Scientific Method Review

Name: ________________________________ Date: ________________

1. Tomato plants in a garden are not growing well. The gardener hypothesizes that the soil is too acidic. To test this hypothesis accurately, the gardener could

A. plant seeds of a different kind of plant  
B. move the tomato plants to an area with less sunlight  
C. change the pH of the soil  
D. reduce the amount of water available to the plant

2. 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.

3. The graph below shows the effect of moisture on the number of trees per acre of five tree species.

![Graph showing the effect of moisture on tree species]

Which observation best represents information shown in the graph?

A. All five species grow in the same habitat.  
B. The American elm grows in the widest range of moisture conditions.  
C. Red oaks can grow in wetter conditions than black willows.  
D. Sugar maples can grow anywhere black oaks can grow.
4. Base your answer(s) to the following question(s) 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.

<table>
<thead>
<tr>
<th>Tomato plant A = 5 cm</th>
<th>Tomato plant F = 9 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tomato plant B = 3 cm</td>
<td>Tomato plant G = 7 cm</td>
</tr>
<tr>
<td>Tomato plant C = 3 cm</td>
<td>Tomato plant H = 5 cm</td>
</tr>
<tr>
<td>Tomato plant D = 3 cm</td>
<td>Tomato plant I = 3 cm</td>
</tr>
<tr>
<td>Tomato plant E = 5 cm</td>
<td>Tomato plant J = 7 cm</td>
</tr>
</tbody>
</table>

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.

<table>
<thead>
<tr>
<th>Height of Tomato Plants</th>
<th>Height of Plant (cm)</th>
<th>Number of Tomato Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Base your answers to the following question(s) 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%, 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 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.
6. 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

7. 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

8. 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

9. In an investigation, students determined the average rate of movement of gill covers of a species of freshwater fish at different temperatures. The results are shown in the accompanying data table.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Fish</th>
<th>Temperature (°C)</th>
<th>Average Rate of Movement of Gill Covers per Minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>7</td>
<td>20</td>
<td>38</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>23</td>
<td>60</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>25</td>
<td>57</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>27</td>
<td>25</td>
</tr>
</tbody>
</table>

Which labeled axes should be used to graph the relationship between the two variables?
10. To determine which colors of light are best used by plants for photosynthesis, three types of underwater green plants of similar mass were subjected to the same intensity of light of different colors for the same amount of time. All other environmental conditions were kept the same. After 15 minutes, a video camera was used to record the number of bubbles of gas each plant gave off in a 30-second period of time. Each type of plant was tested six times. The average of the data for each plant type is shown in the table below.

<table>
<thead>
<tr>
<th>Plant Type</th>
<th>Red Light</th>
<th>Yellow Light</th>
<th>Green Light</th>
<th>Blue Light</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elodea</td>
<td>35</td>
<td>11</td>
<td>5</td>
<td>47</td>
</tr>
<tr>
<td>Potamogeton</td>
<td>48</td>
<td>8</td>
<td>2</td>
<td>63</td>
</tr>
<tr>
<td>Utricularia</td>
<td>28</td>
<td>9</td>
<td>6</td>
<td>39</td>
</tr>
</tbody>
</table>

Which statement is a valid inference based on the data?

A. Each plant carried on photosynthesis best in a different color of light.
B. Red light is better for photosynthesis than blue light.
C. These types of plants make food at the fastest rates with red and blue light.
D. Water must filter out red and green light.

11. Base your answer(s) to the following question(s) on the information and data table below and on your knowledge of biology.

The effect of temperature on the action of pepsin, a protein-digesting enzyme present in stomach fluid, was tested. In this investigation, 20 milliliters of stomach fluid and 10 grams of protein were placed in each of five test tubes. The tubes were then kept at different temperatures. After 24 hours, the contents of each tube were tested to determine the amount of protein that had been digested. The results are shown in the table below.

<table>
<thead>
<tr>
<th>Tube</th>
<th>Temperature (°C)</th>
<th>Amount of Protein Digested (grams)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>4.0</td>
</tr>
<tr>
<td>4</td>
<td>37</td>
<td>9.5</td>
</tr>
<tr>
<td>5</td>
<td>85</td>
<td>0.0</td>
</tr>
</tbody>
</table>

The dependent variable in this investigation is the

A. size of the test tube  
B. time of digestion  
C. amount of stomach fluid  
D. amount of protein digested
12. A slide of human blood cells was observed in focus under the low-power objective of a compound light microscope that had clean lenses. When the microscope was switched to high power, the image was dark and fuzzy. Which parts of the microscope should be used to correct this situation?

A. nosepiece and coarse adjustment  
B. diaphragm and ocular  
C. objective and fine adjustment  
D. diaphragm and fine adjustment

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. A student was comparing preserved specimens of three plant species, X, Y, and Z, in a classroom. Which statement is an example of an observation the student could have made and not an inference?

A. The leaves produced by plant X are 4 cm across and 8 cm in length.  
B. Plant Y has large purple flowers that open at night.  
C. Plant X produces many seeds that are highly attractive to finches.  
D. The flowers of plant Z are poisonous to household pets.

15. 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

16. Base your answer(s) to the following question(s) 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.

Which hypothesis was most likely being tested in this investigation?

A. Plants grown in the dark cannot perform the process or 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.
17. A student conducted an experiment to determine if listening to different types of music would affect pulse rate. She thought that pulse rate would change with different types of music. Each person participating in her experiment listened to seven different selections of music for 30 seconds each. The pulse rates were taken after each 30-second interval of music. Based on her experiment, the student concluded that a person’s pulse rate changed when listening to different types of music.

The component missing from this experiment is a

A. prediction  B. hypothesis  C. control group  D. research plan

18. 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.

19. What is the dependent variable in the experiment summarized in the accompanying graph?

20. Write the structures listed below in order from least complex to most complex.

organ  
cell  
organism  
organelle  
tissue

Least complex: __________________________

___________________________

___________________________

___________________________

Most complex: __________________________

___________________________

___________________________

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

You are the head of the research division of the Leafy Lettuce Company. Your company is experimenting with growing lettuce using hydroponic technology. Hydroponic technology involves growing plants in containers of growth solution in a greenhouse. No soil is used. The growth solution that the company uses contains water, nitrogen, and phosphorus. The company wants to know if adding iron to this formula will improve lettuce growth.

Briefly describe how to test the effect of the formula with iron added. In your description, be sure to:

- state a hypothesis to be tested in the new experiment
- state 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
- state what type of data should be collected to support or refute the hypothesis
22. Base your answers to the following question(s) on the information and data table below and on your knowledge of biology.

Diabetes is a disease characterized by consistently high blood glucose levels (at or above 126 mg/100 mL) as a result of hormone deficiency. For a study of diabetes, blood glucose levels from individual A and individual B were recorded each hour over a 5-hour period following a meal. The results are shown in the data table below. Blood Glucose Levels (mg/100 mL).

### Blood Glucose Levels (mg/100 mL)

<table>
<thead>
<tr>
<th>Hours</th>
<th>Individual A</th>
<th>Individual B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>135</td>
<td>90</td>
</tr>
<tr>
<td>1</td>
<td>175</td>
<td>122</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
<td>110</td>
</tr>
<tr>
<td>3</td>
<td>185</td>
<td>87</td>
</tr>
<tr>
<td>4</td>
<td>165</td>
<td>85</td>
</tr>
<tr>
<td>5</td>
<td>150</td>
<td>90</td>
</tr>
</tbody>
</table>

Directions: 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, without any breaks, on each labeled axis.
23. Plot the data for individual A on the grid, surround each point with a small circle, and connect the points.

Example:

24. Plot the data for individual B on the grid, surround each point with a small triangle, and connect the points.

Example:

25. The current knowledge concerning cells is the result of the investigations and observations of many scientists. The work of these scientists forms a well-accepted body of knowledge about cells. This body of knowledge is an example of a

A. hypothesis  
B. controlled experiment  
C. theory  
D. research plan

26. Base your answer(s) to the following question(s) on the graph and on your knowledge of biology. The graph illustrates a single species of bacteria grown at various pH levels.

Which statement is supported by data from this graph?

A. All species of bacteria can grow well at pH 7.  
B. This type of bacterium would grow well at pH 7.5.  
C. This type of bacterium would grow well at pH 2.  
D. Other types of bacteria can grow well at pH 4.
27. Base your answer(s) to the following question(s) on the passage below and on your knowledge of biology.

**Blown Away**

*Head Lice Meet Hair Dryer of Death*

Head lice are becoming indestructible. A study found that as many as 80 percent of the bugs are [resistant] to insecticides in over-the-counter shampoos, and resistance will only increase. Evolutionary biologist Dale Clayton may have a new line of attack.

Clayton, who usually studies lice on bird feathers, stumbled onto his solution after a major research setback. When he moved his laboratory from England to the University of Utah a decade ago, his entire louse collection perished in the dry desert air. Soon after, his 8-year-old came home from school with head lice. He wondered if human head lice could also be killed by drying them out. “It was sort of a forehead slapper,” Clayton says. After conventional hair dryers failed, Clayton came up with the LouseBuster, a 10-pound device resembling a vacuum cleaner that desiccates [dries out] the bugs with a jet of 140-degree air [140°F]. “It’s a pretty brutal assault,” he says. Tests show the invention is both safe and effective, eradicating 80 percent of live lice and 98 percent of eggs, leaving survivors unable to breed. And, Clayton says, “it will be awfully hard for lice to develop resistance.”


Design a controlled experiment to determine the effect of hot, dry air on head lice. In your experimental design, be sure to:

- state the hypothesis to be tested in the experiment
- state one way the control group will be treated differently from the experimental group
- state one result of the experiment that would support the hypothesis

28. A student designed an investigation to determine the effect of temperature on the rate of seed germination. The student placed moist filter paper in each of four culture dishes. Ten bean seeds were placed on the filter paper in each dish. The four dishes were numbered and placed in the dark at different temperatures as follows: Dish 1: 10°C, Dish 2: 15°C, Dish 3: 20°C, Dish 4: 25°C. The total number of germinated seeds in each culture dish was counted each day for two weeks.

Which data table is best for recording the results of this investigation?

A. | Petri Dish | Day | Temperature | Amount of Light |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. | Petri Dish | Amount of Water | Number of Germinated Seeds | Amount of Light |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. | Day | Temperature |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Dish 1</td>
</tr>
<tr>
<td>2</td>
<td>Dish 2</td>
</tr>
<tr>
<td>3</td>
<td>Dish 3</td>
</tr>
<tr>
<td>4</td>
<td>Dish 4</td>
</tr>
</tbody>
</table>

D. | Day | Number of Germinated Seeds |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>10°C</td>
<td></td>
</tr>
<tr>
<td>15°C</td>
<td></td>
</tr>
<tr>
<td>20°C</td>
<td></td>
</tr>
<tr>
<td>25°C</td>
<td></td>
</tr>
</tbody>
</table>
29. 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

30. Base your answer(s) to the following question(s) on the information, diagram, table, and on your knowledge of biology.

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.

<table>
<thead>
<tr>
<th>Plant Cutting</th>
<th>Total Length of Roots in Centimeters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Treated with Hormone</td>
</tr>
<tr>
<td>Begonia</td>
<td>1.50</td>
</tr>
<tr>
<td>Geranium</td>
<td>0.75</td>
</tr>
<tr>
<td>Rose</td>
<td>0.00</td>
</tr>
</tbody>
</table>

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

31. When using a compound light microscope, the most common reason for staining a specimen being observed is to

A. keep the organism from moving around
B. make the view more colorful
C. determine the effects of chemicals on the organism
D. reveal details that are otherwise not easily seen

32. 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?

A. doing research in a library
B. having discussions with other scientists
C. completing a data table of expected results
D. using what is already known about the enzyme
33. Researchers performing a well-designed experiment should base their conclusions on

A. the hypothesis of the experiment
B. data from repeated trials of the experiment
C. a small sample size to insure a reliable outcome of the experiment
D. results predicted before performing the experiment

34. Base your answer(s) to the following question(s) on the data table below and on your knowledge of biology. The table contains information about glucose production in a species of plant that lives in the water of a salt marsh.

<table>
<thead>
<tr>
<th>Temperature (°C)</th>
<th>Glucose Production (mg/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>30</td>
<td>15</td>
</tr>
<tr>
<td>40</td>
<td>5</td>
</tr>
</tbody>
</table>

At which temperature would the plants most likely use the greatest amount of carbon dioxide?

A. 10° C  B. 20° C  C. 30° C  D. 40° C

35. Which statement best describes a controlled experiment?

A. It eliminates the need for dependent variables.
B. It shows the effect of a dependent variable on an independent variable.
C. It avoids the use of variables.
D. It tests the effect of a single independent variable.

36. 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.
37. 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

38. 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.

   The dependent variable in this experiment is the

   A. type of soda given to each group            C. pulse rate of each group
   B. amount of soda given to each group         D. age of participants in each group

39. A company that manufactures a popular multivitamin wanted to determine whether their multivitamin had any side effects. For its initial study, the company chose 2000 individuals to take one of their multivitamin tablets per day for one year. Scientists from the company surveyed the participants to determine whether they had experienced any side effects. The greatest problem with this procedure is that

   A. only one brand of vitamin was tested            C. the sample size was not large enough
   B. the study lasted only one year                   D. no control group was used

40. Base your answer to the following question(s) on the information below and on your knowledge of biology.

   An investigation is carried out to determine the effect of exercise on the rate at which a person can squeeze a clothespin.

   In this investigation, the independent variable is the

   A. control           B. exercise           C. rate of squeezing           D. number of participants
41. Base your answer(s) to the following question(s) on the information below and on your knowledge of biology.

In order to determine the effect of a certain antibiotic on a species of microorganism, an investigation was carried out. A sample of a specific species of microorganism was added to 100 mL of a liquid culture medium. One mL of a solution of the antibiotic was then added to that culture medium. Each day at 10 a.m., 1 mL of the experimental culture medium was removed and the number of microorganisms in the 1-mL sample was determined. The 1 mL of experimental culture medium was replaced by 1 mL of new sterile culture medium to maintain a constant volume. The results are shown in the table below.

<table>
<thead>
<tr>
<th>Changes in Microorganism Population Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Number of Microorganisms in Sample</td>
</tr>
</tbody>
</table>

Mark an appropriate scale, without any breaks, on each labeled axis.
42. Base your answer(s) to the following question(s) on the information and data table and on your knowledge of biology.

Data Table

In an investigation, three seeds of the same species were allowed to germinate and grow in three different locations. Each seedling was grown in the same amount and type of soil, and each received the same amount of water during a 6-day period. At the end of the investigation, the height of each seedling and the color of its leaves were recorded. The results are shown in the data table to the right.

<table>
<thead>
<tr>
<th>Location</th>
<th>Height (cm)</th>
<th>Leaf Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunny windowsill</td>
<td>7</td>
<td>green</td>
</tr>
<tr>
<td>Indirect sunlight</td>
<td>9</td>
<td>green</td>
</tr>
<tr>
<td>Closed closet</td>
<td>11</td>
<td>whitish yellow</td>
</tr>
</tbody>
</table>

Which hypothesis was most likely being tested in this investigation?

A. A plant grown in the dark will not be green.
B. The type of soil a plant is grown in influences how tall it will be.
C. Plants need water to grow.
D. Plants grown in red light are taller than plants grown in green light.

43. Base your answer(s) to the following question(s) on the information and diagram below.

An investigation was carried out using the two setups shown below. Other than the difference shown in the diagram, all other conditions were identical.

State one possible hypothesis that could be tested using these setups.

44. 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
45. It has been hypothesized that a chemical known as BW prevents colds. To test this hypothesis, 20,000 volunteers were divided into four groups. Each volunteer took a white pill every morning for one year. The contents of the pill taken by the members of each group are shown in the chart below.

<table>
<thead>
<tr>
<th>Group</th>
<th>Number of Volunteers</th>
<th>Contents of Pill</th>
<th>% Developing Colds</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5,000</td>
<td>5 grams of sugar</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>5,000</td>
<td>5 grams of sugar</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>5,000</td>
<td>5 grams of sugar</td>
<td>21</td>
</tr>
<tr>
<td>4</td>
<td>5,000</td>
<td>5 grams of sugar</td>
<td>15</td>
</tr>
</tbody>
</table>

Which group served as the control in this investigation?

A. 1  
B. 2  
C. 3  
D. 4

46. A science researcher is reviewing another scientist’s experiment and conclusion. The reviewer would most likely consider the experiment invalid if

A. the sample size produced a great deal of data  
B. other individuals are able to duplicate the results  
C. it contains conclusions not explained by the evidence given  
D. the hypothesis was not supported by the data obtained

47. Which procedure would most likely provide valid results in a test to determine if drug A would be effective in treating cancer in white mice?

A. injecting 1 mL of drug A into 100 white mice with cancer  
B. injecting 1 mL of drug A into 100 white mice with cancer and 0.5 mL of drug X into 100 white mice without cancer  
C. injecting 1 mL of drug A into 100 white mice with cancer and 0.5 mL of drug X into another group of 100 white mice with cancer  
D. injecting 1 mL of drug A into 100 white mice with cancer and 1 mL of distilled water into another group of 100 white mice with cancer
48. 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

49. 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.

<table>
<thead>
<tr>
<th>Group</th>
<th>Dosage (mg/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100</td>
</tr>
<tr>
<td>B</td>
<td>200</td>
</tr>
</tbody>
</table>

   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 200 mg of the supplement
   B. test the supplement on both groups for 5 weeks instead of 10 weeks
   C. test a third group that receives 150 mg of the supplement
   D. test a third group that does not receive the supplement

50. Base your answer(s) to the following question(s) on the provided information and data table and on your knowledge of biology.

   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.

<table>
<thead>
<tr>
<th>Growth of Duckweed Leaves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time in Days</td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
</tbody>
</table>

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

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

   A. 2.0 days       B. 2.3 days       C. 2.9 days       D. 3.2 days
1. Answer: C
2. Answer: D
3. Answer: B
4. Answer: 

<table>
<thead>
<tr>
<th>Height of Plant (cm)</th>
<th>Number of Tomato Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
</tr>
</tbody>
</table>

5. Answer: A
6. Answer: C
7. Answer: C
8. Answer: A
9. Answer: A
10. Answer: C
11. Answer: D
12. Answer: D
13. Answer: D
14. Answer: A
15. Answer: D
16. Answer: B
17. Answer: C
18. Answer: B
19. Answer: The percent maximum activity of trypsin
20. Answer: organelle, cell, tissue, organ, or organism
21. Answer: 

- a hypothesis to be tested in the new experiment [Note: A hypothesis is a statement with a prediction. (E.g., Adding iron to the hydroponic solution will improve the growth of lettuce.)]
- how the control group will be treated differently from the experimental group (e.g., The control group should be grown in the solution that the company uses, which contains water, nitrogen, and phosphorus, while the growth solution for the experimental group should contain water, nitrogen, phosphorus, and iron.)
- two factors that must be kept the same in both the experimental and control groups (e.g., the intensity of light or the number of plants in the experimental and control groups or any other scientifically correct answer)
- the type of data that should be collected to support or refute the hypothesis (e.g., the height of the plants or the mass of the plants or the total leaf area of the plants) [Note: Growth can only be accepted if attached to a measurable quantity.]
22. Answer: marking an appropriate scale, without any breaks, on each labeled axis.

23. Answer: correctly plotting the data for individual A, surrounding each point with a small circle, and connecting the points.

24. Answer: correctly plotting the data for individual B, surrounding each point with a small triangle, and connecting the points.

25. Answer: C

26. Answer: B

27. Answer: – Lice exposed to high temperatures will have a lower survival rate than those exposed to 98.6°F (body temperature). – Lice not blasted with high temperatures will have a higher survival rate.

28. Answer: D

29. Answer: D

30. Answer: use more plants of each type, use more types of plants, extend the length of the experiment, or repeat the experiment

31. Answer: D

32. Answer: C

33. Answer: B

34. Answer: C

35. Answer: D

36. Answer: C
37. 
Answer: 
- Radish seedlings grow faster when exposed to goldenrod solution. OR Radish seedlings treated with the solution will not grow as tall as the control group. OR The solution will not affect the height of radish seedlings. 
- The experimental group will be given the solution while the control group is given plain water. OR The experimental group will have ground up goldenrod in the soil. 
- A large sample will increase the validity of the results. OR Since some may die, there will be enough left to do the experiment. 
- The number of seedlings that survive in each group will be counted. OR the height of the seedlings 
- Radish seedlings exposed to goldenrod solution were twice as tall as the control group in two weeks. OR If the radish seedlings treated with the solution do not grow as tall as those in the control group, the hypothesis is supported. OR If there is no difference between the height of the group treated with the solution as compared to the control group, the hypothesis will be supported.

38. 
Answer: C

39. 
Answer: D

40. 
Answer: B

41. 
Answer:

42. 
Answer: A

43. 
Answer: Lily plants grow faster at 20°C than at 15°C. OR Temperature affects plant growth. OR Lily plants produce more flowers at higher temperatures.

44. 
Answer: D

45. 
Answer: A

46. 
Answer: C

47. 
Answer: D

48. 
Answer: C

49. 
Answer: D

50. 
Answer: B