

A BIOLOGICAL SCIENCE PRETEST  
FOR NINTH GRADERS

AN HONORS PROJECT  
SUBMITTED TO THE HONORS COMMITTEE  
IN FULFILLMENT OF THE REQUIREMENTS FOR  
I. D. 499

by

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Each fall, in schools throughout Indiana ninth graders are preparing to start a science course - biology. They have been prepared for this class by taking general science in seventh and eighth grades. The new students must be faced by the high school biology teacher. His problem is one of planning an adequate course of study for them. The purpose of this project was to devise a tool to assist him in this planning. The tool which was conceived was a biological sciences pretest.

This test is to be given by the biology teacher in the early weeks of the semester. It is so designed as to allow him to judge the over-all ability of his pupils in the biological sciences as well as to test their abilities in the specific areas of botany, zoology, and human biology.

The first problem encountered in making such a test was the selection of the type of question to be used. The decision was made to use the multiple-choice form of question. In this form, a question is asked or a sentence is left incomplete. The composer then provides four or more answers or completions to the problem thus created. One of the answers is the best one, while the others are so designed as to be plausible but not as good as the selected answer. As an example the first item from the test could be used.

1. Biology means...

A. the study of plants

B. the study of everything which affects man

- C. the study of life in its many forms
- D. the study of animals

The first line poses the problem - what is biology? The next four lines give four possible answers. It can be observed that answers A and D are both partially right, but that neither of them provides a total answer. Answer B restricts biology to man alone. Answer C is the best for it provides the broad and well-based definition.

In the above example, the proper answer would be marked upon an answer sheet. The grader would then have an easy task of marking the paper. This is one of the major advantages to the multiple choice type of question.

Another advantage of this type of question is the fact that it provides the same question and answer structure to each person being tested. This allows for a high degree of objectivity on the part of the grader. Other forms of questions will allow the person being tested to provide a response of his own. That is, a question will be stated and the person will be allowed to give his own version of what the answer should be. Since each individual's answer will vary according to his mode of expression, there will be an endless variety of answers to judge and grade. The multiple choice question provides the answers and thus removes the answer to the language and context of the tester instead of the person being tested. This provides the same experience for all the students being so examined.

When devising the questions an attempt was made to make them simple enough for the ninth graders to easily determine the purpose of the question. The questions were so designed as not to be unusual or tricky. The answers were devised to match the question in grammatical structure. Finally the samples chosen were ones in which the students would have some background.

After the type of question was decided upon, the next difficulty arose in selecting the areas to be tested. It was felt that a reasonable idea of the biology background could be obtained by an examination of the curricula of the seventh and eighth grade general science courses at a typical junior high. The junior high school selected was Storer Junior High. This school was chosen because the author was engaged in student teaching there in the science department. Upon personal experience and interviews with the various general science instructors, it was decided that the textbooks used in these courses would give the author the best idea of the biological science instruction which had been presented in the seventh and eighth grade courses.

Why were textbooks chosen to provide the insight into these previous experiences? One of the basic reasons is that the plan of the textbook usually provides the framework for the course of instruction. It provides the foundation upon which day-by-day instruction is given. Another reason is that it is a concrete example of the many tools used as well as the common one. At the junior high with which the author

was associated, the general science teachers had diverse backgrounds - many having different majors in college. They all, however, had one thing in common - the textbooks that were used. It was therefore decided to make a complete survey of these texts before any preparation got under way.

In the seventh grade the textbooks used are Science I - Observation and Experiment and Science II - Experiment and Discovery by Davis, Burnett, and Gross. These two texts are used in the two consecutive semesters of seventh grade for Storer students. The books being used bear a copyright of 1958 by the authors and were published by Holt, Rinehart, and Winston. The first text, Science I, serves as an introduction to junior high science. Its first unit (pp. 1-29) presents the scientific method and attitude in an excellent manner.

The first ten units are on topics other than biology, but Unit 11 - "How Do Plants Grow and How Do You Use Them?" deals directly with beginning botany (pp. 305-345). The unit begins with a chapter on the many ways in which plants provide food for men. It describes each of the parts of a plant and how these can provide food for man. The following two sections are devoted to a discussion of seeds (pp. 312-320). The parts of a seed are related as well as the purposes of a seed. The following pages introduce the term "germination" and give the requirements for this process. The next section describes the needs of adult plants and mentions briefly the term "photosynthesis." It concludes with a section on the vegetable garden.

Unit 12 - "Why Is Conservation Important Today?" is the final chapter in the text and contains sections on soil conservation (pp. 350-359), forest and wildlife conservation (pp. 359-365), and mineral conservation (pp. 365-371). The unit is a very general one which cites some problems in each field and gives a few possible solutions.

During the second semester of the seventh grade, the students are exposed to Science II - Experiment and Discovery. This also starts with a brief discussion of science. This text has far more references to biological topics than the first. It includes a few units on climate (pp. 133-163) and topology (pp. 163-199) which could be of value in the study of ecology.

The first unit which discusses a topic of direct biological reference is Unit 7 - "What Is the Importance of Plants?" (pp. 199-235). This unit starts with a discussion on the economic importance of plants (pp. 199-205). It provides the students with a general background in how plants can be used.

The next section is a discussion of some of the requirements of plant life. It starts with a discussion of the cell of a plant (p. 207). The section goes on to tell of the requirements of plants to continue existence. This includes a discussion and demonstrations on the need for water and minerals (pp. 209-210). The final part of this section is several pages on the concept of photosynthesis (pp. 211-214). This is probably one of the most basic concepts in botany and one which is covered fairly well in this text. It gives the pro-

cess by which green plants make food and has experiments which are designed to show the pupils which elements are necessary in the process. The third section of this unit (pp. 214-299) tells of the different needs of plants in different areas and goes on to describe how variations in stems, roots, and leaves help meet these needs. The final two sections contain descriptions of agricultural techniques (pp. 220-226) and conservation of plant life. In the first of these the term "botany" is introduced. This unit is very general in nature but serves as a good background to the plant kingdom.

The second unit which presents a biological topic is Unit 8 - "What Is the Importance of Animals?" This is an introduction to the general characteristics of the animal kingdom. The unit starts out much the same as the previous one with a section which gives the value of the animals to man (pp. 238-244). The second section is a discussion of the requirements of animal life (pp. 244-251). Included in this section are the concepts of vertebrates (p. 245), warm-blooded and cold-blooded animals (p. 247), and natural enemies (p. 250). The next section is a unit on ecology although the term is never mentioned. It stresses the interdependence of plants and animals citing many examples. The next section (pp. 255-264) gives some of the many environments of animals and their many adaptations to meet these. The final two sections tell how man can improve his domestic animals and how wildlife can be conserved.

Unit 9 - "What Is the Importance of Insects?" (pp. 278-309) provides the seventh grader with a background in the insect world. The insects are introduced as members of the animal kingdom (p. 282). The unit goes on to describe the various body parts of the insect (pp. 282-286). The next section is devoted to a discussion of the life cycle of the insect (pp. 287-292). This includes an introduction of the term "metamorphosis." The next two sections discuss some of the helpful (pp. 292-296) and harmful (pp. 296-301) aspects of insect life. The final section provides a discussion of the methods of insect control.

The last unit in this text which influences the student is a unit on human biology. It is Unit 10 - "What Are the Needs of the Human Body?" (pp. 310-345). This is an extensive unit on the processes and the systems of the human body. It begins with a discussion of the processes of respiration. It gives not only the products involved but also the process of breathing (pp. 314-316). The unit continues into a discussion of the area of organs, tissues, systems, and cells. The second section of this unit describes digestion and cell usage (pp. 318-322). The third is a section describing the muscular and skeletal systems. It shows how they interact to allow movement in living creatures (pp. 323-327). The unit then continues into a brief discussion of the nervous, circulatory, and endocrine systems. The unit is completed by a section on human development.

When the student enters the eighth grade, his text is Science - Discovery and Progress by Davis, Burnett, and Gross. The text which is being used at Storer Junior High was copyrighted in 1957 and published by Holt, Rinehart, and Winston. Although this text contains nineteen units, there are only three which are strictly biological. This is probably in anticipation of the full year of biology which most students will take.

The first unit in this text which is strictly biological material is Unit 17 -"How Has Man Learned to Grow Plants and Use Them in Daily Life?" (pp. 475-509). This is a continuance of the study of botany which was presented in the previous texts. The discussion begins with a presentation of the value of green plants as food for animals and man. It also has a good explanation of the functions of protoplasm (pp. 476-481). The following section describes the parts of a leaf and gives a description of photosynthesis including the organic formulas. This goes into the process quite deeply and is particularly good. The following chapter describes how plants use water and minerals. It includes sections on how roots are of value to a plant (pp. 486-489).

The unit proceeds into an area on pollination and the role flowers play in the reproduction of plant life. It continues into the development of a plant from seed to seedling. The final two chapters give the problems facing plant growers and some of the ways plants can be improved. This second part is particularly interesting because it contains a chapter on genetics (pp. 501-504). This discusses heredity, dominance and re-

cessiveness, and the concept of the hybrid.

Unit 18 - "How Has Man Increased His Knowledge of His Body?" is a unit on human biology. The first two chapters (pp. 508-519) are primarily on diet. The next section, however, (pp. 519-530) gives detailed descriptions of the processes of breathing, the nervous system, and the endocrine system. It concludes with chapters on alcohol and tobacco.

The final unit in the book, Unit 19 - "How Has Man Learned the Nature and Causes of Decay and Disease?", is of interest because it gives a good description of the living organisms which cause disease. The first four chapters are an introduction to bacteriology including the three different types of bacteria and methods to promote and destroy them. It also shows some of their useful qualities. It ends with a general discussion of parasites.

The purpose of including this resumé is to show the relatively large amount of knowledge of biology which was provided by their textbooks to the incoming ninth-graders. The problem which this project centers on is the amount of knowledge which was retained. Surely all these concepts which were presented in seventh and eighth grades are not all lost.

This is why this test was designed. It will, if successfully devised, provide the biology teacher with an idea of how much these early influences have made an impression upon his pupils. The test is composed of fifty-six items designed to sample the retention of earlier biological material. It

covers a wide range of topics but stays within the guidelines established from studying seventh and eighth grade science texts.

1. Biology means...
- A. the study of plants
  - B. the study of everything which affects man
  - C. the study of life in its many forms
  - D. the study of animals

Answer - C

2. Why did some animals, like the dinosaur, become extinct and disappear while others go on living?
- A. They were eaten by other animals.
  - B. They died from diseases.
  - C. They were unable to reproduce.
  - D. They were unable to change to meet new surroundings.

Answer - D

3. Plants...
- A. always need water
  - B. cannot exist without sunshine
  - C. are unable to move
  - D. always have green leaves

Answer - A

4. Which of the following plants does not make food by using the sun?
- A. Maple tree
  - B. Moss

- C. Mushroom
- D. Dandelion

Answer - C

5. The process by which a plant makes its food is known as...
- A. respiration
  - B. photosynthesis
  - C. chlorophyll
  - D. adaption

Answer - B

6. When a plant makes its own food, which of the following is not necessary?
- A. Sunlight
  - B. Water
  - C. Oxygen
  - D. Carbon dioxide

Answer - C

7. Green plants contain a green coloring that helps to make food. It is known as...
- A. chlorophyll
  - B. cellulose
  - C. nitrogen
  - D. carotene

Answer - A

8. Germination means...
- A. the budding of flowers
  - B. the growth of roots
  - C. the sprouting of seeds
  - D. the development of leaves

Answer - C

9. When a board is removed after lying on the grass for some time, the grass beneath it will have died. Why is this?
- A. It was too hot under the board.
  - B. The leaves were broken by the board's weight.
  - C. The plant could not get enough water.
  - D. The plant could not get enough sunshine.

Answer - D

10. Which of the following is not necessary to make a seed sprout?
- A. Soil
  - B. Air
  - C. Moisture
  - D. Proper temperature

Answer - A

11. When we place one seed in a dark room and another in sunlight, we notice that they will both sprout. What statement could we make about this?
- A. Sunlight has little effect on sprouting.
  - B. The effect of sunlight can not be determined by the experiment.

- C. Plants do not need sunlight.
- D. Sunlight is needed to make seeds sprout.

Answer - A

12. Which of the following plants has flowers?

- A. Ivy
- B. Rose
- C. Maple tree
- D. All of the above have flowers

Answer - D

13. The process of pollination...

- A. keeps harmful insects away from plants.
- B. serves as a form of camouflage for the plants.
- C. is necessary for the formation of seeds.
- D. has no function which has been discovered by scientists.

Answer - C

14. When a radish or carrot is eaten, which part of the plant serves as food?

- A. Root
- B. Stem
- C. Leaf
- D. Flower

Answer - A

15. Which of the following plants would be likely to have large, colorful flowers?

- A. A wind-pollinated plant
- B. An insect pollinated plant
- C. A water pollinated plant
- D. None of the above

Answer - B

16. If a branch on a tree is six feet above the ground when the tree is two years old, how far will it be above the ground when the tree is four years old?
- A. Six feet
  - B. Nine feet
  - C. Twelve feet
  - D. Eighteen feet

Answer - A

17. A root has many functions. Which of the following does it not do?
- A. Stores food
  - B. Absorbs water
  - C. Manufactures food
  - D. Supports plant

Answer - C

18. Evergreen trees such as the pine tree...
- A. never lose their leaves.
  - B. lose their leaves only in the summer.
  - C. do not lose all their leaves at one time.

D. Are unable to make food during the winter.

Answer - C

19. During the autumn months, the leaves of many trees change from green to orange or yellow. Why is this?

- A. The cold weather changes the green coloring to yellow or red.
- B. The shorter days allow more orange and yellow to form.
- C. The cold weather kills the green coloring and lets the orange or yellow show through.
- D. Less sunlight is needed to make orange or yellow than green.

Answer - C

20. Why do plants wilt?

- A. They have received too much heat.
- B. They have received too much sunlight.
- C. They have lost too much water.
- D. They are being attacked by a plant disease.

Answer - C

21. Forest fires destroy millions of acres of trees each year. How are most of them started?

- A. Spontaneous combustion
- B. Lightning
- C. Man
- D. None of the above

Answer - C

22. Your body is composed of very small units. What are they called?

- A. Organs
- B. Cells
- C. Divisions
- D. Tissues

Answer - B

23. The process of breathing or the exchange of gasses is known as....

- A. circulation
- B. digestion
- C. excretion
- D. respiration

Answer - D

24. Which gas is exhaled in the process of breathing?

- A. Carbon dioxide
- B. Oxygen
- C. Nitrogrn
- D. Argon

Answer - A

25. The nervous system includes:

- A. nerves only.
- B. nerves and the spinal cord.
- C. nerves, the spinal cord and the brain.
- D. nerves, the spinal cord, the brain, and the sense organs.

Answer - D

26. Proteins are used to...

- A. build strong bones
- B. develop muscles
- C. aid in eyesight
- D. help hearing

Answer - B

27. An enzyme is a...

- A. cell in the bone structure.
- B. nerve cell.
- C. fluid used to help digestion.
- D. lymph node.

Answer - C

28. An involuntary motion is one that...

- A. may be controlled by the person.
- B. only acts when the person is asleep.
- C. can not be controlled by the person.
- D. only acts when the person is awake.

Answer - C

29. Pads which serve to absorb shock and are found in joints are known as...

- A. ligaments.
- B. cartilage.
- C. tendons.
- D. patellas.

Answer - B

30. Why are there two sets of muscles to control each action?
- A. To provide more power.
  - B. One to hold the bone steady and one to move it.
  - C. To work in opposite directions because muscles can only pull.
  - D. To provide a reserve set in case one should be damaged.

Answer - C

31. Glands such as the thyroid and adrenal produce chemicals to regulate body systems. These are known as...
- A. hormones.
  - B. enzymes.
  - C. lymph nodes.
  - D. excretions.

Answer - A

32. Which of the following is the best statement about the heart?
- A. The heart maintains a steady beat which is rarely changed.
  - B. The heartbeat can be changed by a person whenever he pleases.
  - C. The heartbeat is only increased or decreased by heavy activity.
  - D. The heartbeat can be changed by many things, from heavy activity to excitement.

Answer - D

33. If you were to find a person who was bleeding heavily from a cut artery, where would you apply the pressure to stop the bleeding?
- A. Above the cut and toward the heart.
  - B. Below the cut and away from the heart.
  - C. Either above or below it.
  - D. Neither above or below it.

Answer - A

34. Which statement best describes the way the blood flows when it leaves the heart?
- A. Arteries to capillaries to veins.
  - B. Capillaries to arteries to veins.
  - C. Veins to capillaries to arteries.
  - D. Arteries to veins to capillaries.

Answer - A

35. Which of the following is not a function of the blood stream?
- A. Carry oxygen
  - B. Carry carbon dioxide
  - C. Carry food materials
  - D. All of the above are functions.

Answer - D

36. Which statement best describes the action of the diaphragm or breathing muscle?

- A. It contracts and pulls the air into the lungs.
- B. It relaxes and allows the air to rush in.
- C. It contracts and forces all the air out.
- D. All of the above are right.

Answer - A

37. Cold blooded animals...

- A. have a constant body temperature.
- B. can only live in warm climates.
- C. usually have the same body temperature as the air around them.
- D. can only live in cold climates.

Answer - C

38. Which of the following is a warm blooded animal?

- A. Frog
- B. Bird
- C. Snake
- D. Crayfish

Answer - B

39. During the winter, many animals go into a sleeping or resting period. What is this called?

- A. Estivation
- B. Migration
- C. Hibernation
- D. Egestion

Answer - C

40. The whale is an animal which lives in the water. It is warm blooded and does not lay eggs. It is therefore a...
- A. mammal.
  - B. reptile.
  - C. fish.
  - D. amphibian.

Answer - A

41. If a man gets his oxygen from the air, how does a fish, which lives in water, get his oxygen?
- A. By coming to the top of the water and breathing.
  - B. By absorbing it through his skin.
  - C. By using air which is dissolved in the water.
  - D. A fish does not need oxygen.

Answer - C

42. Many fishes of lakes and streams are colored very dark on their upper half and much lighter on the lower half. Which is the best reason for this?
- A. The coloration makes them attractive to fishes of the opposite sex.
  - B. The dark color blends with the stream bed and the lighter colors blend with the sun-lit water.
  - C. This makes them more streamlined.
  - D. It serves no purpose, but is only for decoration.

Answer - B

43. What is the largest animal that ever lived?

- A. Whale
- B. Elephant
- C. Dinosaur
- D. Rhinoceros

Answer - A

44. What is one way a fish and a frog are different?
- A. A fish is warm-blooded, but a frog is cold-blooded.
  - B. A fish has gills, but a frog never has gills.
  - C. A fish lays his eggs in the water while a frog lays his on land.
  - D. A young fish resembles an adult fish, but a young frog is very different than the adult frog.

Answer - D

45. Which statement below does not tell how a bat is the same as a bird?
- A. Both can fly
  - B. Both are warm-blooded
  - C. Both lay eggs
  - D. Both have a backbone

Answer - C

46. Which of the animals listed below is the closest relative to the snake?
- A. Frog
  - B. Bird
  - C. Gopher

D. Lizard

Answer - D

47. Which insect carries the germ for malaria and yellow fever?

A. Tse-tse fly

B. Mosquito

C. Flea

D. House fly

Answer - B

48. Why are insects which are imported from another country, like the Japanese beetle, frequently terrible pests?

A. The new climate allows them to reproduce better.

B. There are more plants to feed on in the U.S.

C. There are fewer natural enemies here.

D. There are no insect poisons developed to fight them.

Answer - C

49. In what ways are the eyes of insects unusual?

A. They are very accurate.

B. They allow the insect to only see in one direction.

C. They are found on their abdomen.

D. They have many lenses, each of which functions.

Answer - D

50. Insects...

A. are only found in warm areas.

- B. are easily controlled and therefore do little damage.
- C. are not as numerous as birds.
- D. are food for many birds and fish.

Answer - D

51. An insect has two structures on his head which he uses for feeling. What are they called?
- A. Radii
  - B. Spiracles
  - C. Antennae
  - D. Proboscis

Answer - C

52. What is one way in which a moth differs from a butterfly?
- A. Has scales on his wings
  - B. Has six legs
  - C. Has four wings
  - D. Flies at night

Answer - D

53. Ants and bees are known as social insects. This is because...
- A. they are more intelligent than other insects.
  - B. they like to be around man.
  - C. they are very friendly.
  - D. they live in groups or colonies.

Answer - D

54. Which phrase best explains the word heredity?

- A. Which phrase best explains the word heredity?
- A. The surroundings in which a person is reared
  - B. Physical appearance
  - C. All the characteristics which were given an individual by his parents
  - D. Differences used to tell one individual from another

Answer - C

55. When DDT, an insect killer, was first used, it killed nearly every insect. Later, many insects were not killed when exposed. Why is this?
- A. The scientists had not searched well enough at first.
  - B. The insects that survived the first attack were counted again.
  - C. Some of the insects developed a resistance after having been exposed.
  - D. Some of the insects had a natural resistance and therefore were able to reproduce better.

Answer - D

56. What is a hybrid?
- A. A better type of plant or animal developed by breeding
  - B. Any animal or plant which is the result of crossing two different types.
  - C. A type of corn developed by cross-breeding
  - D. A type which is unusual in some way

Answer - B