1. Base your answer to the following question on a mouthwash experiment tested mouthwash against bacteria commonly found in the mouth. Four paper discs each with a different brand of mouthwash were placed onto the surface of a 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

2. Which source would provide the most reliable information about 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

3. 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.

4. 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

5. 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

6. Which statement best describes the term theory as used in the gene-chromosome theory?

A) A theory is never revised as new scientific evidence is presented.  
B) A theory is an assumption made by scientists and implies a lack of certainty.  
C) A theory refers to a scientific explanation that is strongly supported by a variety of experimental data.  
D) A theory is a hypothesis that has been supported by one experiment performed by two or more scientists.

7. 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
8. An investigation was carried out to determine which of three antibacterial soaps is most effective. Four petri dishes labeled A, B, C, and D were set up. The same amount and type of bacteria was added to each dish. Next, 2 mL of a different brand of soap were added to dishes B, C, and D. Then, 2 mL of water were added to dish A, instead of soap. The dishes were incubated at 37°C for 24 hours. At the end of the investigation, the amount of bacteria in each dish was determined. Dish D had the least bacteria. It was concluded that the soap in dish D was the most effective soap to use against bacteria.

Which statement best describes the validity of this conclusion?
A) sample of bacteria was used in this investigation.
B) The conclusion is valid since too small
C) The conclusion is valid since the amounts of bacteria were measured at the end of the investigation.
D) The conclusion might not be valid since the investigation was carried out only once.

9. 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
B) the study lasted only one year
C) the sample size was not large enough
D) no control group was used

10. 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
Base your answers to questions 11 and 12 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.

11. 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.

12. 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.
13. Base your answer to the following question on the data table below and on your knowledge of biology. The data table shows the number of fish species found at various ocean depths.

<table>
<thead>
<tr>
<th>Water Depth (m)</th>
<th>Number of Fish Species Found</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>35</td>
</tr>
<tr>
<td>75</td>
<td>31</td>
</tr>
<tr>
<td>100</td>
<td>22</td>
</tr>
<tr>
<td>150</td>
<td>13</td>
</tr>
<tr>
<td>200</td>
<td>6</td>
</tr>
</tbody>
</table>

The approximate number of fish species that can be found at 120 meters is

A) 5       B) 13       C) 18       D) 31

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

![Bar graph showing plant height](image)

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.

16. The table below shows an effect of secondhand smoke on the birth weight of babies born to husbands and wives living together during pregnancy.

<table>
<thead>
<tr>
<th>Effect of Secondhand Smoke on Birth Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wife: Nonsmoker husband: Nonsmoker</td>
</tr>
<tr>
<td>------------------------------------------</td>
</tr>
<tr>
<td>Number of Couples</td>
</tr>
<tr>
<td>Average weight of baby at birth</td>
</tr>
</tbody>
</table>

Based on these data, a reasonable conclusion that can be drawn about secondhand smoke during pregnancy is that secondhand smoke

A) is unable to pass from the mother to the fetus
B) slows the growth of the fetus
C) causes mutations in cells of the ovaries
D) blocks the receptors on antibody cells
17. 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

18. A piece of refrigerated, cooked meat will remain safe to eat for a longer period of time than a refrigerated piece of raw meat of similar size. Which statement is a valid inference based on this information?
A) Cooking meat kills many bacteria and fungi.
B) Cool temperatures stimulate the growth of microbes on raw meat.
C) Raw meat cannot be preserved.
D) Cooked meat contains antibodies that destroy decomposers.

19. Base your answer to the following question on What is the approximate length of the earthworm shown in the diagram below?

![Diagram of an earthworm with a ruler for measurement]

A) 9 mm  B) 90 mm  C) 10.6 cm  D) 106 cm
20. 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

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

A chemical known as fertex affects external fertilization of sea urchin eggs. An experiment was set up using three tanks to investigate the effect of fertex. Each tank had a different concentration of fertex: 1%, 2%, and 3%. Ten sea urchin eggs and 2 mL of sea urchin sperm were added to each of the three tanks. A fourth tank was set up as a control.

Identify two factors that must be kept the same in all four tanks.

Factor 1: _____

Factor 2: _____
Base your answers to questions 22 and 23 on the data table below and on your knowledge of biology. The data table shows the concentration of estrogen in picograms per milliliter (pg/mL) in the blood of a woman over the course of 28 days.
22. Mark an appropriate scale, without any breaks, on the axis labeled "Concentration of Estrogen."

23. Plot the data for concentration of estrogen on the grid. Surround each point with a small circle and connect the points.
24. A student, using a metric ruler, measured a larva as represented in the diagram below.

What is the length of the larva, in millimeters?
25. Base your answer to the following question on the passage below and on your knowledge of biology. The letters indicate paragraphs.

**Yellow Fever**

A team of doctors was sent to Havana, Cuba, to study a yellow fever epidemic. The doctors wanted to find out how the pathogenic microbe that causes yellow fever is transferred from those who are sick to those who are well. Some people thought that the disease was spread by having contact with a person who had the disease or even through contact with clothing or bedding that they had used.

It was known that yellow fever occurred more frequently in swampy environments than in environments that were dry. Consequently, some people thought that the disease was due to contact with the atmosphere of the swamps. A respected doctor in Havana was convinced that a particular species of mosquito, *Aedes calopus*, spread the disease.

The team of doctors carried out several experiments and collected data. They built poorly ventilated houses in which American soldiers volunteered to sleep on bedding used by individuals who had recently died of yellow fever in local hospitals. The soldiers also wore the nightshirts of those who had died. The houses were fumigated to kill all mosquitoes and the doors and windows of the houses were screened. None of the soldiers living in these houses contracted the disease, though the experiment was tried repeatedly.

In another experiment, the team built houses that were tightly sealed. The doors and windows were screened. The insides of the houses were divided into two parts by mosquito netting. One part of the house contained a species of mosquito, *Aedes calopus*, that had been allowed to bite yellow fever patients in the hospital. There were no mosquitoes in the other part of the house. A group of volunteers lived in each part of the house. A number of those who lived in the part of the house with the mosquitoes became infected; none of those in the other part of the house did.

Putting these facts together with other evidence, the team concluded that *Aedes calopus* spread the disease. The validity of this conclusion then had to be tested. All newly reported cases of yellow fever were promptly taken to well-screened hospitals and their houses were fumigated to kill any mosquitoes. The breeding places of the mosquitoes in and around Havana were drained or covered with a film of oil to kill mosquito larvae. Native fish species known to feed on mosquito larvae were introduced into streams and ponds. The number of yellow fever cases steadily declined until Havana was essentially free of the epidemic.

Describe the control that should have been set up for the experiment described in paragraph C.
26. Base your answer to the following question on An experiment was carried out to determine how competition for living space affects plant height. Different numbers of plants were grown in three pots, A, B, and C. All three pots were the same size. The data collected are shown in the table below.

<table>
<thead>
<tr>
<th>Average Daily Plant Height (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>Pot A—5 plants</td>
</tr>
<tr>
<td>Pot B—10 plants</td>
</tr>
<tr>
<td>Pot C—20 plants</td>
</tr>
</tbody>
</table>

Analyze the experiment that produced the data shown in the table. In your answer be sure to:
• state a hypothesis for the experiment
• identify one factor, other than pot size, that should have been kept the same in each experimental group
• identify the dependent variable
• state whether the data supports or fails to support your hypothesis and justify your answer

27. State one hypothesis the experiment would test

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

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

30. Identify the independent variable in the experiment