Name: _____ Date: _____

1. When scientists carry out an experiment, they are testing a _____.
A) theory
B) question
C) hypothesis
D) control
E) variable

2. When is a hypothesis considered scientific?
A) when it is based on something other than observation
B) when it can be tested and is refutable
C) when it relies on anecdotal evidence
D) when it relies on mystical explanations
E) All hypotheses are considered scientific until experiments determine otherwise.

3. Of the following, which is the first step in the scientific process?
A) generating a hypothesis
B) analyzing data
C) conducting an experiment
D) drawing a conclusion
E) developing questions based on observations

4. In a controlled experiment, which group receives the placebo?
A) the experimental group
B) the control group
C) the dependent group
D) the independent group
E) all groups

5. In the studies of coffee and memory discussed, the independent variable is _____ and the dependent variable is _____.
A) caffeinated coffee; decaffeinated coffee
B) memory; caffeinated coffee
C) caffeine; memory
D) memory; caffeine
E) decaffeinated coffee; caffeinated coffee

6. Use the following information for the question below:
You conduct a clinical trial to test whether a new drug relieves the symptoms of arthritis better than a placebo. You have four groups of participants, all of whom have moderately painful arthritis (rated 7 on a scale of 1 to 10). Each group receives a daily pill as follows: group 1-placebo; group 2-15 mg; group 3-25 mg; group 4-50 mg. At the end of 2 weeks, participants in each group are asked to rate their pain on a scale of 1 to 10.
What is the independent variable in this experiment?

A) the level of pain experienced
B) the different drug treatment groups
C) the degree to which symptoms changed
D) the drug itself
E) the amount of pain experienced at the end of the experiment by the different drug treatment groups

7. Which of the following sources is most likely to provide the most scientifically rigorous and accurate information?

A) a non-randomized clinical trial with 15,000 subjects
B) a randomized clinical trial with 15,000 subjects
C) an epidemiological study with 15,000 subjects
D) an endorsement of a product by a movie star
E) a report on a study presented by a news organization

8. How can statistics be used in a scientific study?

A) They can reveal whether or not the data have been fabricated.
B) They can only be used to support the hypothesis.
C) They determine whether observed differences are significant or a result of chance.
D) They can only be used to refute the hypothesis.
E) They can determine whether the hypothesis is testable and falsifiable.

9. You conduct a clinical trial to test whether a new drug relieves the symptoms of arthritis better than a placebo. You have four groups of participants, all of whom have moderately painful arthritis (rated 7 on a scale of 1 to 10). Each group receives a daily pill as follows: group 1—placebo; group 2—15 mg; group 3—25 mg; group 4—50 mg. At the end of 2 weeks, participants in each group are asked to rate their pain on a scale of 1 to 10.
Based on the process of science, what should your next step be?

A) invest in the drug company
B) conclude that the drug relieves arthritis pain
C) run a statistical analysis on the data collected
D) conclude that the drug doesn't work very well
E) Develop a new hypothesis based on the unanalyzed data.

10. From what you have read in this chapter, would you say a 21-year-old Caucasian female can count on caffeinated coffee to reduce her risk of Parkinson's disease?

A) Yes, because the results of a peer-reviewed study indicated that drinking caffeinated beverages reduced the risk of Parkinson's disease.
B) No, because participants in that peer-reviewed study were Japanese American males; it cannot be inferred that the same results would hold for Caucasian females.
C) No, she would have to restrict her consumption of coffee to decaffeinated coffee to reduce her risk of Parkinson's disease.
D) Yes, the peer-reviewed study proved that coffee reverses the symptoms of Parkinson's disease in people of all ethnicities and ages.
E) No data are available on the relationship between drinking caffeinated beverages and Parkinson's disease because it would be unethical to conduct such an epidemiological study.

11. You hear a news report about a new asthma treatment. What information is NOT something you would want to know before asking your doctor if this treatment was right for you?

A) Was the drug tested in a randomized clinical trial?
B) How many participants were in the trial?
C) Was there a statistically significant difference between the effect of the new drug and the treatment used in the control group?
D) In what populations were the clinical trials conducted?
E) Is asthma a genetic disorder?

12. You are listening to a news report that claims a new study has found convincing evidence that a particular weight-loss product is much more effective than diet and exercise Which statement would be an example of scientifically "convincing" evidence in this case?

A) The study has a hypothesis.
B) Statistical tests showed significantly more weight loss in the participants who used the weight-loss product than those who relied on diet and exercise.
C) All the participants lost at least 10 pounds.
D) Only the participants who used the weight-loss product lost weight.
E) The participants who used the weight-loss product lost an average of 3 pounds, whereas the participants who used diet and exercise lost an average of 2 pounds.

13. Which of these is NOT a factor that may lead to different conclusions from two different studies investigating the same thing (eg., the relationship, if any, between caffeinated coffee and memory)?

A) different sample sizes
B) different types of participants (eg., participants of different ages or professions)
C) different amounts of caffeine
D) different ways of evaluating memory (eg., long-term vs. short-term memory)
E) using a control group

14. A close friend has joined a clinical trial. When you ask her about the types of treatment she might be given, she tells you that neither she nor the doctor running the trial will know until the process has been completed. What type of trial has she joined?

A) peer reviewed
B) double-blind
C) epidemiological
D) unsafe
E) theoretical

15. Can an epidemiologist who finds a correlation between the use of tanning beds and melanoma (an aggressive form of skin cancer) in college-age women conclude that tanning beds cause skin cancer?

A) Yes, as long as the correlation was statistically significant.
B) Yes, but only for college-age women.
C) Yes, but only melanoma skin cancer, not other forms of skin cancer.
D) No, the correlation would have to hold with males and females and in different age groups.
E) No, correlation is not proof of causation.

16. You are working on an experiment to test the effect of a specific drug on reducing the risk of breast cancer in postmenopausal women. Describe your control and experimental groups with respect to age, gender, and breast cancer status.

17. Design a randomized clinical trial to test the effects of caffeinated coffee on brain activity. Design your study so that the results will apply to as many people in as many scenarios as possible.

18. Looking at Infographic 1.4 (Sample Size Matters), you see that both graphs show a positive impact of caffeine on memory. However, the data in the graph on the right carry more weight. Why is that? If you read a study that reported only the data in the left graph, would you find the relationship to be compelling? Why or why not?

19. A scientist who reads an article in a scientific or medical journal can be confident that the report has been peer reviewed.

    a. What is a "peer-reviewed" report? Is an article in a daily newspaper a peer-reviewed article?
    b. What is the role of a peer reviewer of a scientific article?
    c. Why do scientists place so much value on the peer-review process?

20. The mother of a friend is a self-described "coffee addict." She recently received a diagnosis of Parkinson's disease. Does her experience negate the results of the *JAMA* study described in this chapter? Why or why not?

21. You may have seen advertisements on television that show beautiful people with clear skin who claim that a specific skin care product is "scientifically proven" to reduce acne. The product reportedly gave these people glowing, clear skin.

    a. Is their testimony alone strong enough evidence for you to act on? Why or why not?
    b. What kind of scientific evidence would persuade you to spend money on this product? Explain your answer.

22. Following the prompts below, design a clinical trial to test the impact of a particular intervention on a specific aspect of human health. You will need to use everything you have learned in this chapter to do this.

    a. From scientific articles or press releases from health organizations you have read, or from your own experiences, what observation(s) can you start with?
    b. Do some reading and research to generate a testable hypothesis.
    c. Design the trial. Consider sample size, whether or not you will use a placebo, and possible independent and dependent variables.

23. There are many misconceptions about breast cancer and its causes. In the late 1990s, there were rumors that antiperspirants cause breast cancer. There are still retail sources that offer alternative underarm hygiene products that claim to reduce the risk of breast cancer. One viral e-mail claimed that by blocking perspiration, antiperspirants prevent the body from purging toxins, instead forcing the body to store the toxins in lymph nodes in the underarm area near breast tissue. The e-mail stated that men were less likely to develop breast cancer from antiperspirants because their underarm hair trapped most of the product away from direct contact with skin. And as men are less likely to shave their underarms, they are less likely to have shaving nicks through which antiperspirants can enter the body.

a. Read the abstracts of the two articles for which URLs are provided below.

Darbre, 2005: http://is.gd/pPLxwZ

Harvey and Everett, 2004: http://is.gd/ycqDD8

From the abstracts, and from any other investigation you do, name the components of underarm deodorants and antiperspirants that have been identified as possible culprits in causing breast cancer.

b. Briefly comment on the strengths and weaknesses of each study (consider sample size, control groups, and overall study design).

c. From what you read in the abstracts and from other research you do (cite any additional reliable sources that you consulted), do you think that use of antiperspirants or deodorants or both is a consistent risk factor for breast cancer? Has your opinion about underarm hygiene changed? Explain how and why your opinion has either changed or remained consistent, referring to the abstracts that you have reviewed.

24. Of the following, which is the earliest step in the scientific process?

A) generating a hypothesis
B) analyzing data
C) conducting an experiment
D) drawing a conclusion
E) asking a question about an observation

25. In a controlled experiment, which group receives a placebo?

A) the experimental group
B) the control group
C) the scientist group
D) the independent group
E) all groups

26. In the studies of coffee and memory discussed in this chapter, the independent variable is _____ and the dependent variable is _____.

A) caffeinated coffee; decaffeinated coffee
B) memory; caffeinated coffee
C) caffeine; memory
D) memory; caffeine
E) decaffeinated coffee; caffeinated coffee

27. Can an epidemiologist who finds a correlation between the use of tanning beds and melanoma (an aggressive form of skin cancer) in college-age women conclude that tanning beds cause skin cancer?

A) Yes, as long as the correlation was statistically significant.
B) Yes, but only for college-age women.
C) Yes, but only melanoma skin cancer, not other forms of skin cancer
D) No; the study would have to be done with a wider range of participants (males and females of different ages) before it can be concluded that tanning beds cause melanoma.
E) No; correlation is not proof of causation.

28. You carry out a clinical trial to test whether a new drug relieves the symptoms of arthritis better than a placebo. You have four groups of participants, all of whom have mildly painful arthritis (rated 6 on a scale of 1 to 10). Each group receives a daily pill as follows: group 1 (control), placebo; group 2, 15 mg; group 3, 25 mg; group 4, 50 mg. At the end of 2 weeks, participants in each group are asked to rate their pain on a scale of 1 to 10. What is the independent variable in this experiment?

A) the amount of pain experienced at the start of the experiment
B) the amount of pain experienced at the end of the experiment
C) the degree to which pain symptoms changed between the start and the end of the experiment
D) the drug
E) All of the answers could be the independent variable.

29. In which of the following would you have the most confidence?

A) a randomized clinical trial with 15,000 subjects
B) a randomized clinical trial with 5,000 subjects
C) an epidemiological study with 15,000 subjects
D) an endorsement of a product by a movie star
E) a report on a study presented by a news organization

30. What is the importance of statistical analyses?

A) They can reveal whether or not the data have been fabricated.
B) They can be used to support or reject the hypothesis.
C) They can be used to determine whether any observed differences between two groups are real or a result of chance.
D) All of the answers are correct.
E) They can be used to either support or reject the hypothesis, or to determine whether any observed differences between two groups are real or a result of chance.

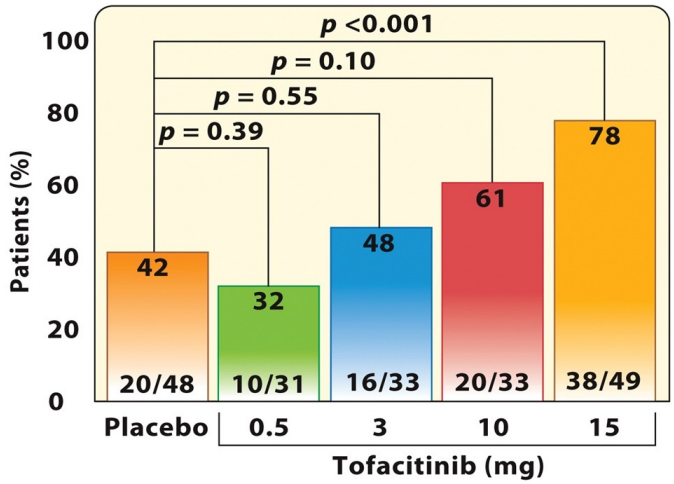
31. You carry out a clinical trial to test whether a new drug relieves the symptoms of arthritis better than a placebo. You have four groups of participants, all of whom have mildly painful arthritis (rated 6 on a scale of 1 to 10). Each group receives a daily pill as follows: group 1 (control), placebo; group 2, 15 mg; group 3, 25 mg; group 4, 50 mg. At the end of 2 weeks, participants in each group are asked to rate their pain on a scale of 1 to 10. The mean pain rating of the participants was 6.5 for the placebo, 6.0 for 15 mg of the drug, 4.5 for 25 mg of the drug, and 4.5 for 50 mg of the drug. What is your next step?

A) Invest in the drug company.
B) Conclude that the drug relieves arthritis pain.
C) Run a statistical analysis to determine if the differences are significant.
D) Conclude that the drug doesn't work very well (even the placebo group went down on the pain scale, and there was no difference in results between doses of 25 mg and 50 mg of the drug).
E) Both investing in the drug company and concluding that the drug relieves arthritis pain.

32. From what you have read in this chapter, would you say a 21-year-old Caucasian female can count on caffeinated coffee to reduce her risk of Parkinson disease?

A) yes, because the results of a peer-reviewed study showed that drinking caffeinated beverages reduced the risk of Parkinson disease
B) no, because participants in that peer-reviewed study were Japanese-American males; it cannot be inferred that the same results would hold for Caucasian females
C) no; she would have to restrict her consumption of coffee to decaffeinated coffee to reduce her risk of Parkinson disease
D) yes; coffee is known to reverse the symptoms of Parkinson disease
E) There are no data on the relationship between drinking caffeinated beverages and Parkinson disease because it would be unethical to conduct such an epidemiological study.

33. Most statistical tests report a *p* value that determines whether or not the results are statistically significant (i.e., not produced by chance). Usually the cutoff for *p* values is 0.05: if the *p* value is less than 0.05, the results are considered to be statistically significant. The graph below shows data from a 2012 study published in the *New England Journal of Medicine*. The study examined the impact of the drug Tofacitinib on ulcerative colitis. From the data shown, what dose(s) of Tofacitinib is/are significantly better than the placebo in treating ulcerative colitis?



Unnumbered 1 p18
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A) 0.5 mg
B) 3 mg
C) 10 mg
D) 15 mg
E) both 10 mg and 15 mg
F) All doses are more effective than the placebo.

34. You hear a news report about a new asthma treatment. What would you want to know before you asked your doctor if this treatment was right for you?

A) Was the drug tested in a randomized clinical trial?
B) How many participants were in the trial?
C) Was there a significant difference between the effect of the new drug and the treatment used in the control group?
D) Did any of the researchers have financial ties to the manufacturer of the new asthma drug?
E) All of the answers are correct.

35. You are listening to a news report that claims a new study has found convincing evidence that a particular weight-loss product is much more effective than diet and exercise. What can you infer about the "convincing evidence" in this case?

A) It agrees with the hypothesis.
B) Statistical tests showed significantly more weight loss in the participants who used the weight-loss product than those who relied on diet and exercise.
C) All the participants lost at least 10 pounds.
D) Only the participants who used the weight-loss product lost weight.
E) The participants who used the weight-loss product lost an average of 3 pounds, while the participants that used diet and exercise lost an average of 2 pounds.

36. How can two different studies investigating the same thing (e.g., the relationship, if any, between caffeinated coffee and memory) come to different conclusions?

A) They may have had different sample sizes.
B) They may have used different types of participants (e.g., participants of different ages or professions).
C) They may have used different amounts of caffeine.
D) They may have evaluated memory differently (e.g., long-term vs. short-term memory).
E) All of the answers are correct.

37. Imagine that you read a study of the effects of exercise on the prevalence of heart disease in women ages 35 to 65. Although you believe the experiment was carried out in an appropriate manner, you still do not believe the results. You decide to conduct your own study to see for yourself. To determine if the results of the first study are valid, should you do everything the same way as the first study or would it be better if you changed several of the variables, such as studying men, or looking at different age groups? Explain your choice, and explain the consequences of the other choice.

38. Why can't science answer questions about the existence of a supernatural being?

39. A scientific hypothesis must have two very important features. What are they?

40. What does it mean to say that a scientific study has undergone "peer review"? Why is this important?

41. Why do scientists say that a hypothesis is "supported" and never say that a hypothesis has been "proven"?

42. A hypothesis is often called an educated guess. Why is it a guess and why is it educated?

43. Use the following information to answer this question:

    To test the effectiveness of a new drug designed to improve concentration in children with hyperactivity disorder, a researcher divided 100 children with hyperactivity disorder into two groups of 50 children each. First, both groups received a test to determine the length of time they could study a word list before their attention wandered. Then, group 1 received the new drug while group 2 received a sugar pill. One hour later, both groups took the concentration test again.

    Which group is the experimental group and which is the control group?

44. Use the following information to answer this question:

    To test the effectiveness of a new drug designed to improve concentration in children with hyperactivity disorder, a researcher divided 100 children with hyperactivity disorder into two groups of 50 children each. First, both groups received a test to determine the length of time they could study a word list before their attention wandered. Then, group 1 received the new drug while group 2 received a sugar pill. One hour later, both groups took the concentration test again.

    Why did group 2 receive a sugar pill instead of simply not taking anything at all?

45. Use the following information to answer this question:

    To test the effectiveness of a new drug designed to improve concentration in children with hyperactivity disorder, a researcher divided 100 children with hyperactivity disorder into two groups of 50 children each. First, both groups received a test to determine the length of time they could study a word list before their attention wandered. Then, group 1 received the new drug while group 2 received a sugar pill. One hour later, both groups took the concentration test again.

    What is the independent variable in this study?

46. Use the following information to answer this question:

    To test the effectiveness of a new drug designed to improve concentration in children with hyperactivity disorder, a researcher divided 100 children with hyperactivity disorder into two groups of 50 children each. First, both groups received a test to determine the length of time they could study a word list before their attention wandered. Then, group 1 received the new drug while group 2 received a sugar pill. One hour later, both groups took the concentration test again.

    What is the dependent variable in this study?

47. What is a placebo treatment and why is it important in a properly designed experiment?

48. Describe the features of an experimental group versus a control group-for example, in an experiment whose hypothesis is “consuming coffee improves memory.”

49. You are running an analysis on different food items to test for the presence of the major biological macromolecules of starch, proteins, and lipids. For each test you examine four food items and distilled water. What is the role of the distilled water?

50. Numerous studies have shown that the more often a person performs a workout routine that increases heart rate, the better their overall heart health is. You have two groups of individuals who are willing to participate in a heart-health experiment. Fifty are non-smoking males, ages 18 to 22, who work out three times per week. Fifty are nonsmoking males, ages 18 to 22, who do not work out on a regular basis. In the experiment, they will step up and down on an 8-inch-high cinder block 120 times/minute for 3 minutes. Researchers will examine their heart rate before starting, immediately after they finish, and every minute after finishing until their heart rate returns to their original rate. Two common measures of heart health are the percentage increase in heart rate caused by exercise and the time the heart rate takes to return to the base rate. Based on these parameters, what is your hypothesis regarding the heart health and test performance of the two groups?

51. You are performing a bacterial transformation where you are trying to transfer DNA that contains the gene for resistance to the antibiotic ampicillin into the bacterium *E. coli*. Ampicillin normally kills *E. coli*, but if you are successful in your transfer of the DNA, the *E. coli* will now be unaffected by ampicillin. *E. coli* grows best on Luria Broth agar plates. Giving a cold period and then a brief heat shock and a cold period has been shown to help bacteria cells take up pieces of DNA.

    You take some cultures of *E. coli*, add cold calcium chloride, keep these on ice for 15 minutes, heat shock them for 90 seconds, then chill them on ice for 1 minute before putting them onto Luria Broth agar plates with ampicillin and Luria Broth plates without ampicillin. These bacteria should be killed by the plates with ampicillin.

    You take some other cultures of *E. coli*, add cold calcium chloride, then add the new DNA, then keep these on ice for 15 minutes, heat shock them for 90 seconds, then chill them on ice for 1 minute before putting them onto Luria Broth agar plates that contain ampicillin and Luria Broth agar plates without ampicillin. If you successfully transferred the DNA, these bacteria should grow on the plates with ampicillin and the ones without ampicillin.

    In this experiment, why were the colonies without the added DNA and the colonies with the added DNA treated the same way (15 minutes cold, then heat shock, then cold)?

52. Explain why evolution is not dismissed as "just a theory" with reference to the Theory of Evolution.

53. What is the difference between a hypothesis and a theory?

54. Does science ever prove a hypothesis or theory? Why or why not?

55. Define the meaning of the word "theory" in everyday usage and scientific usage and give two examples of each type of theory.

56. In several reported incidents, local school boards have insisted that biology texts have a stamp placed inside that states that "evolution is a theory." To their surprise, most science faculty have not objected to this language. Explain how each group interprets the statement that "evolution is a theory."

57. Two studies were conducted to determine if a new drug was effective at reducing tumor size in patients with lung cancer. One study examined men and found that the drug reduced tumor size by 45%; the other study, conducted on women, concluded that the drug had no effect. Is it possible that the results of both studies are correct? Why or why not?

58. Two researchers wish to examine the effect of caffeine on alertness. One researcher has the participants drink a cup of coffee with 100 mg of caffeine, whereas the other researcher has the participants take a capsule with 100 mg of caffeine. In all other respects, these two studies are identical. Which method do you think will answer the question best? Why? Are there any complicating factors that could compromise the results of one of the studies?

59. How can two studies on the same topic have conflicting conclusions?

60. Researchers ran three clinical trials, each using a different one of the following populations:
    - 250 nonsmoking men ages 18 to 25
    - 500 smoking and nonsmoking men and women ages 20 to 55
    - 300 smoking women ages 45 to 60

    Would you expect the results of these three experiments to be the same? Explain.

61. You have been asked to review and summarize three experiments regarding caffeine consumption and cancer.

    A. In experiment A, researchers looked at the incidence of colon cancer among 100 regular tea drinkers and 100 nontea drinkers in Japan, all between the ages of 18 and 38, and found that tea drinkers had less colon cancer than nontea drinkers.

    B. In experiment B, researchers looked at the incidence of pancreatic cancer among 300 heavy drinkers of yerba mate (*Ilex paraguensis*, a tree whose leaves and stems contain high levels of caffeine), 300 moderate yerba mate drinkers, and 300 non–yerba mate drinkers in Argentina, all between the ages of 40 and 60. This study showed that heavy yerba mate drinkers had higher levels of pancreatic cancer than moderate yerba mate drinkers, and moderate yerba mate drinkers had higher levels than nondrinkers.

    C. In experiment C, researchers looked at the levels of prostate cancer among men ages 40 to 80 in the United States. The study examined 1000 coffee drinkers and 1000 non-coffee drinkers and found slightly lower levels of prostate cancer among the coffee-drinking men.

    How do you summarize and reconcile these three experiments that have varying results with respect to the relationship between caffeine and cancer? Are some of them wrong?

62. You are testing the following hypothesis: left-handed people have better hand-eye coordination than right-handed people. Based on a review of literature, you have learned that one common test of hand-eye coordination is measuring the percentage of times that someone can drop a coin into a small container from a height of 3 feet. To perform this experiment, you use a group of 25 left-handed males, 25 right-handed males, 25 left-handed females, and 25 right-handed females. Design an experiment to test your hypothesis and be sure to define your independent and dependent variables.

63. Why does having a large sample size give more reliable results?

64. You have two experiments to review. One looks at 1,000 of the 1,000,000 rabbits in an area. The other study looks at 100 of the 100,000 wolves in an area. Is one study more statistically accurate than the other? Why or why not?

65. You read an article in the newspaper that says people who consume large amounts of red meat show an increased risk of having a heart attack. Is it correct, then, to say that red meat causes heart attacks? Why or why not? If not, what would be an appropriate conclusion?

66. Differentiate between a simple correlation and causation.

67. Imagine you are a journalist whose latest assignment is to write a magazine article on the latest findings about vaccines and autism. What are some of the concerns you might have about how best to convey such a vast amount of information to the general public?

68. Why would the media choose to report on one scientific study versus another? Is their decision always based in science?

69. A researcher wishes to determine the quantity of caffeine intake required to improve alertness. The participants are divided into two groups, with one group receiving a low dose of caffeine and the other group receiving a high dose of caffeine. The subjects are all coffee drinkers who regularly consume more than 100 mg of caffeine per day. All participants, however, are required to abstain from caffeine intake for 12 hours prior to the study. Caffeine is addictive and therefore causes unpleasant side effects when the user stops consuming it. Is the addictiveness of caffeine a potential problem in this study? Why or why not?

70. To differentiate between a simple correlation and causation, researchers often divide subjects into treatment and control groups and follow them for a number of years to see if one group has a higher incidence of disease than the other group. What is this type of study called?

71. Experiments with a small sample size are ____ likely to produce statistically significant results than experiments with a large sample size.

72. A hypothesis is a statement that

A) can be changed throughout the experiment.
B) can be avidly accepted by scientists.
C) can be tested and proven true.
D) can be tested and proven false.
E) precedes a theory.

73. Where are the most reliable scientific results published?
A) in the daily news
B) in science magazines
C) in science journals
D) on scientific websites
E) in peer-reviewed scientific journals

74. The scientific process from beginning to end can be outlined as:
A) hypothesize, test, analyze, and conclude.
B) observe, hypothesize, test, analyze, and conclude.
C) observe, question, test, analyze, and conclude.
D) observe, test, analyze, and conclude.
E) observe, test, hypothesize, analyze, and conclude.

75. Observations used as scientific evidence should NOT include
A) peer-reviewed scientific literature.
B) previous data generated.
C) observations about past work.
D) anecdotal evidence.
E) other people's data.

76. A hypothesis can be everything EXCEPT
A) proven true.
B) not supported.
C) supported.
D) falsifiable.
E) testable.

77. All of the following are true of a scientific hypothesis EXCEPT
A) it is an opinion.
B) it is an educated guess to explain an observation.
C) there must be a way to test the hypothesis.
D) there must exist a possibility of obtaining a result that could prove your hypothesis wrong.
E) there must exist a possibility of obtaining a result that could support your hypothesis.

78. Which of the following places the steps of the scientific process in the correct order?

A) experiment→questions→hypothesis→read literature→conclusions
B) questions→experiment→read literature→hypothesis→conclusions
C) read literature→experiment→questions→conclusion→hypothesis
D) questions→read literature→hypothesis→experiment→conclusions
E) read literature→questions→experiment→hypothesis→conclusions

79. What are the steps used in the process of a scientific study?

A) making initial observations that generate questions, studying the literature, generating hypotheses that are both testable and falsifiable, testing the hypothesis with experiments and analyzing the data, and making conclusions that are supported by data
B) generating hypotheses, conducting experiments, researching literature, making conclusions supported by the literature, and analyzing data
C) making initial observations that generate questions, generating hypotheses, studying the literature, conducting experiments based on literature, and making conclusions supported by data
D) generating hypotheses based on published literature, testing hypotheses, and making conclusions supported by data
E) None of the above.

80. What is the first step in the scientific process?

A) designing an experiment
B) choosing test subjects
C) peer review of your study
D) analyzing your data
E) formulating a hypothesis

81. What is the importance of peer review in the scientific process?

A) It helps a scientist formulate a hypothesis.
B) It helps a scientist choose test subjects.
C) It ensures that a study has been appropriately designed and correctly interpreted.
D) It helps the scientist collect data.
E) It is the first step in any scientific study.

82. I notice that all the students in my class seem very drowsy 45 minutes into my class period. Knowing that it could not possibly be my lecture putting them to sleep, I consider other factors such as the fact that my class is at 5 P.M. and the sun is usually setting at that time of the day, which I think may make people drowsy. What type of evidence am I collecting in making this observation?

A) experimental
B) anecdotal
C) peer reviewed
D) coincidental
E) untestable

83. What are the criteria for a good hypothesis?

A) It must be realistic and have only one possible result.
B) It must have only one possible result and be peer reviewed.
C) It must be based on anecdotal evidence and be testable.
D) It must be based on peer-reviewed journal articles and be realistic.
E) It must be testable and falsifiable.

84. Based on previous published data and some preliminary experiments done in my lab, I hypothesize that a drug called “shrinkase” will inhibit the growth of a particular type of cancerous tumor. What is my next step in the scientific process?

A) find people with that kind of tumor
B) obtain a large supply of shrinkase
C) determine what my control and experimental groups will be
D) submit my hypothesis for peer review
E) analyze the results of my experiments

85. What conclusions can be drawn from a hypothesis?

A) If evidence supports the hypothesis, the hypothesis is considered scientific theory.
B) If evidence rejects the hypothesis, then it can be removed from the list of possible answers to the original question.
C) If data support the hypothesis, then it is accepted and further testing is not warranted.
D) If there is data to support the hypothesis, then it is accepted until further testing suggests otherwise.
E) Both B and D.

86. Evidence that is not based on systematic scientific study is known as ____ evidence.
A) empirical
B) causational
C) anecdotal
D) logical
E) statistical

87. If the results of an experiment contradict the hypothesis, you have _____ the hypothesis.
A) supported
B) falsified
C) proved
D) failed
E) verified

88. Scientific journals send out potential articles to other scientists working in the same research area, and those scientists make comments regarding the research. This is known as
A) jurisprudence.
B) peer rebuttal.
C) journalistic integrity.
D) journalistic license.
E) peer review.

89. A hypothesis must be ____ and _____.
A) logical; verifiable
B) logical; falsifiable
C) testable; logical
D) irrefutable; testable
E) testable; falsifiable

90. You have the following known facts: Smoking causes accumulation of materials in the lungs, thereby decreasing oxygen-absorbing capability of the lungs. Long-term smoking causes more accumulation of materials in the lungs. Decreased lung capacity increases the workload of the heart. Which of the following hypotheses can you make from these observations?

A) People who never smoke will never develop lung problems.
B) Long-term smokers have poorer heart health than nonsmokers.
C) New smokers have poorer heart health than long-term smokers.
D) Stopping smoking eliminates lung problems within two years.
E) Stopping smoking eliminates heart problems within two years.

91. A controlled experiment describes the use of

A) separate control and experimental groups.
B) precise measurements.
C) accurate and careful measurements.
D) more than one variable changing separately.
E) careful testing of the hypothesis.

92. In a controlled experiment, the control and experimental groups differ in the

A) environmental variable.
B) controlled variable.
C) independent variable.
D) dependent variable.
E) result.

93. A placebo is given to the:

A) dependent group.
B) control group.
C) independent group.
D) experimental group.
E) variable group.

94. In a controlled experiment usually only one factor is changed, which is the

A) placebo.
B) controlled variable.
C) coordinate variable.
D) independent variable.
E) dependent variable.

95. A study is conducted to see if walking reduces joint stiffness in people suffering from arthritis of the knee. Half the participants are instructed to walk an additional 1 mile every day, while the other half are told to go about their normal daily routine with no additional exercise. In this study, the group that walks an extra mile every day is referred to as the

A) control group.
B) experimental group.
C) placebo group.
D) dependent group.
E) independent group.

96. A study was conducted to determine if the growth rate of babies differs between babies that are bottle-fed and babies that are breast-fed. In this experiment, growth rate is referred to as the

A) controlled variable.
B) experimental variable.
C) dependent variable.
D) independent variable.
E) placebo variable.

97. Two groups of people are given a drug that they are told will make them drowsy. However, only one group actually receives this drug, while the other group secretly receives a sugar pill. Strangely, both groups report feeling very tired 30 minutes later. The group receiving the sugar pill is said to be experiencing the

A) control effect.
B) experimental effect.
C) dependent effect.
D) independent effect.
E) placebo effect.

98. What is the importance of a placebo?

A) It allows the researcher to treat control and experimental groups differently while allowing them to believe they are being treated the same.
B) It allows the researcher to treat control and experimental groups the same while allowing them to believe they are being treated differently.
C) It allows the researcher to use an experimental drug on more people.
D) It removes the need for a control group.
E) All of the above.

99. In a well-designed experiment the independent variable
A) does not depend on another factor or condition.
B) changes from subject to subject randomly.
C) can never be manipulated by the researcher.
D) will depend on the dependent variable.
E) None of the above.

100. Use the following information to answer this question:

A scientific study looked at the effect of tanning beds on DNA damage. The scientists took skin cells and exposed them to UV radiation (the type used in indoor tanning beds) for different lengths of time: some for 1 minute, some for 5 minutes, some for 15 minutes, and some for 30 minutes. They then looked for signs of DNA damage and compared the results to cells that had never been exposed to UV light.

What is the independent variable in this experiment?
A) the number of skin cells
B) the type of light
C) the length of time the cells are exposed to UV light
D) the untreated cells
E) the amount of DNA damage in the cells

101. Use the following information to answer this question:

A scientific study looked at the effect of tanning beds on DNA damage. The scientists took skin cells and exposed them to UV radiation (the type used in indoor tanning beds) for different lengths of time: some for 1 minute, some for 5 minutes, some for 15 minutes, and some for 30 minutes. They then looked for signs of DNA damage and compared the results to cells that had never been exposed to UV light.

What is the control in this experiment?
A) the number of skin cells
B) the type of light
C) the length of time the cells are exposed to UV light
D) the untreated cells
E) the amount of DNA damage in the cells

102. You finish a research project and submit your findings to a journal for peer review. The reviewers decide that they do not think your experimental results were convincing enough to support or disprove your hypothesis. What is your next step?

A) cry
B) formulate a new hypothesis that better fits your data
C) design and carry out more experiments to support or disprove your hypothesis
D) reanalyze your data
E) fix your results so they better fit your hypothesis

103. A controlled experiment must

A) have a dependent variable.
B) have an independent variable.
C) be falsifiable.
D) be repeatable.
E) All of the above.

104. Which of the following is an example of an everyday (nonscientific) theory?

A) Objects are attracted to one another by gravity.
B) Broccoli tastes better than cauliflower.
C) All life forms are related to each other through common ancestry.
D) All living things are made of cells.
E) The universe was created from a large cosmic explosion.

105. Which is NOT an everyday (nonscientific) theory?

A) If you carry an umbrella it won't rain.
B) Evolution occurs by natural selection.
C) The freezer is the best place for valuables.
D) Wearing bright clothes cheers one up.
E) 3,000 subjects perform better after a full night's sleep.

106. Which of the following is NOT a scientific theory?

A) Cells come from pre-existing cells.
B) Objects are attracted to one another by gravity.
C) A hypothesis supported by results from an experiment with 3,000 subjects.
D) All life forms are related to each other through common ancestry.
E) The universe was created from a large cosmic explosion.

107. A hypothesis is
A) an idea that has been rigorously tested and never been disproven.
B) an idea that has been rigorously tested and only been disproven a few times.
C) an idea that can be tested and falsified.
D) an opinion.
E) an idea based on a person's experience or knowledge.

108. A scientific theory is
A) a hypothesis that has been rigorously tested and never been disproven.
B) a hypothesis that has been rigorously tested and only been disproven a few times.
C) a hypothesis that has been tested at least five times.
D) an opinion.
E) an idea based on a person's experience or knowledge.

109. A scientific theory
A) is a hypothesis that has been upheld by many experiments.
B) is an uneducated guess.
C) has not been tested.
D) is an educated guess.
E) can never be proven wrong.

110. I observe that squirrels that live in the southeastern United States are much thinner than squirrels that live in the northeastern part of the country. I theorize that this is because the squirrels that live in the northeast have greater fat reserves for the winter months when food is scarce. Is this a scientific theory?
A) Yes, it is a good educated guess.
B) Yes, I am taking into consideration physiological reasons for their larger size, so it's scientific.
C) No, it's just a hypothesis; it has not been proven to be true through extensive experimentation or quantification.
D) No, it cannot be proven true.
E) Yes, I theorized it so it qualifies as a theory.

111. An idea that has been examined numerous times and has never been falsified may be called a
A) theory.
B) hypothesis.
C) conclusion.
D) conundrum.
E) ideology.

112. In everyday usage, the word “theory” is used to mean an untested idea. Which of the following scientific terms is most similar to the everyday usage of “theory”?

A) concept
B) conclusion
C) observation
D) hypothesis
E) theory

113. In a scientific study evaluating the beneficial effects of caffeine on the elderly, who would be the best subjects to test?

A) elderly men and women
B) elderly women
C) pregnant women
D) elderly men
E) teenagers

114. Studies involving the benefits or risks of drinking coffee may be obscured by

A) side effects of caffeine.
B) how the coffee was roasted or processed.
C) other chemicals in coffee.
D) the age of the people studied.
E) All of the above.

115. Studies involving coffee drinking have shown

A) a link to pancreatic cancer.
B) no link to pancreatic cancer.
C) a link to infertility.
D) a lowering of the incidence of ovarian cancer.
E) All of the above.

116. Two studies were carried out to determine if children in daycare got more ear infections than children who stayed at home. The first study compared ear infection rates in 50 Canadian girls ages 1 to 2, half of whom attended daycare and half of whom stayed home. The second study compared ear infection rates in 1000 Swedish boys ages 3 to 4, half of whom attended daycare and half of whom stayed home. The results of these two studies differed greatly.

Which of the following is LEAST likely to be the cause of such differences?

A) different genders
B) different mothers
C) different ages
D) different sample sizes
E) different countries

117. Would it be possible for a scientist to bias a scientific study?

A) No, there are so many checks and balances outside of the scientist's control that it's impossible to show bias in a scientific study.
B) No, because all scientific experiments are designed to be fair.
C) Yes, if the scientist used a large number of test subjects.
D) Yes, if the scientist chose specific individuals to include in the study.
E) Yes, if it was a randomized double-blind study.

118. An experiment was performed using 1000 nonsmoking males ages 18 to 22. Which of the following experimental groups would most likely produce the most similar results?

A) 800 nonsmoking females ages 30 to 45
B) 800 smoking males ages 30 to 45
C) 1000 smoking females ages 25 to 40
D) 1000 nonsmoking males ages 30 to 55
E) 800 nonsmoking males ages 20 to 25

119. Increasing a sample size

A) provides more reliable data.
B) increases likelihood of getting a positive result.
C) increases likelihood of getting a negative result.
D) provides better variables.
E) provides better controls.

120. In a clinical trial with 400 subjects, the most reliable results would be obtained if ____subjects were in the experimental group and ____in the control.

A) 200; 200
B) 300; 100
C) 100; 300
D) 350; 50
E) 50; 350

121. Statistical significance

A) indicates a high likelihood that your results are due to your treatment versus due to chance.
B) is more likely to be reliable if you have a small sample size versus a large sample size.
C) is a requirement of the data from a scientific experiment.
D) indicates that the hypothesis should be rejected.
E) depends on large data sets.

122. In designing a scientific research project, the ideal control group should

A) be identical to the placebo group.
B) be identical to the experimental group but receive the placebo.
C) receive the placebo or receive no experimental manipulation.
D) be identical to the experimental group.
E) be identical to the independent variable.

123. Increasing sample size increases

A) the control group.
B) the experimental group.
C) randomness.
D) reliability of data.
E) variation.

124. A significant result from a scientific study indicates

A) a statistical error.
B) it occurred by chance.
C) a positive result.
D) a negative result.
E) a nonrandom result.

125. A large sample size is important for all of the following reasons EXCEPT
A) large sample sizes reduce the possibility that results are due to chance alone.
B) large sample sizes increase the likelihood of finding a statistically significant result.
C) large sample sizes make the results more reliable.
D) large sample sizes increase the accuracy of the results.
E) large sample sizes increase the likelihood that a very rare result will be noticed.

126. Which sample group would give the most statistically significant data?
A) 10 individual mice each tested once
B) one mouse tested 10 times
C) one pig
D) five pigs each tested five times
E) one mouse tested 100 times

127. A small sample size
A) will likely yield a high degree of statistical significance.
B) is unacceptable in scientific studies.
C) is usually a benefit to researchers.
D) does not allow the use of dependent and independent variables.
E) None of the above.

128. What is/are the major factor(s) affecting the strength of a conclusion?
A) sample size
B) independent variable
C) dependent variable
D) the type of study carried out
E) Both A and D.

129. I carried out a series of experiments testing the effect of caffeine on mice. I used two mice. I fed one mouse caffeinated water and fed the other plain water. I then measured the ability of each mouse to find its way through a maze. I timed their progress. My results were exciting and conclusive, the caffeinated mouse found his way through the maze much more rapidly and accurately than the noncaffeinated mouse. I sent my results to a peer-reviewed journal but they rejected my paper. They said the results were not valid. Why?
A) I should have let the mice go through the maze at different times.
B) I should have given the mouse different amounts of caffeine.
C) I didn't use the right form of caffeine.
D) I didn't have enough mice in the study.
E) None of the above.

130. You are reviewing the results of five similar experiments, but each had a different sample size. Which of the following experiments has the most reliable results?

A) the experiment with a sample size of 10
B) the experiment with a sample size of 100
C) the experiment with a sample size of 1,000
D) the experiment with a sample size of 10,000
E) the experiment with a sample size of 100,000

131. Scientific studies involving a subjectively assessed benefit (i.e., caffeine and enhanced memory recall) can be complicated by

A) too few observations.
B) improper controls.
C) poor subject selection.
D) side effects from the drug.
E) All of the above.

132. You conduct an experiment to test the effectiveness of a new drug in controlling blood sugar levels in diabetics. Unfortunately, half the participants experienced nausea. Nausea would be considered

A) a control effect.
B) an experimental effect.
C) a tangential effect.
D) a side effect.
E) a placebo effect.

133. All of the following are true of side effects EXCEPT

A) side effects may make data interpretation difficult.
B) side effects are unintended results.
C) side effects are usually considered problematic.
D) side effects always invalidate the results of the study.
E) side effects may vary from person to person.

134. Many chemicals can cause positive reactions in the human system but may also cause a variety of negative effects. These are called

A) side effects.
B) causal effects.
C) peripheral effects.
D) homeopathic effects.
E) indirect effects.

135. Scientific studies within a single ethnic population
A) demonstrate cause and effect for that population only.
B) may miss correlations in other ethnicities.
C) are usually done to determine cause and effect for all populations.
D) can be extrapolated to other ethnicities.
E) show links between multivariables in that population.

136. A positive correlation on a memory test and drinking coffee would show
A) decreasing coffee consumption correlates with increasing memory test score.
B) increasing coffee consumption correlates with increasing memory test score.
C) decreasing coffee consumption has no relationship to memory test score.
D) increasing coffee consumption correlates with decreasing memory test score.
E) no change on memory test score with or without coffee.

137. If you read about several studies on the effectiveness of a new drug to treat diabetes, which of the following would give you the most confidence in the results?
A) one study with 50 people
B) one study with 500 people
C) one study with 1000 people
D) three studies done the same way, each with 50 people
E) three studies done the same way, each with 1000 people

138. A correlation in a scientific study indicates
A) insufficient data.
B) a cause and effect between variables.
C) a clear link between two variables.
D) a possible link between two variables.
E) the necessity for a new hypothesis.

139. A negative correlation in a scientific study means
A) one variable causes a change in another variable.
B) one variable is linked to another variable.
C) one variable increases while the other decreases.
D) there is no link between the variables studied.
E) both variables decrease proportionately.

140. A positive correlation in a scientific study means
A) both variables increase proportionately.
B) one variable is linked to another variable.
C) one variable increases while the other decreases.
D) there is a link between the variables studied.
E) both variables decrease proportionately.

141. Based on Infographic 1.7, which statement is TRUE?
A) Parkinson's disease is caused by drinking too much coffee.
B) Parkinson's disease is reduced by drinking coffee.
C) Japanese male coffee drinkers have a lower incidence of Parkinson's disease than Japanese males who do not drink coffee.
D) Japanese coffee drinkers have a lower incidence of Parkinson's disease than Japanese who do not drink coffee.
E) There is no link between caffeine and Parkinson's disease.

142. Correlation is
A) a problem encountered when the drug under study causes many different reactions.
B) a type of study in which researchers examine what happens to a group of people over time.
C) when one variable causes an observed result.
D) when two variables are related to one another in a predictable manner.
E) when the effect of one variable hides the effect of the other variable.

143. You are a researcher studying alcohol intake and smoking. You find that as alcohol intake increases, the number of cigarettes smoked also increases. Which of the following is an appropriate conclusion?
A) Alcohol consumption causes smoking.
B) Smoking causes alcohol consumption.
C) Alcohol consumption and smoking are not related.
D) Alcohol consumption and smoking are correlated.
E) No appropriate conclusions can be drawn from this study.

144. Which published scientific data would be most reliable?
A) A local daily newspaper
B) A website
C) A drug company's clinical trial results
D) A popular scientific magazine
E) A peer-reviewed scientific journal

145. Peer review means what in relation to scientific journals?
A) Review by specialists in the field
B) Review by the editor
C) Review by top scientists
D) Review by an editorial board
E) Review by people of the same age, gender, and ethnicity

146. Some of the issues faced by media personnel when reporting the latest scientific findings include all of the following EXCEPT
A) simplifying complex issues.
B) conveying information clearly.
C) avoiding misunderstandings.
D) determining what is most important about a study.
E) communicating the researcher's opinion about the study.

147. Rank the following in order from *most* reliable to *least* reliable sources of information.
A) scientific journals→magazine article written by scientist→magazine article written by journalist→public opinion
B) scientific journals→magazine article written by journalist→magazine article written by scientist→public opinion
C) magazine article written by scientist→scientific journal→magazine article written by journalist→public opinion
D) magazine article written by scientist→scientific journal→public opinion→magazine article written by journalist
E) magazine article written by scientist→magazine article written by journalist→scientific journal→public opinion

148. Why do some media reports about scientific discoveries end up being exaggerations?
A) Findings can be misunderstood and misinterpreted.
B) Some studies are not done using the proper controls or scientific method, so they are unreliable; however, journalists often do not realize the distinction.
C) Media reports can come from sources that are not peer reviewed.
D) Media agencies may sensationalize news to draw more attention.
E) All of the above.

149. Which news source is the most reliable source of scientific advances?
A) Wikipedia
B) A peer-reviewed scientific journal
C) A newspaper
D) A popular science news website
E) The evening television news

150. Which of the following plays a factor in misrepresentation of research data in the media?
A) lack of understanding of the topic by the reporter
B) overstating the importance of the study results by the researcher
C) misinterpretation of the scientific terminology when trying to disseminate it to the public
D) time and space limitations by the media
E) All of the above.

151. Caffeine can
A) help enhance memory.
B) cause anxiety.
C) cause seizures.
D) increase urination.
E) All of the above.

152. Some side effects of caffeine are
A) vomiting.
B) fevers.
C) confusion.
D) fever.
E) All of the above.

153. Which of the following is NOT considered to be a side effect of caffeine consumption?
A) dehydration
B) rapid breathing
C) ringing in ears
D) memory enhancement
E) twitching

154. Side effects of caffeine may include all of the following EXCEPT
A) shaking.
B) irregular heartbeat.
C) frequent urination.
D) slower breathing.
E) anxiety.

155. Epidemiologists
A) study the incidence of diseases and risk factors in populations.
B) investigate skin diseases.
C) perform clinical trials on health issues.
D) examine autopsy data.
E) assess cancer treatments and survival outcomes.

156. Pitfall(s) to avoid from the analysis of data from single epidemiological studies is/are
A) nonrandomized subjects.
B) too small of a sample size.
C) disease complexity.
D) lack of proper controls.
E) All of the above.

157. Epidemiological studies
A) are the least common form of human health study.
B) have a small number of participants.
C) are used when manipulating people is unethical.
D) make conclusions based on laboratory studies.
E) are usually very expensive to conduct.

158. All of the following are true of a clinical trial EXCEPT
A) participants are randomly assigned to different treatment groups.
B) it can often be conducted with a large survey.
C) it can be very expensive.
D) it can be difficult to get participants to adhere to the treatment regime.
E) it can be unethical if the treatment group can cause serious harm.

159. The study of the incidence of disease in a population that cannot be directly manipulated is called
A) an experiment.
B) population biology.
C) evolutionary biology.
D) epidemiology.
E) systemic biology.

160. Do epidemiologists perform planned scientific experiments with rigorous controlled experimentation?
A) Yes, they work in labs and perform lab experiments to prove their hypothesis.
B) Yes, they use the standard scientific method.
C) No, they only form a hypothesis but do not analyze or compile any data.
D) No, they examine data that have already been compiled and look for patterns.
E) No, they only do uncontrolled experiments.

161. An epidemiologist looks at a compilation of studies done at a medical center in which they have catalogued the lifestyle and habits of thousands of women. When she looks at the women in this group who have contracted breast cancer versus those who are healthy, she finds that women who have breast cancer drink more milk then those who do not have cancer. Does this mean drinking milk causes breast cancer?
A) Yes, if there is a correlation between the two, milk causes cancer.
B) Yes, an epidemiologist uses statistics to look at populations, so it is not a coincidence.
C) No, just because there is a correlation, it does not mean that milk is the cause of the cancer.
D) No, it's just a coincidence; correlations never indicate a cause-and-effect relationship.
E) None of the above.

162. You should not use just one epidemiological study to make policy decisions because
A) diseases are complex.
B) all variables cannot be controlled in one study.
C) sample size can affect accuracy.
D) one population may not be representative of the entire population.
E) All of the above.

Answer Key

1. C
2. B
3. E
4. B
5. C
6. D
7. B
8. C
9. C
10. B
11. E
12. B
13. E
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72. D
73. E
74. B
75. D
76. A
77. A
78. D
79. A
80. E
81. C
82. B
83. E
84. C
85. E
86. C
87. B
88. E
89. E
90. B

91. A
92. C
93. B
94. D
95. B
96. C
97. E
98. A
99. A
100. C
101. D
102. C
103. E
104. B
105. B
106. C
107. C
108. A
109. A
110. C
111. A
112. D
113. A
114. E
115. E
116. B
117. D
118. E
119. A
120. A
121. A
122. B
123. D
124. E
125. E
126. A
127. E
128. E
129. D
130. E
131. E
132. D
133. D
134. A
135. B
136. B

137. E
138. D
139. C
140. A
141. C
142. D
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152. E
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155. A
156. E
157. C
158. B
159. D
160. D
161. C
162. E