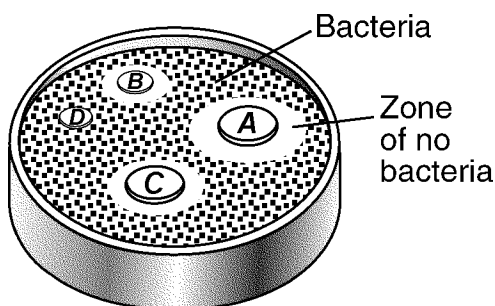


Name: _____

UNIT: SCIENTIFIC INQUIRY

- 1) Which statement *best* describes a scientific theory?
- 1) It is a scientific fact that no longer requires any evidence to support it.
 - 2) It is a collection of data designed to provide support for a prediction.
 - 3) It is an educated guess that can be tested by experimentation.
 - 4) It is a general statement that is supported by many scientific observations.
- 2) In 1910, Thomas Morgan discovered a certain pattern of inheritance in fruit flies known as sex linkage. This discovery extended the ideas of inheritance that Gregor Mendel had discovered while working with garden peas in 1865. Which principle of scientific inquiry does this illustrate?
- 1) A control group must be part of a valid experiment.
 - 2) The same experiment must be repeated many times to validate the results.
 - 3) Scientific explanations can be modified as new evidence is found.
 - 4) Values can be used to make ethical decisions about scientific discovery.
- 3) 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?
- 1) using what is already known about the enzyme
 - 2) doing research in a library
 - 3) having discussions with other scientists
 - 4) completing a data table of expected results
- 4) The development of an experimental research plan should *not* include a
- 1) list of safety precautions for the experiment
 - 2) list of equipment needed for conducting the experiment
 - 3) conclusion based on data expected to be collected in the experiment
 - 4) procedure for the use of technologies needed for the experiment
- 5) Which source would provide the *most* reliable information for use in a research project investigating the effects of antibiotics on disease causing bacteria?
- 1) a current professional science journal article on the control of pathogens
 - 2) the local news section of a newspaper from 1993
 - 3) a news program on national television about antigens produced by various plants
 - 4) an article in a weekly news magazine about reproduction in pathogens
- 6) A biologist used the Internet to contact scientists around the world to obtain information about declining amphibian populations. He was able to gather data on 936 populations of amphibians, consisting of 157 species from 37 countries. Results showed that the overall numbers of amphibians dropped 15% a year from 1960 to 1966 and continued to decline about 2% a year through 1997.
- What is the importance of collecting an extensive amount of data such as this?
- 1) Results from all parts of the world will be found to be identical.
 - 2) The quantity of data will lead to a better understanding of the extent of the problem.
 - 3) Researchers will now be certain that the decline in the amphibian populations is due to pesticides.
 - 4) The data collected will prove that all animal populations around the world are threatened.
- 7) 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?
- 1) 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
 - 2) injecting 1 mL of drug A into 100 white mice with cancer and 0.5 mL of drug X into white mice without cancer
 - 3) 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
 - 4) injecting 1 mL of drug A into 100 white mice with cancer
- 8) Which of the following statements *best* describes a controlled experiment?
- 1) It avoids the use of variables.
 - 2) It eliminates the need for dependent variables.
 - 3) It shows the effect of a dependent variable on an independent variable.
 - 4) It tests the effect of a single independent variable.
- 9) The first trial of a controlled experiment allows a scientist to isolate and test
- 1) a logical conclusion
 - 2) a single variable
 - 3) a variety of information
 - 4) several variables

- 10) Students were asked to determine if they could squeeze a clothespin more times in a minute after resting than after exercising. An experiment that accurately tests this question should include all of the following *except*
- 1) a large number of students
 - 2) two sets of clothespins, one that is easy to open and one that is more difficult to open
 - 3) a hypothesis on which to base the design of the experiment
 - 4) a control group and an experimental group with equal numbers of students of approximately the same age
- 11) An experiment was carried out to determine which mouthwash was most effective against bacteria commonly found in the mouth. Four paper discs were each dipped into a different brand of mouthwash. The discs were then placed onto the surface of a culture plate that contained food, moisture, and bacteria commonly found in the mouth. The diagram below shows the growth of bacteria on the plate after 24 hours.



- Which change in procedure would have improved the experiment?
- 1) using the same size paper discs for each mouthwash
 - 2) using the same type of mouthwash on each disc
 - 3) using bacteria from many habitats other than the mouth
 - 4) using a smaller plate with less food and moisture
- 12) Which of the following statements most accurately describes scientific inquiry?
- 1) It does not allow scientists to judge the reliability of their sources.
 - 2) It ignores information from other sources.
 - 3) It may lead to explanations that combine data with what people already know about their surroundings.
 - 4) It should never involve ethical decisions about the application of scientific knowledge.
- 13) Researchers performing a well-designed experiment should base their conclusions on
- 1) the hypothesis of the experiment
 - 2) results predicted before performing the experiment
 - 3) a small sample size to insure a reliable outcome of the experiment
 - 4) data from repeated trials of the experiment

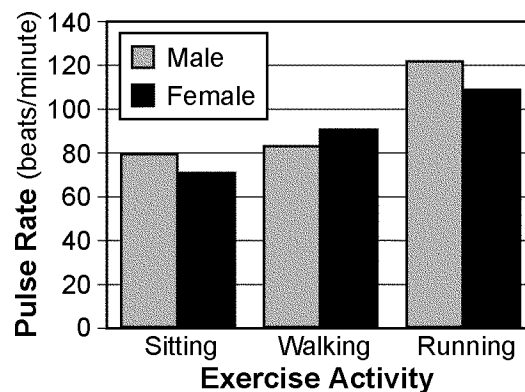
- 14) A science researcher is reviewing another scientist's experiment and conclusion. The reviewer would most likely consider the experiment invalid if
- 1) other individuals are able to duplicate the results
 - 2) it contains conclusions not explained by the evidence given
 - 3) the sample size produced a great deal of data
 - 4) the hypothesis was not supported by the data obtained
- 15) The data in the table below were collected during a reaction time experiment conducted in five biology classes. Average reaction times for each class were determined first at room temperature and then after cooling each student's hand in cold water for two minutes.

Average Reaction Times to Grab a Falling Ruler

Class	At Room Temperature (seconds)	After Cooling (seconds)
1	0.42	0.48
2	0.36	0.41
3	0.35	0.47
4	0.43	0.58
5	0.44	0.47
AVERAGE	0.40	0.48

Which statement is *best* supported by the data?

- 1) Cooling the hand increases the reaction time.
 - 2) Cooling the hand does not affect the reaction time.
 - 3) Cooling the hand affects only some subjects.
 - 4) Two minutes of cooling is not enough to affect reaction time.
- 16) In an investigation, 28 students in a class determined their pulse rates after performing each of three different activities. Each activity was performed three times during equal time intervals. The average results are shown in the graph below.



Before constructing the graph shown, it would have been most helpful to organize the results of the investigation in

- 1) an equation
- 2) an energy pyramid
- 3) a research plan
- 4) a data table

- 17) A scientist conducted an experiment in which he fed mice large amounts of the amino acid cysteine. He observed that this amino acid protected mouse chromosomes from damage by toxic chemicals. The scientist then claimed that cysteine, added to the diet of all animals, will protect their chromosomes from damage. State whether or not this is a valid claim. [*Support your answer.*]

- 18) A student performed an experiment to determine if treating 500 tomato plants with an auxin (a plant growth hormone) will make them grow faster. The results are shown in the table below.

Days	Average Stem Height (cm)
1	10
5	13
10	19
15	26
20	32
25	40

Explain why the student can *not* draw a valid conclusion from these results.

- 19) The concentration of salt in water affects the hatching of brine shrimp eggs. Brine shrimp eggs will develop and hatch at room temperature in glass containers of salt solution. Describe a controlled experiment using three experimental groups that could be used to determine the best concentration of salt solution in which to hatch brine shrimp eggs. Your answer must include at least:
- (1) a description of how the control group and each of the three experimental groups will be different
 - (2) *two* conditions that must be kept constant in the control group and the experimental groups
 - (3) data that should be collected
 - (4) *one* example of experimental results that would indicate the *best* concentration of salt solution in which to hatch brine shrimp eggs

- 20) A scientist wants to determine the best conditions for hatching brine shrimp eggs. In a laboratory, brine shrimp hatch at room temperature in glass containers of salt water. The concentration of salt in the water is known to affect how many brine shrimp eggs will hatch.

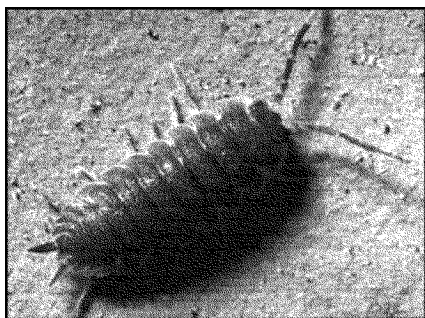
Design an experiment to determine which of three saltwater concentrations (2%, 4%, or 6%) is *best* for hatching brine shrimp eggs. In your experimental design, be sure to:

- (1) State how many containers to use in the experiment, and describe what would be added to each container in addition to the eggs.
 - (2) State *two* factors that must be kept constant in all the containers.
 - (3) State what data must be collected during this experiment.
 - (4) State *one* way to organize the data so that they will be easy to analyze.
 - (5) Describe a result that would indicate the best salt solution for hatching brine shrimp eggs.
- 21) You have been assigned to design an experiment to determine the effects of light on the growth of tomato plants. In your experimental design be sure to:
- (1) State *one* hypothesis to be tested.
 - (2) Identify the independent variable in the experiment.
 - (3) Describe the type of data to be collected.
- 22) A certain plant has white flower petals and it usually grows in soil that is slightly basic. Sometimes the plant produces flowers with red petals. A company that sells the plant wants to know if soil pH affects the color of the petals in this plant.

Design a controlled experiment to determine if soil pH affects petal color. In your experimental design be sure to:

- (1) State the hypothesis to be tested in the experiment.
- (2) State *one* way the control group will be treated differently from the experimental group.
- (3) Identify *two* factors that must be kept the same in both the control group and the experimental group.
- (4) Identify the dependent variable in the experiment.
- (5) State *one* result of the experiment that would support the hypothesis.

- 23) The photograph below shows a pill bug. Pill bugs are small animals frequently found in wooded areas near decomposing organic material.



Describe some parts of an experiment designed to determine the preference of pill bugs for light or darkness. In your answer be sure to:

- (1) State a hypothesis.
 - (2) Identify the independent variable in the experiment.
 - (3) Identify *two* conditions that should be kept the same in all experimental setups.
 - (4) State *one* example of experimental data that would support your hypothesis.
- 24) The drugs usually used to treat high blood pressure do not affect blood vessels in the lungs. Bosentan is a new drug being studied as a treatment for high blood pressure in the lungs. In an experiment, patients treated with bosentan showed an improvement in the distance they could walk without fatigue within 12 weeks.
- Design an experiment to test the effectiveness of bosentan as a drug to treat high blood pressure in the lungs. In your answer be sure to:
- (1) State the hypothesis your experiment will test.
 - (2) State how the control group will be treated differently from the experimental group.
 - (3) State *two* factors that must be kept the same in both the experimental and control groups.
 - (4) State the type of data that should be collected to determine if the hypothesis is supported.
- 25) A student hypothesizes that the pulse rate of a person and background music that is playing are related. The student designs an experiment to test this hypothesis. What would be an appropriate control for this experiment?

- 26) A student hypothesized that the pulse rate in humans would increase 1 hour after eating a meal. Pulse rates were obtained from nine classmates 1 hour after eating lunch. The data in beats per minute were recorded as: 60, 64, 56, 68, 72, 76, 72, 80, and 68. State *one* error in this experiment.
- 27) An experiment was designed to see what effects ibuprofen would have on laboratory mice. Large numbers of male mice and an equal number of female mice were used in this investigation. The male mice were placed in an area with food and water. The female mice were placed in a separate area of the same size. The female mice were given additional food and water. The males were each given 100 milligrams of ibuprofen each day, mixed with their food, and the females were each given 50 milligrams of ibuprofen each day, mixed with their food.
- Identify *two* errors in the design of this investigation.
- 28) A student squeezed a clothespin as many times as possible in a 30-second time period. The student repeated this procedure nine more times in quick succession. The data obtained are in the chart below.

Trial	Number of Squeezes in 30 Seconds
1	32
2	29
3	28
4	27
5	26
6	25
7	23
8	21
9	19
10	17

State *one* hypothesis that this data would support concerning the relationship between number of trials and number of squeezes in 30 seconds.

Questions 29 and 30 refer to the following:

Two students collected data on their pulse rates while performing different activities. Their average results are shown in the data table below.

Data Table

Activity	Average Pulse Rate (beats/min)
sitting quietly	70
walking	98
running	120

29) Based on the data shown, state the relationship between activity and pulse rate.

32) 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.

	Average Daily Plant Height (mm)						
	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Pot <i>A</i> —5 plants	2	4	6	8	10	14	16
Pot <i>B</i> —10 plants	2	4	6	8	10	12	12
Pot <i>C</i> —20 plants	2	2	2	6	6	8	8

Analyze the experiment that produced the data shown in the table. In your answer be sure to:

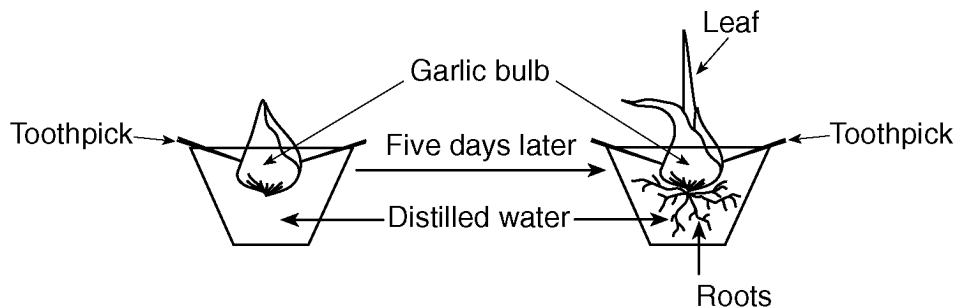
- (1) State a hypothesis for the experiment.
- (2) Identify *one* factor, other than pot size, that should have been kept the same in each experimental group.
- (3) Identify the dependent variable.
- (4) State whether the data supports or fails to support your hypothesis and justify your answer.

30) State *one* way that the investigation described could be improved.

31) A student squeezes and releases a clothespin as often as possible for 2 minutes and then takes his pulse for 20 seconds. After a 2-minute rest, he repeats the procedure. This pattern is repeated one more time. The student's 20-second pulse counts were 23, 26, and 21.

Based on the reading passage, what additional data should the student have collected in order to determine the effect of squeezing a clothespin on his pulse rate?

- 33) The diagram below illustrates the result of growing a garlic bulb in a cup of distilled water over five days.



Design an experiment consisting of a control and three different experimental groups to test the prediction, "Garlic grows better as the salt concentration of the solution in which it is grown increases." In your answer, be sure to:

- (1) Describe the control to be used in the experiment.
- (2) Describe the difference between the three experimental groups.
- (3) State *one* type of measurement that should be made to determine if the prediction is accurate.
- (4) Describe *one* example of experimental results that would support the prediction.

Questions 34 through 36 refer to the following:

YELLOW FEVER:

Paragraph A: 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.

Paragraph B: 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.

Paragraph C: 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.

Paragraph D: 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.

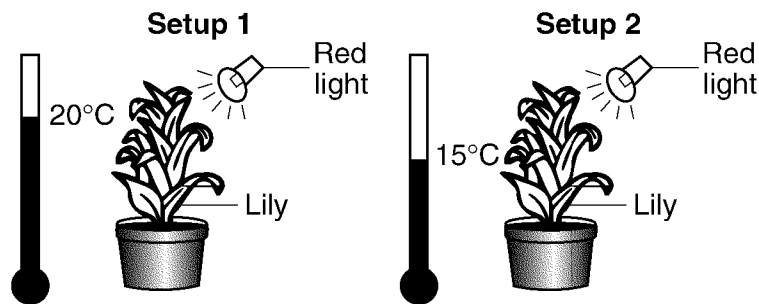
Paragraph E: Putting these facts together with other evidence, the team concluded that *Aedes calopus* spread the disease. The validity of this conclusion then had to be tested. All newly reported cases of yellow fever were promptly taken to well-screened hospitals and their houses were fumigated to 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.

- 34) State the problem the team of doctors in the given reading passage was trying to solve.
- 35) State *one* hypothesis from paragraph A that was tested by one of the experiments in the given reading passage.

- 36) Describe the control that should have been set up for the experiment described in paragraph C of the given reading passage.

Questions 37 and 38 refer to the following:

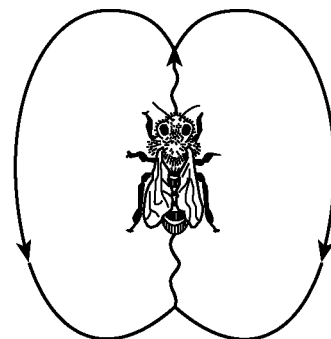
An investigation was carried out using the two setups below. Other than the difference shown in the diagram, all other conditions were identical.



- 37) (a) State *one* possible hypothesis that could be tested using the setups shown.
- (b) What data should be collected in order to test this hypothesis?
- 38) Describe *one* change that could be made in the investigation shown to improve it.

- 39) Honeybees have a very cooperative way of living. Scout bees find food, return to the hive, and do the "waggle dance" to communicate the location of the food source to other bees in the hive. The waggle, represented by the wavy line in the diagram below, indicates the direction of the food source, while the speed of the dance indicates the distance to the food. Different species of honeybees use the same basic dance pattern in slightly different ways as shown in the table below.

Number of Waggle Runs in 15 Seconds		Distance to Food (feet)
Giant Honeybee	Indian Honeybee	
10.6	10.5	50
9.6	8.3	200
6.7	4.4	1,000
4.8	2.8	2,000



Based on the given data, state the relationship between the distance to the food source and the number of waggle runs in 15 seconds.