is a general statement that is supported by many scientific observations.
6. When a test tube of water containing elodea (an aquatic plant) is placed near a bright light, the plant gives off gas bubbles. When the light is placed at different distances from the plant, the rate of bubbling is affected. The independent variable in this demonstration is the
- 1) concentration of gas in the water
 - 2) type of aquatic plant in the test tube
 - 3) amount of water in the test tube
 - 4) distance of the plant from the light
7. Which statement about the use of independent variables in controlled experiments is correct?
- 1) A different independent variable must be used each time an experiment is repeated.
 - 2) The independent variables must involve time.
 - 3) Only one independent variable is used for each experiment.
 - 4) The independent variables state the problem being tested.

Base your answers to questions 8 through 10 on the information below and on your knowledge of biology.

A scientist conducted an experiment to test the hypothesis that maple seeds exposed to acid rain will take longer to germinate than seeds exposed to normal rain, which has a pH of 5.6. The scientist set up four groups, each containing 200 maple seeds. The water used for each group had a different pH value: 5.6, 4.0, 3.0, and 2.0. All other conditions were kept the same. After ten days, the number of seeds that had germinated in each group was counted.

8. Identify the dependent variable in this experiment.

9. Identify the control group in this experiment.

10. State *one* example of experimental results that would indicate that acid rain, which has a pH between 4.5 and 4.0, could be responsible for a *decrease* in the number of young maple trees in some forest regions.

11. Which statement describes the best procedure to determine if a vaccine for a disease in a certain bird species is effective?

- 1) Vaccinate 100 birds and expose all 100 to the disease.
- 2) Vaccinate 100 birds and expose only 50 of them to the disease.
- 3) Vaccinate 50 birds, do not vaccinate 50 other birds, and expose all 100 to the disease.
- 4) Vaccinate 50 birds, do not vaccinate 50 other birds, and expose only the vaccinated birds to the disease.

12. 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

- | | |
|---------------|-----------------------|
| 1) control | 3) dependent variable |
| 2) hypothesis | 4) limiting factor |

13. Base your answer to the following question on

State *one* safety procedure that should be followed when the product is sprayed on plants.

14. Which sentence represents a hypothesis?

- 1) Environmental conditions affect germination because of chemical changes that occur.
- 2) Boil 100 milliliters of water, let it cool, and then add 10 seeds to the water.
- 3) Is water depth in a lake related to available light in the water?
- 4) A lamp, two beakers, and elodea plants are selected for the investigation.

15. Which statement best describes a hypothesis?

- 1) A hypothesis is the process of making careful observations.
- 2) The conclusion drawn from the results of an experiment is part of a hypothesis.
- 3) A hypothesis serves as a basis for determining what data to collect when designing an experiment.
- 4) The facts collected from an experiment are written in the form of a hypothesis.

16. A laboratory procedure calls for heating 50 milliliters of a sugar solution to 60°C. Which piece of laboratory equipment will *not* be needed?

- | | |
|-----------------------|-----------------------|
| 1) protective eyewear | 3) thermometer |
| 2) ruler | 4) graduated cylinder |
-

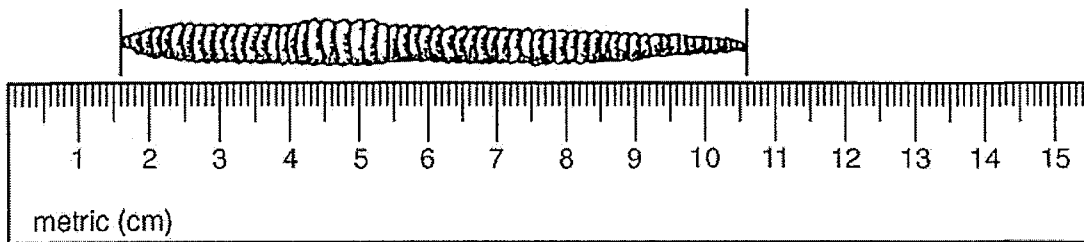
Base your answers to questions 17 and 18 on the investigation described below and on your knowledge of biology.

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 soon died. The seedlings grown in the sunlight were green and healthy.

17. Which hypothesis was most likely being tested in this investigation?
- 1) Plants grown in the dark cannot perform the process of respiration.
 - 2) Sunlight is necessary for the normal growth of bean plants.
 - 3) Light is necessary for the germination of bean seeds.
 - 4) Light is necessary for proper mineral absorption by plants.

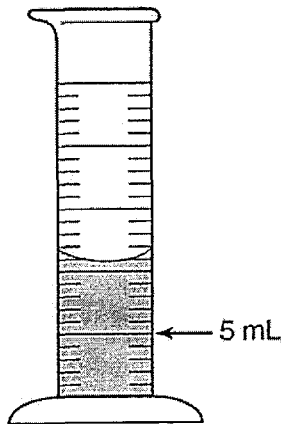
18. Identify the independent variable in this investigation.

-
19. What is the approximate length of the earthworm shown in the diagram below?



- 1) 9 mm 2) 90 mm 3) 10.6 cm 4) 106 cm

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



- 1) 6 mL 3) 11 mL
2) 7 mL 4) 12 mL

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

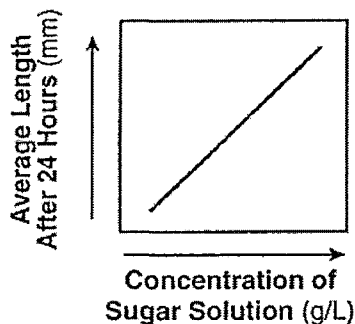
Students cut 20 rod-shaped pieces of potato of the same diameter and length. Five pieces of potato were placed into each of four beakers containing different concentrations of sugar solutions. Each potato piece was measured again after 24 hours. The table below shows the results of their experiment.

Change in Length

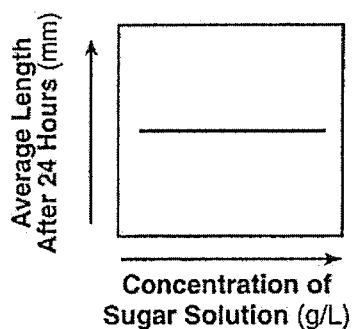
Concentration of Sugar Solution (grams per liter)	Original Length of Potato Pieces (mm)	Average Length After 24 Hours (mm)
0	50.0	52.0
5	50.0	44.0
8	50.0	43.5
10	50.0	42.5

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

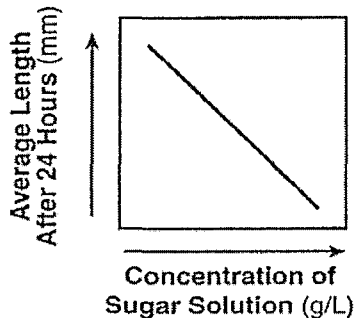
1)



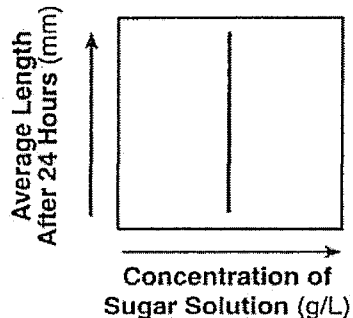
3)



2)

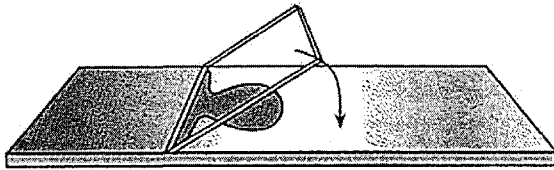


4)



(4)

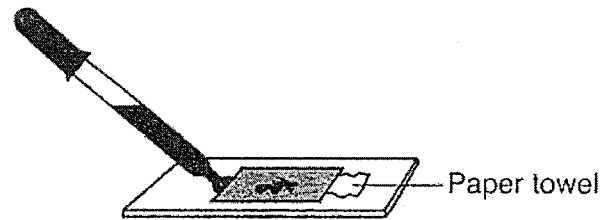
22. Which activity might lead to damage of a microscope and specimen?
- 1) cleaning the ocular and objectives with lens paper
 - 2) focusing with low power first before moving the high power into position
 - 3) using the coarse adjustment to focus the specimen under high power
 - 4) adjusting the diaphragm to obtain more light under high power
23. The diagram below shows how a coverslip should be lowered onto some single-celled organisms during the preparation of a wet mount.



Why is this a preferred procedure?

- 1) The coverslip will prevent the slide from breaking.
 - 2) The organisms will be more evenly distributed.
 - 3) The possibility of breaking the coverslip is reduced.
 - 4) The possibility of trapping air bubbles is reduced.
24. After switching from the high-power to the low-power objective lens of a compound light microscope, the area of the low-power field will appear
- 1) larger and brighter
 - 2) smaller and brighter
 - 3) larger and darker
 - 4) smaller and darker

25. Which laboratory procedure is represented in the diagram below?



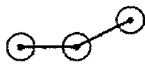
- 1) placing a coverslip over a specimen
- 2) removing a coverslip from a slide
- 3) adding stain to a slide without removing the coverslip
- 4) reducing the size of air bubbles under a cover-slip

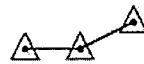
26. the information and data table below and on your knowledge of biology.

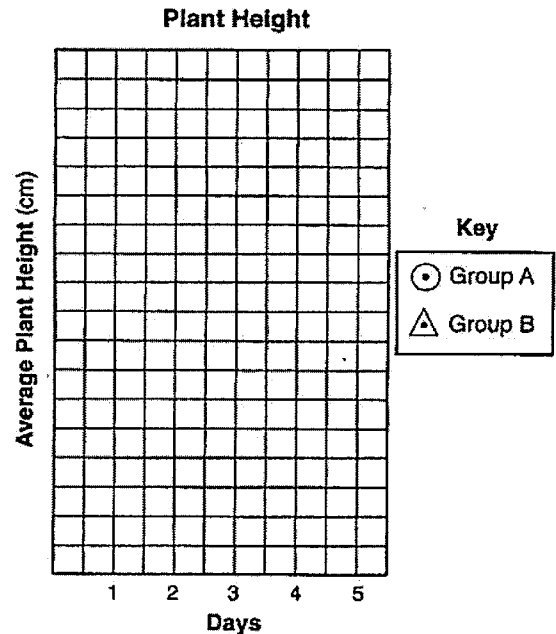
A number of bean seeds planted at the same time produced plants that were later divided into two groups, A and B. Each plant in group A was treated with the same concentration of gibberellic acid (a plant hormone). The plants in group B were not treated with gibberellic acid. All other growth conditions were kept constant. The height of each plant was measured on 5 consecutive days, and the average height of each group was recorded in the data table below.

Data Table

	Average Plant Height (cm)				
	Day 1	Day 2	Day 3	Day 4	Day 5
Group A	5	7	10	13	15
Group B	5	6	6.5	7	7.5

Example: 

Example: 



Using the information in the data table, construct a line graph on the grid on the next page, following the directions below.

- Mark an appropriate scale on the axis labeled "Average Plant Height (cm)."
- Plot the data for the average height of the plants in group A. Surround each point with a small circle and connect the points.
- Plot the data for the average height of the plants in group B. Surround each point with a small triangle and connect the points.
- State the independent variable. Give two reasons why this is the independent variable.
- d. State the dependent variable. Give two reasons why this is the independent variable
- f. Which group is the control? How do you know?

27. Plants respond to their environment in many different ways. Design an experiment to test the effects of *one* environmental factor, chosen from the list below, on plant growth.

- Acidity of precipitation
- Temperature
- Amount of water

In your answer, be sure to:

- identify the environmental factor you chose
- state *one* hypothesis the experiment would test
- state how the control group would be treated differently from the experimental group
- state *two* factors that must be kept the same in both the experimental and control groups
- identify the independent variable in the experiment
- label the columns on the data table below for the collection of data in your experiment

Environmental factor: _____

Data Table

-
28. An experiment was designed to see what effects ibuprofen would have on laboratory mice. Large numbers of male mice and an equal number of female mice were used in this investigation. The male mice were placed in an area with food and water. The female mice were placed in a separate area of the same size. The female mice were given additional food and water. The males were each given 100 milligrams of ibuprofen each day, mixed with their food, and the females were each given 50 milligrams of ibuprofen each day, mixed with their food.

Identify *two* errors in the design of this investigation.

29. A scientist conducted an experiment in which he fed mice large amounts of the amino acid cysteine. He observed that this amino acid protected mouse chromosomes from damage by toxic chemicals. The scientist then claimed that cysteine, added to the diet of all animals, will protect their chromosomes from damage. State whether or not this is a valid claim. Support your answer
30. Many plants can affect the growth of other plants near them. This can occur when one plant produces a chemical that affects another plant.
Design an experiment to determine if a solution containing ground-up goldenrod plants has an effect on the growth of radish seedlings. In your experimental design be sure to:
- state a hypothesis to be tested
 - describe how the experimental group will be treated differently from the control group
 - explain why the number of seedlings used for the experiment should be large
 - identify the type of data that will be collected
 - describe experimental results that would support your hypothesis