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1. 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

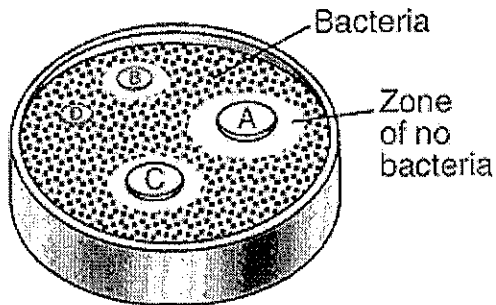
After 10 weeks, neither group reported a case of the flu. Which procedure would have made the outcome of this study more valid?

- 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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2. Which activity would be an appropriate first step when designing an experiment?

- A) reporting a conclusion based on multiple experimental trials
  - B) researching the problem, using information from a variety of sources
  - C) creating a data table to organize experimental observations
  - D) repeating the experiment with a different hypothesis
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3. 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
4. Which source would provide the most reliable information for use in a research project investigating the effects of antibiotics on disease-causing bacteria?
- A) the local news section of a newspaper from 1993
  - B) a news program on national television about diseases in plants
  - C) a current professional science journal article on the control of disease
  - D) an article in a weekly news magazine about reproduction in viruses
5. A student formulated a hypothesis that cotton will grow larger bolls (pods) if magnesium is added to the soil. The student has two experimental fields of cotton, one with magnesium and one without. Which data should be collected to support this hypothesis?
- A) height of the cotton plants in both fields
  - B) diameter of the cotton bolls in both fields
  - C) length of the growing season in both fields
  - D) color of the cotton bolls in both fields
6. 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
7. A biologist plans to spend a year investigating the mating behavior of a certain species of frog. To make meaningful observations, the biologist should observe
- A) a small number of frogs in their natural habitat
  - B) a large number of frogs in their natural habitat
  - C) several groups of frogs maintained in different temperatures in the laboratory
  - D) several groups of frogs maintained on different diets in the laboratory

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8. 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

Base your answers to questions 9 through 11 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.

9. Which activity might help to increase the validity of this experiment?
- A) repeating the experiment several times
  - B) using two different types of radish seeds in each group
  - C) using the same pH for both groups of plants
  - D) placing one set of plants in sunlight and one in darkness
10. 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
11. Which sentence is a possible hypothesis that was tested in this experiment?
- A) Does the pH of water affect the growth of radish plants?
  - B) Will the amount of water alter the heights of the radish plants?
  - C) The temperature of the water will affect the heights of the radish plants.
  - D) The pH of the water will affect the heights of the radish plants.
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12. 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

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13. Which statement about the use of independent variables in controlled experiments is correct?

- A) A different independent variable must be used each time an experiment is repeated.
- B) The independent variables must involve time.
- C) Only one independent variable is used for each experiment.
- D) The independent variables state the problem being tested.

14. Reasons for conducting peer review include all of the following *except*

- A) analyzing the experimental design
  - B) pointing out possible bias
  - C) identifying an illogical conclusion
  - D) changing data to support the hypothesis
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15. Base your answer to the following question on the information below and on your knowledge of biology.

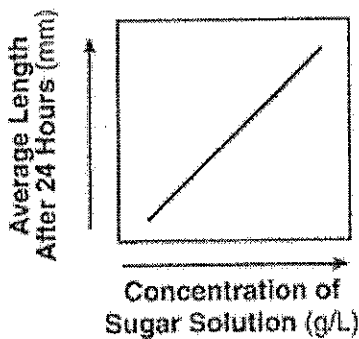
Students cut 20 rod-shaped pieces of potato of the same diameter and length. Five pieces of potato were placed into each of four beakers containing different concentrations of sugar solutions. Each potato piece was measured again after 24 hours. The table below shows the results of their experiment.

Change in Length

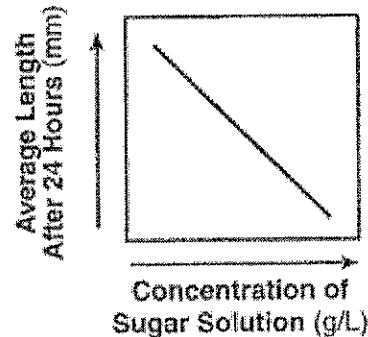
Concentration of Sugar Solution (grams per liter)	Original Length of Potato Pieces (mm)	Average Length After 24 Hours (mm)
0	50.0	52.0
5	50.0	44.0
8	50.0	43.5
10	50.0	42.5

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

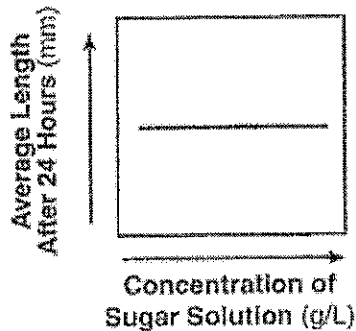
A)



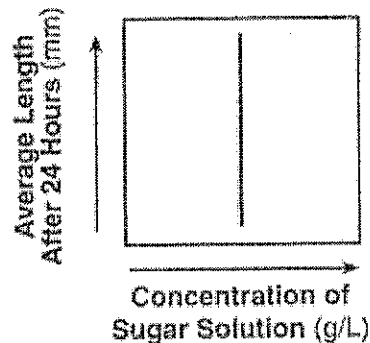
B)



C)



D)



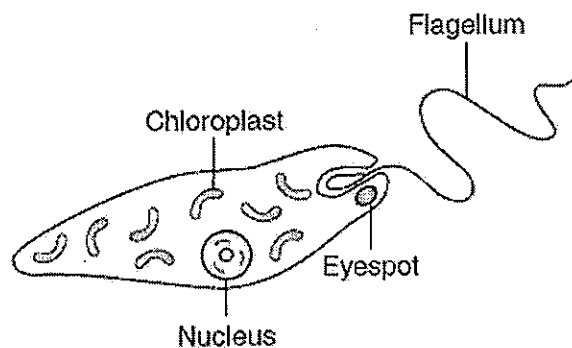
(4)

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16. Diagrams, tables, and graphs are used by scientists mainly to
- A) design a research plan for an experiment
  - B) test a hypothesis
  - C) organize data
  - D) predict the independent variable
17. Graphs of the data from laboratory investigations are used to
- A) observe general trends in the data
  - B) make the observed data more accurate
  - C) prevent errors in measuring data
  - D) help change the original data tables
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Base your answers to questions 18 and 19 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.

18. 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.
19. Which statement correctly identifies a variable in this experiment?
- A) The independent variable is the concentration of nitrate solution used.
  - B) The dependent variable is the number of euglena placed in the tanks.
  - C) The independent variable is the amount of sunlight.
  - D) The dependent variable is the number of tanks used.
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20. Base your answer to the following question on the information below and on your knowledge of biology.

A student grew ten tomato plants from seed. After three weeks, the heights of the ten plants were measured in centimeters (cm). The results are shown below.

Tomato plant A = 5 cm      Tomato plant F = 9 cm  
Tomato plant B = 3 cm      Tomato plant G = 7 cm  
Tomato plant C = 3 cm      Tomato plant H = 5 cm  
Tomato plant D = 3 cm      Tomato plant I = 3 cm  
Tomato plant E = 5 cm      Tomato plant J = 7 cm

Organize the data by completing *both* columns in the data table below, so that the height of the plants increases from the top to the bottom of the table.

**Height of Tomato Plants  
After Three Weeks**

Height of Plant (cm)	Number of Tomato Plants





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25. 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:

**A. State a hypothesis to be tested**

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

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**C. Explain why the number of seedlings used for the experiment should be large**

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**D. Identify the type of data that will be collected**

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**E. Describe experimental results that would support your hypothesis**

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