Game Plan Science

Quickly Preview the Test Section, but Skip the Directions

Last-minute adjustments to the test format are theoretically (but not practically) possible, so check the subject test before you start to work, especially the number of passages, the number of items, and the time limit. And yes, the test-writers always tell you to "read the directions carefully." But they don't tell you that you have to read them during the test. Instead, become familiar with them before test day. That way, you won't waste 30 seconds or more (enough time to answer an item) re-reading directions you are already familiar with.

Personalize the Passage Order

You are not required to do the passages in the order in which they appear in the test booklet. You can do the first passage second, or fourth, or last; and you can do the last passage first or third. So, you have the flexibility of choosing which ones you will do before the others, and you'll want to do first those passages that seem easier. "Easier," in this context, is really a subjective matter; it means the ones with which you are most comfortable, either because of the type of presentation or the subject matter.

- First, do those passage formats that you find easiest to handle.
- Then, of the remaining passages, do the familiar ones.
- Finally, do the rest of the passages, from the simplest to the most complicated.

Put large numbers in the margins of the test booklet beside each passage to indicate where the passage comes in the order.

Read the Passage

For the Science Test, "reading the passage" means "reading through" the passage. You can't afford to study the passage, and don't forget that this is an "open-book" test. So, learn generally what is going on and where things are located. Then, let the items tell you where to look more carefully.

- Read any introductory paragraph(s). Not only does this material usually explain why an experiment is being conducted or data are being collected, but it often defines a key term that is essential to understanding the connections of the various parts of the passage.
- Examine any diagrams or schematics. The focus of a passage is often a device that includes beakers, tubing, switches, pulleys, test tubes, and other paraphernalia associated with science. Try to understand what the device is designed to accomplish and how the various parts work together.
- Look at the various subparts of the passage. The subparts are things such as experiments that change initial conditions, tables of data, and graphs. Do not try to fully understand these. Just get a general notion of what they do. For example, for a graph, read the title and the labels of the x- and y-axes. For tables, read the column heads and the titles of the rows. Do not, however, read specific values on a graph or in a table. There are too many of them, and only one or two are likely to be relevant to answering one of the few items based on that passage (compared to all the different questions that the test-writers could have chosen).

Answer the Items

Answer the question that is being asked. One of the most commonly made mistakes is to read the item stem carelessly and then answer the "wrong" question. It's just a matter of inattention, in which you respond to what you think you read rather than what is actually there on the page. Since wrong answers often correspond to wrong readings, if you make this mistake, you are probably going to find a pretty good answer—to the wrong question.

Pay attention to thought-reversers. "Thought-reversers" are words in the item stem like "NOT," "BUT," and "EXCEPT." These words turn the question upside-down. What is normally the right answer is now a wrong answer, and what is normally a wrong answer is the right answer. Circle these words or put stars beside them so that they get your attention again.

Locate the relevant information. The first and often last step in answering an item is to locate the information you need. Most item stems use a key word or phrase to tell you where to look. For example, "in Table 2" tells you that the information you need is located in Table 2; "the troposphere..." tells you that you need the graph, table, or description that supplies information about the troposphere; and "lowering the temperature" indicates that the answer is in the subpart of the passage that provides information about temperature.

Use the Answer Choices

Study the answer choices for guidance. The answer choices, like an item stem, can direct you to the subpart of the passage that contains the information you need. Consider the following item, in which only the answer choices are visible:

Example:

A. Sodium
B. Potassium
C. Lithium
D. Oxygen

With this array, you know to look at that table or graph or paragraph that includes that list of terms. The choices will also give you guidance as to what degree of precision is required by the item.

Often, the choices are ranges of values, such as $0.015w$ to $0.018w$, rather than specific values, such as simply $0.018w$. Do not look for more precision than the choices allow.

Read the answer choices carefully. The test-writers love to put in wrong answers that look right. For example, if a particular value doubles with a decrease in temperature from 40° to 20° (it doesn't matter what scale; this is just a sketch of a question), a question might ask: "Assuming the temperature rises from 20° to 40°, what happens to the value?" The correct answer is, of course: "The value is reduced by half." But you can bet that the wrong answers will include ideas like "doubles," "increases by one-fourth," and "decreases by four"—or some other variation on those ideas.

Eliminate Choices, Guess (If Necessary), and Move On

Do NOT spend too much time on any one item. Remember that you get +1 for the hardest item and +1 for the easiest item. The items that correspond to a Science passage tend to be arranged from easiest to most difficult. (This is not an absolute rule; it is just a useful tool.) The first item may ask you to find a single number in a table.

The second item may ask for a value that is the largest or smallest in a series. And the third item may require you to interpolate a value. Then, the going might get considerably more difficult. So, try the next item, and if it is completely whack, blow off the others and go to the next passage where the difficulty resets to the lowest setting. And don't forget: the ACT test has no penalty for guessing. If you find yourself stuck on a difficult item, eliminate as many choices as possible, guess, and move on!

40 questions in 35 mins.

LESSON

The passages and items in this section accompany the in-class review of the skills and concepts tested by the ACT Science Test. You will work through the items with your instructor in class. Answers are on page 690.

DIRECTIONS: Each passage below is followed by several items. After reading a passage, choose the best answer to each item. You may refer to the passages as often as necessary. You are NOT permitted the use of a calculator.

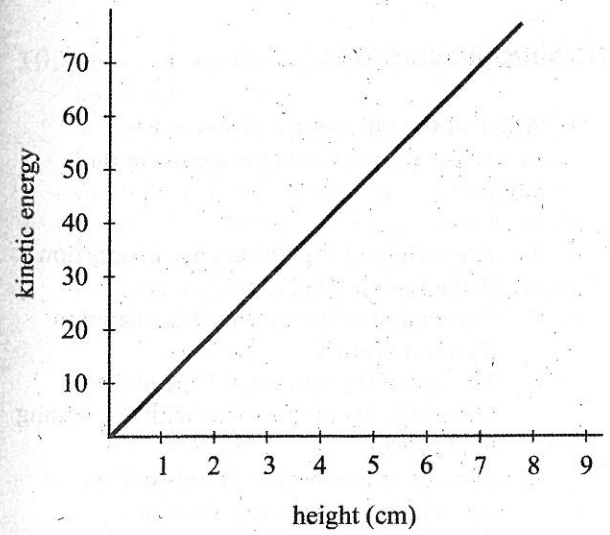
Data Representation Review and Strategies

Graphs

Graph Reading Strategies

Passage I

The kinetic energy of an object with mass m (measured in grams) after a fall from a height h (measured in centimeters) was recorded for different heights. A graph was made representing the kinetic energy versus height.



1. If the kinetic energy is given in units of $g \cdot cm^2 / s^2$ what units must the slope have?

   A. $g \cdot cm / s$
   B. $g \cdot cm / s^2$
   C. $s \cdot cm / g$
   D. $s^2 / (g \cdot cm)$

2. It is discovered that if we redo the experiment with an object with twice the mass, the kinetic energy obtained for every height is doubled. The slope of the new set of experiments can be obtained by doing what to the old slope?

   F. Multiplying by 2
   G. Dividing by 2
   H. Squaring
   J. Taking the square root

3. What would be the kinetic energy (in $g \cdot cm^2 / s^2$) of an object of mass m if it were dropped from a height of 4.5 cm?

   A. 4.5
   B. 9.0
   C. 45
   D. 90

Tables

Understanding the Nature of Data

Passage II

A scientist investigated the variables that affect the age at which a female of the animal species *taedi periculum* first gives birth. Some of the results of this study are summarized in the table below.

EXPERIMENT	TEMPERATURE (°C)	AVERAGE FOOD INTAKE (grams)	AGE WHEN FIRST GAVE BIRTH (months)
1	25	15	7
2	25	30	6
3	25	45	4
4	35	15	5
5	35	30	3
6	35	45	3

4. Which of the following would be good animals to use for the experiment?

F. Adult females
G. Newborn females
H. Newborn males
J. Adult males

5. Which of the pairs of experiments listed below would be useful for studying the effect of temperature on the age of first birth?

A. 1 and 2
B. 1 and 5
C. 1 and 4
D. 2 and 6

Recognizing Trends

6. If all other variables are kept constant, which of the following will result in an increase in the age at which the animals give birth?

F. Increase in temperature from 25°C to 35°C
G. Increase in food from 15 grams to 45 grams
H. Decrease in food from 30 grams to 15 grams
J. Increase in temperature from 25°C to 30°C

7. Which experiment was the control for temperature for Experiment 5?

A. Experiment 1
B. Experiment 2
C. Experiment 3
D. Experiment 6

8. If an experiment was set up with the temperature set at 30°C and the food intake at 30 grams, which of the following would be a reasonable prediction of the age in months of the animals when they first gave birth?

F. 7.5
G. 6.0
H. 4.5
J. 2.5

Drawing Conclusions

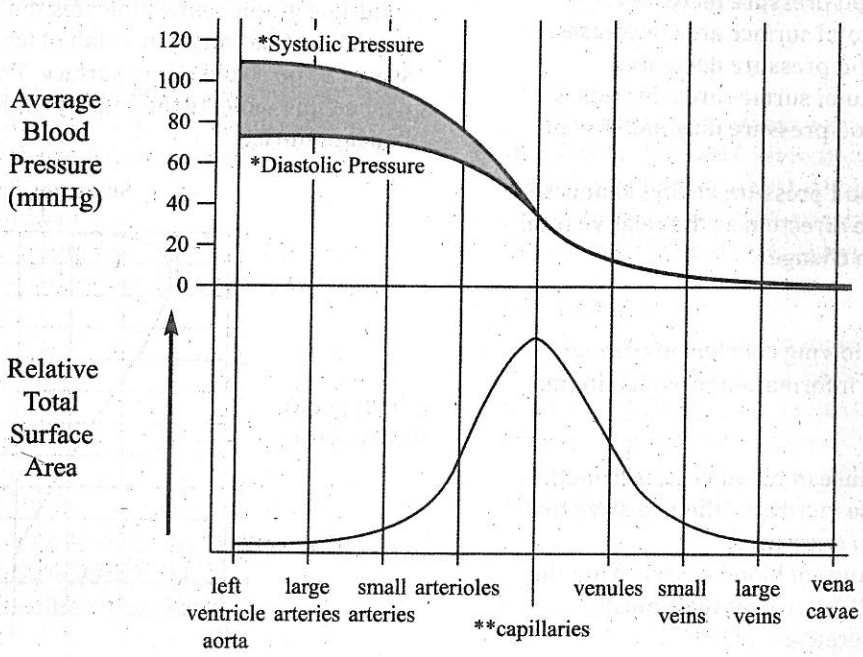
9. Which of the following conclusions is consistent with the data presented in the table?

A. The weight of the firstborn is proportional to the food intake.
B. The weight of the firstborn is related to the temperature.
C. The age of the mother at time of first offspring's birth increases with decreasing food intake.
D. The age of the mother at time of first offspring's birth decreases with decreasing food intake.

Typical Data Representation Items

Passage III

The chart below shows the average blood pressure and relative total surface area associated with the different types of human blood vessels.



*Pulse pressure is the difference between systolic and diastolic pressure.
**Blood velocity is lowest in the capillaries (averaging 3 cm/sec).

10. According to the diagram, pulse pressure can be detected:

F. in large arteries only.
G. in large arteries as well as in large veins.
H. in blood vessels between the aorta and the capillaries.
J. primarily in the arterioles, capillaries, and venules.

11. Based on the information in the diagram, which of the following conclusions about average blood pressure is correct?

A. The average blood pressure decreases continuously as it gets further away from the left ventricle.
B. The average blood pressure remains approximately the same as it passes through the different blood vessels of the body.
C. Starting at the aorta, average blood pressure first increases and then decreases.
D. The average blood pressure is highest in the blood vessels with the greatest relative total surface area.

12. Which of the following correctly states the relationship between the relative total surface area of different blood vessels and their average blood pressure?

F. As relative total surface area decreases, average blood pressure increases.
G. As relative total surface area decreases, average blood pressure decreases.
H. As relative total surface area decreases, average blood pressure may increase or decrease.
J. Average blood pressure always changes in the opposite direction as the relative total surface area changes.

13. Which of the following conclusions can be drawn from the information provided in the diagram?

A. As the distance of blood vessels from the left ventricle increases, their relative total surface area decreases.
B. As the distance of blood vessels from the left ventricle increases, their pulse pressure increases.
C. Blood vessels with the greatest relative total surface area have the highest pulse pressure.
D. Blood vessels closest to and farthest away from the left ventricle have the smallest relative total surface area.

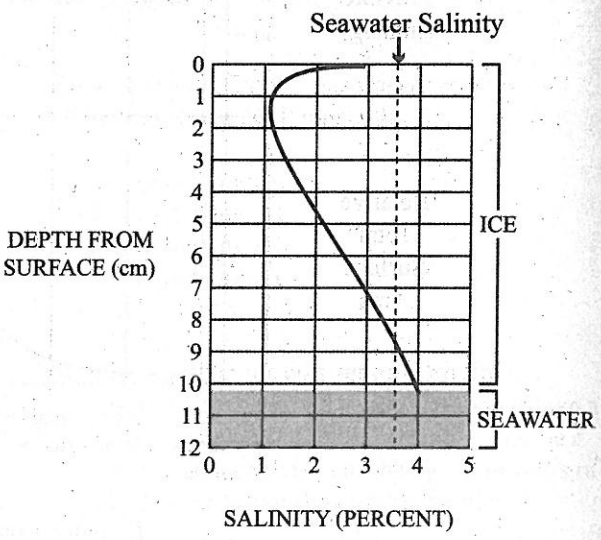
14. A physician examining a newly discovered tribe of people deep in the Amazon jungles found that the relative total surface area of their capillaries was greater than that previously reported for any other group of people. If the physician were to predict the average velocity of blood through the capillaries of these people, which of the following values would be most reasonable?

F. 2 cm/sec
G. 3 cm/sec
H. 4 cm/sec
J. 5 cm/sec

Data Representation Strategies

Passage IV

Ocean water contains "salt"—actually a mixture of ions, primarily sodium, chloride, potassium, calcium, magnesium, bicarbonate, and sulfate. The solid-line graph below indicates the percentage of these ions ("salinity") in a slab of ice that lies over seawater on a cold ocean surface. The arrow and dashed line indicate the salinity of the water beneath the ice.



15. According to this figure, the salt content of the ice above the ocean water:

A. equals 0.
B. is constant at all depths.
C. generally decreases with greater depth.
D. generally increases with greater depth.

16. Compared to the ocean water below it, the salinity of the ice is:

F. generally lower.
G. about the same.
H. generally higher.
J. unable to be determined.

17. The salinity of the ice at the surface of the slab is equal to the salinity of:

A. the ice at a depth of approximately 1.5 cm.
B. the ice at a depth of approximately 7.0 cm.
C. the ice at a depth of approximately 9.0 cm.
D. the water beneath the ice.

18. A researcher wants to take a sample of ice that is one half the salinity of the seawater below. At what depth should the researcher sample?

F. Between 1 and 2 cm
G. Between 4 and 5 cm
H. Either between 0 and 1 cm or between 3 and 4 cm
J. Between 5 and 6 cm

19. The researcher takes a 1-gram sample of ice from a depth of 10 cm, and wishes to take a sample of ice from 1.3 cm depth that will contain the same weight of total salts. How large a sample is needed?

A. 0.25 grams
B. 1.0 grams
C. 4.0 grams
D. 10.0 grams

Research Summary Review and Strategies

Typical Research Summary Items

Passage V

To test the hypothesis that all antibiotics are equally effective in preventing bacterial growth, the following three experiments were carried out using clear plastic plates filled with nutrient agar (a mixture of ingredients that supports the growth of bacteria).

Experiment 1

Three plates (A, B, and C) of agar were set up, each with an equal amount of bacterial culture (Bacterium X) spread over the agar surface and with a paper disk placed in the center. Plate A's disk was soaked in Antibiotic I; Plate B's disk was soaked in Antibiotic II; Plate C's disk was soaked in plain water. After incubation overnight at 37°C (body temperature), Plates A and B had a clear area, 2" in diameter surrounding the paper disk, but beyond this 2" region, the plates were cloudy. Plate C was entirely cloudy, including the area adjacent to the paper disk. When bacteria reproduce successfully, colonies form on the agar, giving it a cloudy appearance.

Experiment 2

Identical procedures were followed except that Plates A, B, and C were incubated overnight at 22°C (room temperature). After incubation, Plate A had a clear area, 2" in diameter, surrounding the paper disk. Plates B and C were entirely cloudy.

Experiment 3

Identical procedures were followed except that the concentrations of Antibiotic I (Plate A) and Antibiotic II (Plate B) were made twice as strong. After incubation overnight at 22°C, Plates A and B both had clear, 2" areas around the paper disk, while Plate C remained entirely cloudy.

20. After incubation, a clear area around a previously soaked paper disk represents a region where:

F. agar had washed away.
G. decomposition had occurred due to high incubation temperatures.
H. bacterial growth did not occur.
J. bacteria grew best.

21. Which of the following results would indicate that the antibiotics being tested have nothing to do with the control of bacterial growth?

A. A clear, 2" region was always observed around the disks soaked in water.
B. All results remained the same at the two experimental temperatures and at the two antibiotic concentration levels.
C. Plates A and B always remained clear.
D. The disks soaked in water were not used in the experiments at all.

22. Which statement is supported by the results of Experiment 1 alone?

F. Antibiotic I, Antibiotic II, and water are equally effective as inhibitors (preventers) of bacterial growth at 37°C.
G. Dry paper disks can be effective in controlling bacterial growth at 37°C.
H. The concentration of an antibiotic may influence its effectiveness in controlling bacterial growth at 37°C.
J. Both Antibiotics I and II can inhibit bacterial growth at 37°C.

23. The results of both Experiment 2 and Experiment 3 lead to which of the following conclusions?

A. Antibiotics I and II have similar effects on bacterial growth, regardless of concentrations.
B. Antibiotic II and water have similar effects on bacterial growth, regardless of concentrations.
C. The effectiveness of Antibiotic I at 22°C depends on its concentration.
D. The effectiveness of Antibiotic II at 22°C depends on its concentration.

24. Which hypothesis best explains the observation that the agar plates never appear clear beyond a 2" area surrounding the soaked paper disks?

F. The bacteria cannot grow well within 2" of any moist paper disks.
G. The antibiotics cannot seep through the agar beyond a distance of 2".
H. At the experimental incubation temperatures used, the two antibiotics interfere with each other's effectiveness.
J. The paper disks can absorb nutrients out of the agar from the distance of 2".

25. If either Antibiotic I or II could be prescribed for internal use to prevent the spread of Bacterium X infections, which recommendation, based on the experimental results, is appropriate if the cost due to the amount of antibiotic used per dose is the most critical factor (the antibiotics are equal in cost for equal concentrations)?

A. Either Antibiotic I or II can be taken at equal cost.
B. Antibiotic I would be less expensive.
C. Antibiotic II would be less expensive.
D. Neither Antibiotic I nor II would be effective in preventing the spread of Bacterium X.

Passage VI

To investigate the hypothesis that the quality of the detail of a fossil depends on the size of the particles that make up the rock surrounding the fossil, three experiments were performed using a particular type of leaf with many fine veins.

Experiment 1

A leaf was placed on a flat bed made of paste from extra-fine plaster and then completely covered with more of the same paste. A glass cover with a 5-lb weight was placed on top of the paste for one hour, until the plaster set. The plaster was then baked for 30 minutes at 25°C. When the cast was opened, the imprint of the leaf showed all of the veins, including the finest ones.

Experiment 2

A leaf was placed on a flat bed made of paste from fine-grade plaster and then completely covered with more of the same paste. A glass cover with a 5-lb weight was placed on top of the plaster for one hour, until the plaster set. The plaster was then baked for 30 minutes at 25°C. When the cast was opened, all the main veins were visible, but only isolated traces of the finer veins were found.

Experiment 3

A leaf was placed on a flat bed made of paste from coarse-grain plaster and then completely covered with more of the same paste. A glass cover with a 5-lb weight was placed on top of the plaster for one hour, until the plaster set. The plaster was then baked for 30 minutes at 25°C. When the cast was opened, only the thickest veins were visible, and some of the leaf edge was difficult to discern.

26. Should the investigator have used a different type of leaf in each experiment?

F. Yes: different types of structure could be studied.
G. Yes: in real life, many different types of fossils are found.
H. No: the leaf served as a controlled variable.
J. No: the nature of the leaf is not important.

27. When a fossil is formed, the sediment that surrounds it is normally compressed by the tons of earth deposited over it. What part of the model simulates this compressing element?

A. The 5-lb weight
B. The glass
C. The upper layer of paste
D. The baking oven

28. A fourth experiment was set up the same way as the previous three, except the paste was made by mixing equal amounts of very coarse sand with the extra-fine plaster. The investigator is likely to discover:

F. no change from Experiment 1 because only the plaster counts.
G. no change because the same kind of leaf is used.
H. the imprint is better than Experiment 1 because the sand provides air pockets.
J. the imprint is worse than Experiment 1 because the average particle size is bigger.

29. Which of the following hypotheses is supported by the results of Experiment 1 alone?

A. The finer the sediment the greater the detail of the resulting fossil.
B. Hardened sediment can preserve the imprint of a specimen.
C. All fossils must have been baked at high temperatures.
D. Only organic material can leave imprints in sediment.

30. Which of the following changes in the experiments would have permitted a test of the hypothesis that the quality of a fossil imprint depends on the pressure applied?

F. Repeat the experiments except for using a 10-lb weight in Experiment 2, and a 20-lb weight in Experiment 3.
G. Choose one of the plasters, and run experiments using the same plaster in all trials while varying the weights.
H. Rerun all the experiments without the glass.
J. Vary the depth of the leaf in each new trial, because in nature increased pressure means the fossil is at a greater depth.

Research Summary Strategies

Passage VII

Erosion refers to processes that wear down rocks and soil, as well as processes that transport the worn-away materials to other locations. Although these processes usually cause effects gradually (over geologic time), laboratory models can be designed to investigate which environmental factors affect erosion rate.

Three experimental sandboxes were set up that were identical in size (10-feet-by-10-feet), had identical types of soil and rocks, and were filled to equal depths (3 feet). The sandboxes were kept for two weeks in large environmental chambers, each maintained at a constant temperature, with a continuous wind flow of 5 mph.

Sandbox 1

One half was kept bare (just soil and rocks), while the other half had a variety of grasses and weeds planted among the soil and rocks. After two weeks, the bare half had small channels (ruts) running along its length that averaged 1 inch in width. The planted half had few channels, and those that were found averaged less than 1 inch wide.

Sandbox 2

The conditions were identical to those of Sandbox 1, with the addition that both halves were subjected to light, 15-minute showers of water every twelve hours. After two weeks, the bare half had channels averaging 4 inches wide, while the

planted half had fewer channels averaging 2 inches wide.

Sandbox 3

The conditions were identical to those of Sandbox 2, but the entire box was mechanically raised to rest at an angle of 15° to simulate a steep slope. After two weeks, the bare half had channels averaging 7 inches wide, while channels in the planted half were less common and averaged 4 inches in width.

31. Results from all three sandboxes indicate that:

A. different types of soils and rocks are affected differently by environmental factors.
B. under all tested conditions, plants reduce erosion.
C. changing wind and temperature conditions can affect erosion patterns.
D. water from short periods of rain has little or no effect on erosion patterns.

32. Which of the following claims does the design and results of the experiments NOT support?

F. Light winds have no erosive effect.
G. Slopes have more erosion than level surfaces.
H. Water has major erosive effects.
J. The effects of changing temperature remain unanswered.

33. Sudden cloudbursts are known to cause more erosion than longer periods of mild rains. How could the present experiments be changed to examine this idea?

A. Raise the angle in Sandbox 3 to produce a steeper slope.
B. Add the "rain conditions" from Sandbox 2 to the conditions in Sandbox 1.
C. Include light, 15-minute showers every six hours instead of every twelve hours.
D. Every twelve hours allow the same total volume of water to fall in a 5-minute span rather than in a 15-minute span.

34. Should the investigator have used different soil types in each sandbox experiment?

F. Yes, because different soils may erode differently.
G. Yes, because a different group of plants could have been used in each sandbox as well.
H. No, because some soils can be washed completely away within the 2-week experiment.
J. No, because the soil type was a controlled variable in all three experiments.

35. Sandbox 3 specifically demonstrates the role of which particular variable in the set of experiments?

A. Rain
B. Wind
C. Gravity
D. Temperature

36. If another sandbox were set up, which of the following conditions would probably cause wider and deeper channels in the soil of the new sandbox than those in Sandbox 3?

I. Steeper angles for the sandbox
II. A greater volume of water during the 15-minute showers every twelve hours
III. Removal of plants from soil

F. I only
G. I and II only
H. II and III only
J. I, II, and III

Conflicting Viewpoints Review and Strategies

Typical Conflicting Viewpoints Items

Passage VIII

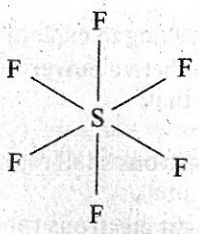
Theory 1

Early in the twentieth century, many chemists believed that the stability of the molecule methane, CH_4, could be explained by the "octet" rule, which states that stability occurs when the central atom, in this case carbon, is surrounded by eight "valence," or outer, electrons. Four of these originally came from the outer electrons of the carbon itself, and four came from the four surrounding hydrogen atoms (the hydrogen atom was considered an exception to the rule since it was known to favor a closed shell of two electrons as helium has.) According to the octet rule, neither CH_3 nor CH_5 should exist as stable compounds, and this prediction has been borne out by experiment.

Theory 2

While the octet rule predicted many compounds accurately, it also had shortcomings. Ten electrons, for example, surround the compound PC_{15}. The greatest shock to the octet rule concerned noble gases such as krypton and xenon, which have eight electrons surrounding them in their atomic states, and therefore should not form compounds since no more electrons would be needed to make an octet. The discovery in 1960 that xenon could form compounds such as XeF_4 forced consideration of a new theory, which held that (a) compounds formed when electrons were completely paired, either in bonds or in non-bonded pairs; (b) the total number of shared electrons around a central atom varied, and could be as high as twelve; (c) the shapes of compounds were such as to keep the pairs of electrons as far from each other as possible.

For example, since six electrons in the atomic state surround sulfur, in the compound SF_6 it acquired six additional shared electrons from the surrounding fluorines for a total of twelve electrons. The shape of the compound is "octahedral," as shown below, since this conformation minimizes the overlap of bonding pairs of electrons.



37. According to Theory 1, the compound CH_2Cl_2:

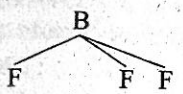
A. should have eight electrons surrounding the carbon atom.
B. cannot exist since the original carbon atom does not have eight electrons.
C. should have eight electrons surrounding each hydrogen atom.
D. requires more electrons for stability.

38. According to Theory 1, the compound XeF_4:

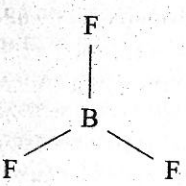
F. exists with an octet structure around the xenon.
G. should not exist since more than eight electrons surround the xenon.
H. will have similar chemical properties to CH_4.
J. exists with the xenon surrounded by twelve electrons.

39. The atom boron has three outer electrons, and in bonding to boron, a fluorine atom donates one electron. The BF_3 molecule is known to exist. Which of the following is true?

A. BF_3 obeys Theory 1.
B. The existence of BF_3 contradicts Theory 2.
C. According to Theory 2, the structure of BF_3 is a pyramid:



D. According to Theory 2, the structure of BF_3 is triangular and planar:



40. A scientist seeking to explain why Theory 2 has more predictive power than Theory 1 might argue that:

F. eight electrons shall represent a "closed shell."
G. while eight electrons represent a "closed shell" for some atoms, for others the closed shell may be six, ten, or twelve.
H. it is incorrect to assume that a given atom always has the same number of electrons around it.
J. CH_4 is not as important a compound as XeF_4.

41. Theory 2 could be threatened by evidence of:

A. the existence of SF_4.
B. the existence of XeF_5.
C. molecules with stable octets.
D. the existence of SF_6.

Passage IX

Scientist 1

The atmosphere of the Earth was at one time almost totally lacking in oxygen. One piece of evidence supporting this assertion is the very fact that life got started at all. The first chemical reactions that are necessary for the origin of life, the formation of amino acids, require ultraviolet light. Most of the ultraviolet light coming from the Sun is now absorbed by oxygen in the atmosphere. If there were as much oxygen in the atmosphere then as there is now, there would have been too little ultraviolet light available to enable life to begin. Also, the oldest bacteria, the ones that have the shortest DNA, are almost all anaerobes—they either do not need oxygen or die if exposed to oxygen. Most of the oxygen that exists now entered the atmosphere later from volcanic fumes.

Scientist 2

The prevailing opinion is that the atmosphere, though thicker now than it was in the past, is not essentially different in composition. The argument that the Earth must originally have been deficient in oxygen is flawed. First of all, the presence of iron and other oxides in the rocks from this time indicates that there was oxygen available. Secondly, the requirement for a great deal of ultraviolet light holds only if there is a low concentration of the starting materials in the water. If the water in some prehistoric lake began to freeze, the starting materials would be concentrated in a small volume of unfrozen water. The high concentration of the starting materials would offset the so-called deficiency of ultraviolet light, and life could begin.

42. According to the hypothesis of Scientist 1, which of the following would have been among the last living things to evolve?

F. Anaerobes
G. Plants
H. Insects
J. Viruses

43. According to the information presented by Scientist 1, if his theory of the origin of oxygen in the atmosphere is correct, the total amount of oxygen in the air over the next million years, on the average, should:

A. decrease, then increase.
B. increase, then decrease.
C. increase.
D. decrease.

44. Underlying the argument of Scientist 2 is the assumption that the oxygen in the oxides in the rocks was:

F. always tied up in the rocks.
G. involved in biological reactions.
H. all gaseous during the early days of the atmosphere.
J. proportional to the oxygen in the atmosphere at the time.

45. Underlying Scientist 1's suggestion that the evolutionary record supports the idea of an oxygen deficiency on the early Earth is the assumption that the oldest living things:

A. have the shortest DNA.
B. have the most fragmented DNA.
C. have changed radically.
D. must have died out.

46. Which of the following is the strongest argument Scientist 1 could use to counter Scientist 2's suggested mechanism for the origin of life?

F. There was not enough ultraviolet light available.
G. Chemical reactions occurred differently then.
H. The temperature at the surface of the Earth at that time was always above 35°C because of geothermal heat release.
J. Most lakes would not have covered large enough areas to guarantee that all the essential building blocks were present.

47. To refute Scientist 1's hypothesis, Scientist 2 might best show that:

A. the amount of oxide in rocks has changed little over the past four billion years.
B. there are ways of making the biologically important molecules without ultraviolet light.
C. there are complex anaerobic bacteria.
D. the atmospheric pressure has not changed over the Earth's history.

Conflicting Viewpoints Strategies

Passage X

In the 1940s, 1950s, and 1960s, the growing field of animal behavior maintained an ongoing debate about the origin of observed behavior in many different animal species. Two extreme viewpoints were at the center of this "Nature vs. Nurture" debate.

Viewpoint 1 (Nature)

Many behaviors or instincts are literally programmed by one or more genes. Genes serve as "blueprints" that enable an individual to carry out a particular stereotyped behavior (Fixed Action Pattern) as soon as the appropriate stimulus (releaser) is observed. Other individuals do not have to be observed performing the behavior. The releasing stimulus need never have been seen before. At first view of the releaser and every time thereafter, the Fixed Action Pattern will be carried out to completion in the exact same way—even if the releaser is removed before the Fixed Action Pattern is finished! Examples include: a) the pecking of baby gulls at the red spot on their mother's bill (which causes the mother gull to regurgitate food), b) song birds producing their species song without ever having heard it before, and c) a male stickle-back fish defending its territory by attacking anything red because other breeding males always have red underbellies.

Viewpoint 2 (Nurture)

Many behaviors are determined by experience and/or learning during an individual's lifetime. Genes provide the limits of the "blank slate" that each individual starts out as, but then various experiences will determine the actual behavior patterns within the individual genetic range of possibilities. In other words, behavior can be

modified. Examples include: a) positive ("reward") reinforcement and punishment causing a behavior to increase and decrease (respectively), and b) songbirds producing their species song only after having heard it performed by other individuals of their species.

48. The red spot on a mother gull's bill is called a(n):

F. Fixed Action Pattern.
G. instinct.
H. releaser.
J. stereotyped response.

49. To refute the strict "genetic blueprint" ideas of Viewpoint 1, a scientist could show that:

A. baby gulls peck at a stick with a red spot.
B. baby gulls will peck at mother gulls' red spot as soon as they hatch out of their eggs.
C. baby gulls pecking at the red spot happens exactly the same way each time.
D. baby gulls' accuracy in pecking at mother gulls' red spot improves with practice.

50. A food-seeking blue jay captured a distinctively colored butterfly that had a bad-tasting substance in its tissues. After spitting out the butterfly, it never again tried to capture a similarly colored butterfly. This incident seems to support:

F. Viewpoint 1.
G. Viewpoint 2.
H. both viewpoints.
J. neither viewpoint (the incident is irrelevant).

51. Which of the following supports Viewpoint 1?

A. A rat reaches the end of a maze by the same route, but finishes faster after each trip.
B. Monkey A watches other monkeys wash sweet potatoes before they eat them; then, he washes sweet potatoes before he eats them.
C. A male stickleback fish attacks a picture of a red mailbox held in front of his aquarium.
D. A bird performs its species song after hearing the song only once.

52. If baby chickens peck at grains of food on the ground when hungry, but not as much after they have recently eaten, then this:

F. supports Viewpoint 1.
G. supports Viewpoint 2.
H. does not refer to behavior.
J. is irrelevant to the Nature vs. Nurture debate.

53. It is thought that some species of birds "learn" to fly. This belief is based on observations of young birds fluttering and flapping their wings at the nest until they reach the age when flight is possible. In Species X, nestlings were kept in harmless, but tight plastic tubes in which they could not carry out such "practice movements." They were released when they reached the age of flight. Viewpoint 1 predicts that the birds will fly:

A. after fluttering their wings for a time.
B. after watching other birds flutter their wings.
C. after watching other birds flutter and fly.
D. immediately.

54. A songbird can sing its species song after it hears other birds of its own species singing. Yet, if it hears the song from another species, the bird will not sing the "foreign" song. This suggests that:

F. genetic "programming" and experience play a role in this species' ability to sing its song.
G. this species' song is a Fixed Action Pattern.
H. song development in this species is strictly a learned behavior with no genetic component.
J. genes appear to be far more important than experience in this example.