COMPARATIVE STUDIES OF STUDENTS IN FIRST TERM COLLEGE BIOLOGY

by

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COMPARATIVE STUDIES OF STUDENTS IN FIRST TERM COLLEGE BIOLOGY

The colleges formerly distinguished between students who had had high school biology and students who had not in terms of the collegiate courses to which the respective groups were assigned. Those who had had a year of high school biology were assigned to the second quarter or semester of the related college elementary course while the others were assigned to the first quarter or semester. Later, and in terms of current general practice, no distinction is being made between the students in these two groups in that all of them are placed in the same beginning courses in biology. The colleges believe in terms of their practices that the high schools, as a group, are not effective enough in their preparation of pupils in biology to warrant giving credit for courses in high school biology, since all college freshman majoring in the natural sciences are required to enter the same college courses in biology. The writer of this paper desired to re-examine the question of the justifiability of the foregoing assumption.

From the high school point of view, it appears desirable to teach the sciences in high school because of the relatively small percentages of high school pupils who go to college. The majority of high school pupils receive in high school the only formal training in the sciences which most of them will ever receive. From the college point of view, if the high school courses have resulted in real training of the pupils in the sciences in which they took classes, the students should not be required to repeat work which they have already

mastered and waste time which they might spend more profitably in more advanced study. For colleges to continue to give no credit for high school achievement in the sciences on the assumption that the high schools are not effective in their teaching and may not even teach all of the minimally essential subtopics held by general consent of teachers of these subjects to be requisite for basic understanding of the respective fields of knowledge is an indictment of the quality of the training given in high schools in these fields. It is not the faults of the students that the high school courses have not been effective, if they have not. It is only partly the faults of the high schools, since the quality of the work of the high schools cannot exceed by any large margin the standards held to be satisfactory by the communities in which they are located.

In an attempt to find that high school biology has or does not have a significant value in biology at the college level, the writer has undertaken this brief study of the comparative achievements of two groups in college biology. The study measures the differences in performance of a group of students who had had high school biology and a group of students who had had no formal training in biology before entering college. A further comparison has been made between the performances of the men and women in this subject as an indication that the ancient superstition that women have less scientific aptitude than men is or is not correct within the limitations of this little paper and that the more modern superstition that women are the better students, including the field of biology, is or is not correct.

For the purposes of this paper the group which had had high school biology will be designated as "Hads" and the group which had had no high school biology as "Had Nots."

The problem has been to show the significant differences in the achievements, first, between the "Hads" and "Had Nots" and, second, between the men and the women in this course. This necessitated an elementary statistical treatment of the scores of these four groups in each of the five non-standardized objective college classroom tests in biology. The basic criterion for judgment was the usual formula for the differences between means (1:121-137) from these classroom tests. In addition, the scores from the American Council on Education Psychological Examination for College Freshmen were collected in order that any marked differences in the mean scores of any of the four groups on this examination might be noted. Necessarily there were limitations to the study. The group completing this one quarter course was composed of 165 students who either had or had not had high school biology. Of these, five did not state that they had had or had not had high school biology and could not be included in this comparison. The study comparing the men and women included the 165 students. The number of women included in the study was 113. The number of men varied from 58 on the first test to 52 on the fourth and fifth tests, as the scholastically poorest of the men withdrew from the course. The effect of tutoring between the first and second classroom tests influenced the comparison between the "Hads" and the "Had Nots" for the reason that, of the thirty-three students

who were tutored, twenty-four were "Had Nots" and nine were "Hads." The tutoring consisted of a two hour session, given by a graduate student, on material to be covered in the second test.

The tests were drawn up by the teacher of the course and were composed of selections from among thousands of similar objective test items in a proportion believed by the instructor to parallel the emphasis given the various subtopics in the text, the lectures, and the laboratory. The test items were predominantly of the matching form. The remainder were of the simple (one word) completion form. Copies of these tests are included in the appendix.

Prior studies of the classroom achievements of students in elementary biology courses in college in which comparisons are made between those who had had and those who had not had high school biology show that there are no differences or at most slight differences in achievement in college biology favoring those who had had high school biology.

Cunningham (2:579) holds the view that high school training in biology has a definite carry-over value to college work in biology. The following tabulations from Cunningham indicate the results of a three year study in the fields of college zoology and college botany:

ZOOLOGY

(1) Total students presenting High School Biology 426
(2) Total students not presenting High School Biology 247

Percentage Making	A	B	C	D	F
(1)	6.1	20.6	50.7	14.3	8.7
(2)	3.7	16.6	47.7	21.0	11.7

"It must not be concluded however that the failure to take high school biology prohibits a student from making a top grade; and possibly one should expect a much wider difference in performance than is indicated in this study."

Cunningham (2:581) goes on to say about the students of botany: "The difference here is also in favor of the student who has had (high school) biology, but it is not so striking as may be seen in the following tabulation...."

BOTANY

(1) Total students presenting (High School) Biology. 225
(2) Total students not presenting (High School) Biology. . . . 126

Percentage Making	A	B	C	D	F
(1)	2.6	20.8	36.	30.2	10.0
(2)	3.2	15.	31.7	38.	12.0

"A high school course in biology does have a beneficial effect on one's performance in college zoology, provided the course has been pursued in our better schools. The beneficial effect on botany, while present is not so evident from our data (2:588)."

Ferguson (3:677-679) maintained that there was no significant difference favoring the "Hads" or the "Had Nots". In his study, he found that even though the "Hads" received a higher percentage of "A" grades in college biology, they also received a higher percentage of "D" grades and failures than did the "Had Nots." Ferguson stated (3:679): "It is the opinion of the writer that the students who had biology in high school showed no significant superiority over those who did not study biology in high school."

Cole (4:247) said of the sciences:

> To be sure, it helps a freshman if he brings with him the beginnings of a special vocabulary and an initial experience with the subject, but the knowledge of technical words (from high school training) is generally so low that a good reader can compete on practically equal terms with those who have already had work in science before reaching college.

Douglass (5:174) is of the belief that high school work has little value for success in college. Douglass wrote: "There is no significant correlation between the number of units of credit earned in high school in any subject-matter field and scholastic success in college. There is but slight relationship between the size of high school from which pupils graduate and their subsequent college marks...." Douglass further stated (6:287): "Not only was there little or no relation between pattern of high school credits and college success, but apparently there is little relation between the mastery of any particular subject (in high school) and college success."

Previous studies, of which there are many, have been made to determine which of the sexes is superior in intelligence. The findings have shown that the sexes are on a par intellectually and that men and women as a whole show significant differences only in so far as interests are concerned.

Cole (7:450), in writing of the sex differences, stated:

> As matters stand at present, no differences between the sexes in general ability have been adequately demonstrated. There does, however, seem to be one difference between scores made by boys and girls that is so marked as to be in excess of a reasonable influence from normal elimination. In the separate tests that together make up a scale for measuring intelligence, girls make much superior scores in tests depending upon verbalism, and boys upon tests involving mathematics.

Atkinson (8:65) made the observation from his study that: "Boys show a slight superiority over girls in the study of General Science in-so-far as the above tests indicate."

Woodworth (9:241) is of the point of view that:

> The main intellectual differences that have been found by use of tests are that girls excel in verbal or linguistic ability, boys in mechanical or spatial ability. Girls and women surpass in various language tests, such as vocabulary, opposites, sentence completion.... Girls seem to have a definite advantage in all sorts of language activity. In school they outdo boys in language work. On the whole the sexes are about on a par intellectually.

Smith (10:55-57) comparing sex differences in achievement in biology wrote: "Material generally covered in biology shows no sex difference in general, but the subdivisions show slight differences.... The subject (General Science) as a whole is much easier for boys than for girls."

In his study of the comparative performance of men and women, Cunningham summarized his findings as follows (2:587-88):

> While men show a better record, it must be remembered that nearly half of them are pre-medics functioning at a higher level. Our data do not admit a careful analysis of the subject but they indicate that the level of performance for women and non pre-medics men is about the same. The relative performances of men and women in zoology or botany does not seem to differ materially, other things being equal.

The basic data for this study were the raw scores of five objective classroom biology tests. The test items were of two types, completion and matching. The completion tests called for one-word answers. Each matching item had twenty-five sub-items in one column and twice that number of possible answer choices in the opposite

column. Very infrequently, a number from the short column was to be used two or more times in the longer column. These tests were prepared by the instructor in the course and were similar to most college biology tests. Grading of the tests was done with the aid of a stencil. From the raw scores the means, standard deviations of the means, differences of the means, probable error of the differences of the means, and the chances in one hundred of the differences being reliable were computed.

The following tabulation shows the results of the "Hads" and the "Had Nots" in this biology class:

TABLE I

COMPARISONS OF OBJECTIVE TESTS RESULTS BETWEEN THE "HADS" AND THE "HADNOTS"

Test	Group and No. of Students	Possible Points on Test	Mean Points Made	SD	Diff. between M's	PE Diff.	Chances in 100	Group Favored
No.1	Had 118	50	36.8	7.3	0.4	0.3	64	Had
	HadNot 48		36.4	6.4				
No.2	Had 117	125	85.1	11.9	2.8	1.3	92	HadNot
	HadNot 48		82.2	12.6				
No.3	Had 115	75	51.3	8.3	1.8	1.0	86	Had
	HadNot 48		49.5	10.4				
No.4	Had 113	50	38.3	7.2	0.9	1.0	86	Had
	HadNot 47		37.3	4.2				
No.5	Had 113	200	166.8	13.7	3.5	1.5	93	Had
	HadNot 47		163.2	14.0				

In the study comparing the differences in the achievement of the "Hads" and the "Had Nots," the "Hads" showed what would appear to be significant superiority on four of these five tests according to a statistical table of chances of a true difference greater than zero, given the actual difference. The "Had Nots" scored higher on the second test.

In the second part of the study the differences in scores on these five tests between the men and the women taking these tests showed the women to be the superior group in four of the five tests. The men did better than did the women on the fourth test. The table that follows summarizes the comparative data between these men and women.

TABLE II

ACHIEVEMENT DIFFERENCES ON CLASSROOM BIOLOGY TESTS BETWEEN MEN AND WOMEN

Test	Group and No. of Students	Possible Points on Test	Mean Points Made	SD	Diff. between M's	PE Diff.	Chances in 100	Group Favored
No.1	Women 113	50	37.3	5.7	2.1	2.2	99	Women
	Men 58		35.1	6.0				
No.2	Women 113	125	85.8	15.0	5.4	2.5	99	Women
	Men 57		80.4	12.5				
No.3	Women 113	75	51.6	7.4	1.9	1.1	87	Women
	Men 55		49.7	11.3				
No.4	Women 113	50	37.5	4.1	0.6	0.5	73	Men
	Men 52		38.1	7.2				
No.5	Women 113	200	166.0	14.2	0.6	0.3	64	Women
	Men 52		165.4	8.4				

Assuming the scores on the American Council on Education Psychological Examination to be in large part measures of ability to do college work, it was found that the "Hads" were the superior group. The mean score on this examination for the "Hads" was 94.3; that for the "Had Nots" was 88.9. The mean score for the men in this group was 94.4; the mean score for the women was 92.2. The difference between the mean scores on this examination between the "Hads" and the "Had Nots" is probably of some significance even though it is small. A reasonable conclusion would be that, to a limited extent, the more able students enroll in high school science courses. The difference between the mean scores of the men and the women is of very little or no significance.

While the differences between the scores of the "Hads" and the "Had Nots" in terms of the chances in one hundred that these differences are real differences, it is believed that several factors tend to reduce the seeming significance of these differences. First, the numbers of test items in all of the classroom tests except the final examination were small, thus making the influence of chance in their answering larger than it would have been in examinations containing larger number of test items. Second, the number of men in the class was small, increasing the factor of chance in the selection of these men as a representative group. Third, the poorest men in this class scholastically, withdrew from the class during the quarter, in this way narrowing the range of ability and interest in biology within the group of men in this class. Fourth, the scholastic

ability of the "Hads" was slightly higher than that of the "Had Nots" as shown on the American Council on Education Psychological Examination. Fifth, it would appear to be a reasonable assumption, although it is not here demonstrable, that the "Hads" had greater interest in biology than the "Had Nots" by reason of their having chosen to enroll in this course in high school and to enroll in it again in college. Some few of the "Had Nots" might have attended high schools so small that there were no courses in biology offered. Some of the "Hads" might have been required to enroll in biology in high school by reason of the nature of the curriculum offered. As a whole, however, the high schools of Oregon permit enough choices of classes by the pupils to make the numbers of members of this college course in biology so affected very limited, if they were affected at all. This interest in biology as a subject for study would, in all probability, affect the quality of the work done apart from the study of this subject in high school.

In summary, this paper is based upon a small study which had as its purpose the determination of the effect of previous high school training in biology upon achievement in college biology classes; and the differences in achievement in classroom biology between the men and women in a college biology class.

A review of the literature regarding the carry-over value of high school biology into college achievement is not conclusive. There is a conflict of conclusions regarding its value and conflicting evidence from various research projects. In the opinion of the writer

the carry-over value of high school biology to college is small if it is real. In a study comparing the differences in the achievements between the "Hads" and "Had Nots", the "Hads" showed slight superiority in four of the five classroom tests, from sixty-four to ninety-three chances in 100. As previously noted, the second test gave the "Had Nots" an apparent advantage which was evidently due to tutoring a relatively large number of "Had Nots." On the one hand, very few of the "Had Nots" had had any science subjects in high school and, hence, had had no acquaintance with science terminology, no training in the special ways of studying biology, no practice in the drawing and labeling of parts, no practice in assembling biological data under various headings, and no definite experience in keeping systematic notes. These are fundamental in the study of the sciences and should be definite values in the carry-over. This prior training, and the fact that recall or relearning of material once learned is easier than the initial learning plus some knowledge of how to study biology are the factors favoring the higher college achievement of the "Hads." On the other hand, alert and interested students can gain the relatively small amounts of these skills required in an elementary course in college biology rapidly during such a course. The quality of the instruction in the high school class would, without much doubt, be a noteworthy factor--if it could be measured--in any carry-over to college courses in biology which there might be.

The literature shows that women are superior to the men in linguistic or glossary work. The results of comparing the college

classroom biology achievements of the men and women in the five tests showed a superiority of the women in four of the five tests but that, as the course progressed, the chances in favor of the women decreased. Since this course in general biology and the examinations thereon emphasize the acquiring of a considerable amount of terminology, this slight superiority of the women is in keeping with the greater linguistic interest and achievement of women as a group and their generally greater industry as students.

It is the conclusion of this writer that the influence of high school training in biology has, in general, little carry-over value in college courses in biology and that any superiority which men students may have in the study of the sciences is exceeded by the greater industry and verbal interests of the women students. To a limited extent, the more able high school pupils enroll in high school science courses, among which are the courses in biology. To a probably greater extent, the pupils more interested in biology enroll in biology courses in high school and, later, in college. It would appear, therefore, that the general practice of colleges and universities of placing all beginning students in biology, regardless of their having had or not having had high school biology courses, is justified.

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BIOLOGICAL SCIENCE SURVEY

Name _____ Lect. Seat No. 15

Place the number of the statement in the appropriate blank in the column to the right. Use a number as many times as you see fit.

1. The study of the organism in relation to the environment is known as.....
2. The physical basis of life is.....
3. The most abundant element found in protoplasm.
4. Who was the first man known to have seen cells?
5. To what cardinal principle of education does biology probably have the greatest application?
6. The loss of water from the protoplast so that it is withdrawn or shrinks away from the cell wall is called
7. What is the first process involved in the entrance of water into the cell?
8. A membrane which permits the movement of molecules of different substances at different rates is.....
9. What part of the nucleus takes a heavy stain?
10. What substances found in cells, activate chemical reactions in the cell?
11. What pigment in plants is the source of Vitamin A?
12. What structure in the animal cell, in addition to the nucleus is concerned with cell division?
13. The sum total of the constructive and destructive processes in an organism is said to be.....
14. A colloid in which the dispersed phase is a liquid and the continuous phase is a solid is a.....
15. What property of protoplasm causes it to respond to stimuli?
16. Which of the three nutrients found in protoplasm give the most heat for per unit of weight?
17. The liberation of energy by organisms is known as....
18. The study of the functions of organisms is called.....
19. The most common compound found in protoplasm is.....
20. The vacuole of the cell is filled with.....
21. What kind of carbohydrate is glucose?
22. What part of the cell is chiefly concerned with the regulation and control of osmosis?
23. What kind of material is protoplasm?
24. What are the components of a true solution?
25. About what percentage of protoplasm is hydrogen
26. A cell that contains more than one nucleus is a .....

_____ anabolism
_____ carbohydrates
_____ carotin
_____ cell sap
_____ cellulose
_____ cell wall
_____ centrosome
_____ chloroplasts
_____ chromatin
_____ chromoplasts
_____ chromosomes
_____ coenocyte
_____ colloid
_____ Corti
_____ cytology
_____ cytoplasm
_____ diffusion
_____ digestion
_____ disaccharide
_____ ecology
_____ enzymes
_____ fats
_____ fifty per cent
_____ gel
_____ health
_____ Hooke
_____ imbibition
_____ impermeable
_____ irritability
_____ katabolism
_____ metabolism
_____ monosaccharide
_____ nucleus
_____ oxygen
_____ permeable
_____ physiology
_____ plasmolysis
_____ plasma membrane
_____ polysaccharide
_____ protein
_____ protoplasm
_____ rhythmicity
_____ semipermeable
_____ sol
_____ solute
_____ solvent
_____ ten per cent
_____ true solution
_____ vocation
_____ water

BIOLOGICAL SCIENCE SURVEY

Name_____ Lect. Seat No.____

Place the number of the statement in the appropriate blank before the words in the column to the right. Use each number once, and one number in a blank.

1. The study of the functions of organisms is called....
2. The lowest group of plants is known as....
3. In what type of habitat do Blue-green algae grow?
4. What is the most common compound in protoplasm?
5. Vitamin A is obtained from what plant pigment?
6. What important substance is obtained from certain Red algae?
7. The Blue-green algae reproduce by....
8. Because Oedogonium has unlike gametes, it is said to be....
9. Red snow owes its color to the presence of what organisms?
10. What structure is present in the animal cell that is absent in most plant cells?
11. Sexual reproduction in Spirogyra is called....
12. The egg of Vaucheria is present in the....
13. The male gametes of Oedogonium are able to move about with the aid of....
14. Starch is stored in what bodies in the green algae?
15. Where does Protococcus thrive?
16. The vacuole of the cell is composed largely of....
17. The study of classification of organisms....
18. An important element of protoplasm, found chiefly in the nucleus is...
19. What common element is present in proteins that is absent in fats and carbohydrates?
20. Energy stored in the cell is....
21. Cane and malt sugars are known as....
22. A colloid in which the dispersed phase is a liquid, and the continuous phase a solid, is....
23. The tendency for molecules to disperse themselves homogeneously in the available space is....
24. The idea that life is something more than purely physical and chemical manifestations is....
25. Blue-green algae are considered to be primitive because they lack....

_____ anatomy
_____ agar-agar
_____ antheridium
_____ Blue-green algae
_____ bark of trees
_____ carbon dioxide
_____ carotin
_____ chlorophyll
_____ centrosome
_____ chromoplasts
_____ conjugation
_____ cilia
_____ crystals
_____ cell sap
_____ chromatin
_____ chloroplasts
_____ disaccharides
_____ diffusion
_____ fungi
_____ fission
_____ fertilization
_____ fins
_____ fresh water
_____ gel
_____ heterogamous
_____ iodine
_____ isogamous
_____ in soil
_____ kinetic energy
_____ leucoplasts
_____ mechanism
_____ monosaccharides
_____ nitrogen
_____ nucleolus
_____ oxygen
_____ oogonium
_____ pathology
_____ physiology
_____ phosphorus
_____ pyrenoids
_____ potential energy
_____ Red algae
_____ salt water
_____ spores
_____ sol
_____ sulphur
_____ Thallophytes
_____ taxonomy
_____ vitalism
_____ water

BIOLOGICAL SCIENCE SURVEY

Name _____ Odd Lect. Seat No. ____

Place the number of the statement before the appropriate term to the right.

1. The study of the organism in relation to the environment is called.....
2. Certain red algae are commercially important because they produce a substance called.....
3. About 2.5% of protoplasm is composed of what element?
4. The fertilized egg of Oedogonium is known as the..
5. By what process does food become incorporated in the protoplasm?
6. The amoeba engulfs its food by means of protoplasmic extensions known as.....
7. Jello as eaten is what kind of a colloid?
8. Protoplasm has a method of growth from within known as.....
9. The sex cells of organisms are known by the general name of .....
10. The color in hot springs is sometimes caused by what organisms?
11. Fusion of unlike gametes is known as.....
12. The blue green algae reproduce only by.....
13. The color of brown algae is due to a pigment called.....
14. What algae have formed valuable mineral deposits in the past?
15. With respect to its kinds of gametes Ulothrix is said to be.....
16. Blue green algae are considered as primitive because they lack what two structures?
17. African sleeping sickness is carried by what insect?
18. When the particles of a solution are of molecular size, it is a.....
19. About 10 per cent of protoplasm is composed of what element?
20. About 15 per cent of protoplasm is composed of what compound?
21. A green alga that grows in salt water.....
22. Hormones are secreted by the.....
23. Structures in the chloroplasts of green algae that are concerned with starch storage
24. The lowest phylum of plants are the.....
25. The waste products of respiration are.....

_____ accretion
_____ agar-agar
_____ assimilation
_____ binary fission
_____ blue green algae
_____ calcium
_____ carbon dioxide
_____ chloroplasts
_____ conjugation
_____ colloidal solution
_____ cytology
_____ desmids
_____ diatoms
_____ digestion
_____ digestive glands
_____ ecology
_____ endocrine glands
_____ fats
_____ flagella
_____ fertilization
_____ fucoxanthin
_____ gametes
_____ gel
_____ heterogamous
_____ house fly
_____ hydrogen
_____ isogamous
_____ intussusception
_____ iron
_____ morphology
_____ nitrogen
_____ nuclei
_____ oospores
_____ oxygen
_____ plastids
_____ potassium iodide
_____ protein
_____ pseudopodia
_____ pyrenoids
_____ phycocyanin
_____ red algae
_____ salt
_____ sea lettuce
_____ sea palm
_____ sol
_____ Thallophytes
_____ true solution
_____ tsetse fly
_____ water
_____ zoospores
_____ zygospores

BIOLOGICAL SCIENCE SURVEY
Midterm Exam

Name _____ Lecture seat No. _____

Completion Statements

1. Amoebic dysentery is caused by a member of what group of Protozoa? 1. _____
2. Potassium and iodine are obtained from what group of algae? 2. _____
3. A group of cells specialized for a specific function... 3. _____
4. The science of the relation of the organism to the environment. 4. _____
5. The process whereby digested food is incorporated into the protoplasm. 5. _____
6. Because Vaucheria has a multi-nucleate filament, it is said to be.... 6. _____
7. A fertilized egg-cell is known as a 7. _____
8. The amoeba wraps itself around a particle of food by protoplasmic extensions known as... 8. _____
9. A paramecium rids itself of surplus water by means of the... 9. _____
10. Glandular secretions that control the growth of an organism. 10. _____
11. Blood is considered as what type of tissue? 11. _____
12. The sexual reproduction of the malarial parasite takes place in what organism? 12. _____
13. The sleeping-sickness protozoan belongs to what class? 13. _____
14. The paramecium protects itself by means of its... 14. _____
15. A property of protoplasm which enables an organism to respond to stimuli... 15. _____
16. When the more solid medium of a colloid is the continuous phase it is called a... 16. _____
17. The lowest animals are known as.... 17. _____
18. Starch, cellulose, and cane sugar are foods that are classed as... 18. _____
19. The most abundant element in protoplasm. 19. _____
20. The most abundant compound in protoplasm. 20. _____
21. The surface of an organism is usually covered with what type of tissue? 21. _____
22. The most important substance in the nucleus 22. _____
23. The oxidation of food in the cell is called.. 23. _____
24. Osmosis is largely controlled by what part of the cell? 24. _____
25. A common nitrogenous metabolic waste is... 25. _____

BIOLOGICAL SCIENCE SURVEY

Name _____ Seat No. 19.

1. To what group of organisms do bacteria seem to be most nearly related? 1 _____
2. What type of nutrition do iron and sulphur bacteria have? 2 _____
3. What fungus resembles animals during a portion of its life cycle? 3 _____
4. The condition of two organisms of different species living together for mutual benefit is known as.... 4 _____
5. Who is considered as having been the father of bacteriology? 5 _____
6. The sexual cycle of the malarial parasite occurs where? 6 _____
7. The paramecium belongs to what class of protozoa? 7 _____
8. Organisms that live on dead organic material are known as..... 8 _____
9. The chalk deposits in the cliffs of Dover were formed by the tests of what protozoan? 9 _____
10. What protozoan is often present in the human mouth? 10 _____
11. A member of what class of protozoa digests wood for the termite? 11 _____
12. What plant-like protozoan forms a spherical colony and demonstrates intercellular division of labor? 12 _____
13. In what form are carbohydrates stored in the fungi? 13 _____
14. What alga does black mold resemble in its life cycle? 14 _____
15. Bacteria that need free oxygen in order to live are known as..... 15 _____
16. The decomposition of proteins by bacteris is called 16 _____
17. A substance containing antibodies injected into the body to prevent disease is known as a.... 17& _____
18. Immunity aqquired by having a disease is called..... 18 _____
19. Bacteria or protozoa that cause disease are said to be..... 19 _____
20. Certain agents of sub-microscopic size that cause disease are the..... 20 _____
21. A substance injected into or applied to the body that causes the body to build antibodies is called... 21 _____
22. Who was the first man to knowingly apply the principles of vaccination? 22 _____
23. Inherent immunity is considered as ..... 23 _____
24. The time required for the symptons of a disease to appear after infection is known as the period of.... 24 _____
25. White corpuscles that have the power to kill and devour bacteris are clled..... 25 _____
26. Yeast secretes an enzyme known as..... 26 _____
enzyme

BIOLOGICAL SCIENCE SURVEY

Name _____ Lecture Seat No. _____

In addition to hydrogen and oxygen, an important element in carbohydrates is (1). The source of this element is the (2) where it exists in combination with oxygen in the form of a (3), known as (4). The first step involved in its incorporation into living matter is the process of (5) which occurs only in (6). In this process it is united with (7) to form (8). After this compound is formed it may be used in making more complex carbohydrates for storage such as (9). The substance designated as (4) may be first released in the process of (10) carried on by (6). These organisms may be eaten by (11), which by the same process release it into the (2). Decomposition of organic matter ny (12) may also release the substance (4). Another method whereby it is released is in the process of (13) of (14) compounds. The entire foregoing process is the (15).

16. A serum contains what kind of anti-disease substance?
17. Immunity attained by the injection of a serum.
18. Sulphur and iron bacteria secure their energy by.....
19. Who was the father of bacteriological technique?
20. What are the cocci bacteria that form chains?
21. How do bacteria reproduce?
22. Organisms that live on dead organic material are called.....
23. When organisms live together for mutual benefit it is called.....
24. The theory that life does not arise from pre-existing life.
25. Bacteria that cause disease are said to be...
26. Cells of the body that ingest bacteria are...
27. Substances or organisms smaller than bacteria that may cause disease in plants and animals.
28. Who first made use of the principle of vaccination?
29. The ability of bacteria to invade the body and produce disease is known as....
30. Substances in the body that kill and dissolve bacteria.

_____ air
_____ aerobic
_____ anaerobic
_____ animals
_____ antitoxin
_____ attenuated bacteria
_____ ammonia
_____ active immunity
_____ acquired immunity
_____ bacteria
_____ bacteriophages
_____ carbon
_____ carbon dioxide
_____ carbohydrates
_____ carbon cycle
_____ chemosynthesis
_____ commensalism
_____ fission
_____ gas
_____ green plants
_____ glucose
_____ infection
_____ Jenner
_____ Koch
_____ lysins
_____ Lister
_____ nitrogen
_____ nitrogen cycle
_____ opsonins
_____ oxidation
_____ parasites
_____ pathogenis
_____ phagocytes
_____ Pasteur
_____ passive immunity
_____ photosynthesis
_____ red corpuscles
_____ respiration
_____ starch
_____ staphlococci
_____ streptococci
_____ spores
_____ saprophytes
_____ symbiosis
_____ spontaneous generation
_____ toxins
_____ vitalism
_____ viruses
_____ virulence
_____ water

BIOLOGICAL SCIENCE SURVEY

Name _____ Even Seat No. ____

1. Immunity present from the time of birth is..... 1 _____
2. Substances in the body that kill bacteria..... 2 _____
3. A substance applied to the body to stimulate the production of antibodies is a..... 3 _____
4. A world of micro-organisms is called a..... 4 _____
5. Who is considered as the "father of bacteriology? 5 _____
6. How does yeast reproduce? 6 _____
7. Who was the first man to discover the principle of vaccination? 7 _____
8. What disease-producing organisms or substances are ultra-microscopic? 8 _____
9. What is the fist line of bodily defense against disease germs? 9 _____
10. Increase in the number of white corpuscles due to the presence of disease germs is called.... 10 _____
11. What stage of the malaria protozoan is transferred from the mosquito to man? 11 _____
12. The situation of flagellates living in the intestine of the termite is known as..... 12 _____
13. Immunity acquired by being treated with an anti-toxin is said to be..... 13 _____
14. A mass of fungal filaments ic called a..... 14 _____
15. The paramecium has a method of sexual reproduction known as..... 15 _____
16. What bacteria are spherically shaped? 16 _____
17. What protozoa are useful in oil geology? 17 _____
18. How many nuclei in the paramecium? 18 _____
19. What kind of organism causes infantile paralysis? 19 _____
20. When the virulence of a disease germ has been weakened, it is said to be..... 20 _____
21. Respiration in the absence of oxygen, such as takes place in yeast is called..... 21 _____
22. What substances in the body help the white corpuscles to ingest bacteria? 22 _____
23. Toxic poisoning from eating canned vegetables containing a certain kind of bacteris is 23 _____
24. What kind of mold frequently attacks fish? 24 _____
25. In what structure of black mold, are the spores produced? 25 _____

BIOLOGICAL SCIENCE SURVEY

Name _____ Seat No. _____ 22

Use each number as many times as you see fit.

1. What fungus-like organism resembles animals at certain stages of its life history?
2. By what structures does black mold attach itself to the substratum?
3. What sppres of the wheat rust are produced on the wheat plant?
4. To what group of fungi do mushrooms belong? (Check only the scientific name.).
5. Yeast belongs to what group of fungi? (Check only the scientific name.)
6. In the Ascomycetes, what is the name of the structure in which the spores are produced?
7. What organism is the algal component of the lichen?
8. In order to eradicate white pine blister rust, what plant should be destroyed?
9. What special kind of carbohydrate is synthesized by the fungi?
10. What are the different kinds of Basidiomycetes as listed by their common names?
11. Because wheat rust requires two hosts in order to complete its life cycle, it is said to be....
12. Because Obelia has two individuals in its life cycle, it exhibits a condition known as .....
13. What stage in the life cycle of the Obelia produces the gametes?
14. The two walls of the Hydra are separated by a layer of jelly called the.....
15. The thread capsule of the Hydra is contained within a cell known as the.....
16. What kind of symmetry does the Hydra have?
17. Because the Hydra produces eggs and sperms on the same individual, it is said to be....
18. In the cup fungi, the layer of spore-bearing structures is called the.....
19. What mold commonly attacks fish?
20. A mass of fungal filaments is known as ....
21. In the mushroom, much of the fungus occurs in the.....
22. What kind of digestion occurs within the gastrovacular cavity of the Hydra?
23. The sponges belong to what phylum?
24. In order for sexual reproduction to occur in black mold, there must be....
25. In the bracket fungus, most of the fungus may be in the.....
26. What spores of white pine blister rust occur on the pine tree?

_____ Ascomycetes
_____ ascus ations
_____ alternation of gener-
_____ aeciospores
_____ Basidiomycetes
_____ barberry bush
_____ bilateral symmetry
_____ black mold
_____ basidium
_____ cnidocil
_____ cnidoblast
_____ Ctenophora
_____ Coelenterata
_____ coral fungi
_____ dioecious
_____ extracellular
_____ green alga
_____ gill fungi
_____ glycogen
_____ heteroecious
_____ heterogeneous
_____ hermaphroditic
_____ hypha
_____ hymenium
_____ intracellular
_____ mesoderm
_____ mesoglea
_____ medusa
_____ mycelium
_____ nematocyst
_____ Phycomycetes
_____ pore fungi
_____ polyp
_____ Porifera
_____ pycniospores
_____ plus and minus strains
_____ radial symmetry
_____ rhizoids
_____ red alga
_____ sac fungi
_____ sporangia
_____ soil
_____ slime mold
_____ stolons
_____ teliospores
_____ tooth fungi
_____ tree
_____ uredospores
_____ water mold
_____ wild currant

BIOLOGICAL SCIENCE SURVEY
FINAL EXAM

Fill in the blanks with the appropriate terms.

1. List the four types of tissues. 1_____

2. What protozoa emanate light? 2_____

3. What kind of immunity is acquired by inoculation with anti-toxin? 3_____

4. The capacity of an animal to form lost parts is.... 4_____

5. The Hydra may reproduce asexually by..... 5_____

6. What group of plants have nodules on their roots that contain bacteria important in the nitrogen cycle? 6_____

7. The tendency of regenerated parts to have the same axial position as the original animal is called..... 7_____

8. Particles within the cell, but that are not an integral part of the cytoplasm are known as..... 8_____

9. Because the Planaria has one more germ layer than the Hydra, it is said to be..... 9_____

10. Into what adult form does the zygote of Obelia develop? 10_____

11. Planaria has what kind of symmetry? 11_____

12. What term is applied to the stage of the animal embryo resembling a hollow sphere? 12_____

13. The skeleton of the commecial sponge is composed of what substance? 13_____

14. All animals composed of more than one cell are spoken of collectively as the..... 14_____

15. What worm may be contracted by man by eating uncooked pork? (Threadworm). 15_____

16. What is a common nitrogenous waste of metabolism? 16_____

17. List the three basic activities of organisms? 17_____

18. The elements oxygen, carbon, hydrogen, and nitrogen make up about what percentage of protoplasm? 18_____

19. A species of organism that has two distinct sexes is said to be..... 19_____

20. What kind of circular islands are formed by coral? 20_____

In the column to the left is a list of organisms that we have studied, are cited in your textbook, have been observed in laboratory, or have been given in lecture. Place the number of the organism before the group to which it belongs. Place as many different numbers as necessary in each blank.

1. Spirogyra
2. Oscillatoria
3. Vaucheria
4. Fucus (rockweed)
5. Protococcus
6. Nostoc
7. Paramecium
8. Amoeba
9. Malaria parasite
10. Trypanosomes
11. Euglena
12. Streptococcus
13. Yeast
14. Rhizopus nigricans
15. Cup fungus
16. Saprolegnia
17. Slime molds
18. Mushrooms
19. wheat rust
20. Hydra
21. Planaria
22. Sea anemone
23. Corals
24. Obelia
25. Sponges
26. Liver flukes
27. Tapeworms
28. Hookworm
29. Trichinella
30. Green molds
31. Ascaris
32. Rotifers
33. Vorticella
34. Bacteriophages
35. Foraminifera

_____ Ascomycetes

_____ Bacteria

_____ Basidiomycetes

_____ Blue green algae

_____ Brown algae

_____ Ciliates

_____ Coelenterata

_____ Flagellates

_____ Green algae

_____ Nemathelminthes

_____ Platyhelminthes

_____ Phycomycetes

_____ Porifera

_____ Sarcodina

_____ Sporozoa

_____ Trochelminthes

_____ Viruses

True and False.

Encircle the appropriate letter.

T F The chief differences between plants and animals is that plants have no locomotion.

T. F The atmosphere consists of about .03 per cent of nitrogen.

T F The cell wall is the chief control of osmosis.

T F Sleeping sickness is caused by a trypanosome.

T F Planaria is the lowest organism that is diploblastic.

T F The loss of metabolic wastes from the body is called egestion.

T F Termites are able to digest the cellulose of wood.

T F Euglena is a protozoan that has chlorophyll.

T F Energy is obtained by organisms through digestion.

T F Planaria is the lowest animal constructed on the organ-system basis.

T F The paramecium protects itself by means of its nematocysts.

T F The hollow sphere stage in animal development is called the blastula.

T F The brown algae are largely marine plants.

T F The sporophore is the edible portion of the mushroom.

T F Certain kinds of cheeses are flavored with bread mold.

T F The club root of cabbage is caused by a slime mold.

T F The Coelenterata are characterized by radial symmetry.

T F Hookworm is a member of the Platyhelminthes.

T F The alternate host of the liver fluke is a fresh water snail.

T F Tuberculosis is caused by a filterable virus.

T F The amoeba can move faster than the paramecium.

T F Malaria is transmitted to man by the tsetse fly.

T F The sexual cycle of the malarial parasite occurs in man.

T F The sac fungi are characterized by a structure known as an ascus.

T F Pasteur was the first man to see bacteria.

T F Active immunity may be acquired only by having a disease.

BIOLOGICAL SCIENCE SURVEY

Use each number as many times as you see fit, or place as many numbers in each blanks as necessary.

1. What characteristic of protoplasm causes it to respond to stimuli?
2. Stored up energy is known as .....
3. The method of growth of protoplasm is known as...
4. Black mold shows similarities to what alga?
5. A medium in which the particles are of molecular size, and homogeneously dispersed is a....
6. What structure of the cell controls its metabolism?
7. That all life begins as a single cell is a part of what biological principle?
8. During the process of cell division the chromatin of the nucleus is organized into bodies known as the.....
9. What structure does the animal cell have that is absent in the plant cell?
10. A colloid in which liquid is the continuous, and a soild the discontinuous phase....
11. The response of an organism to light is....
12. A group of cells similar in structure and having the same structure.....
13. What kind of a carbohydrate is cane sugar?
14. What is the most abundant element in protoplasm?
15. What is the most abundant compound in protoplasm?
16. The elimination of metabolis wastes is called
17. What structure of the Amoeba and Paramecium is concerned with water equilibrium?
18. The organism that causes African sleeping sickness belongs to what group of Protozoa?
19. Nostoc has a special cell that servos as a means for breaking up the filament, known as....
20. Because the gametes of Spirogyra are similar, the plant is said to be.....
21. In Oedogonium the egg is contained in the....
22. Motile spores of the algae are called.....
23. Sexual reproduction of Plasmodium vivax takes place where?
24. What are the alternate hosts of the Chinese liver fluke?
25. When an animal develops from an unfertilized egg, it is known as.....

_____ accretion
_____ antheridium
_____ carbon dioxide
_____ cell inclusions
_____ cell theory
_____ centrosome
_____ chromoplasts
_____ chromosomes
_____ ciliates
_____ colloid
_____ disaccharide
_____ egestion
_____ excretion
_____ fish
_____ flagellates
_____ gel
_____ heterocysts
_____ heterogamous
_____ heterothallis
_____ human blood
_____ intussusception
_____ irritability
_____ isogamous
_____ kinetic
_____ mitochondria
_____ monosaccharide
_____ mosquite's stomach
_____ nitrogen
_____ nucleus
_____ oogonium
_____ organ
_____ Oscillatoria
_____ oxygen
_____ parthenogensis
_____ phototropism
_____ potential
_____ Protococcus
_____ pseudopodia
_____ pulsating vacuole
_____ rythmicity
_____ snail
_____ sol
_____ tissue
_____ true solution
_____ thermotropism
_____ Vaucheria
_____ vitalism
_____ water
_____ zoospores
_____ zygospores

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Comparative Studies of Students in First Term College Biology

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The colleges formerly distinguished between students who had had high school biology and students who had not in terms of the collegiate courses to which the respective groups were assigned. Those who had had a year of high school biology were assigned to the second quarter or semester of the related college elementary course while the others were assigned to the first quarter or semester. Later, and in terms of current general practice, no distinction is being made between the students in these two groups in that all of them are placed in the same beginning courses in biology. The colleges believe in terms of their practices that the high schools as a group, are not effective enough in their preparation of pupils in biology to warrant giving credit for courses in high school biology.

From the high school point of view, it appears desirable to teach the sciences in high school because of the relatively small percentages of high school pupils who go to college. The majority of high school pupils receive the only formal training in the sciences which most of them will ever receive. From the college point of view, if the high school courses have resulted in real training in the sciences, the students should not be required to repeat work which they have already mastered and waste time which they might spend more profitably in more advanced study. For colleges to continue to give no credit for high school achievement in the sciences seems to be an indictment of the quality of the training given in these fields.

Prior studies of the classroom achievements of students in elementary biology courses in college show that there are no differences or at most slight differences in achievement in college biology favoring those who had high school biology. . . .

In his attempt to find that high school biology has or does not have a significant value in biology at the college level, the writer has undertaken this brief study of the comparative achievements of two groups in college biology. The study measures the differences in performance of a group of students who had high school biology and a group of students who had no formal training in biology before entering college. A further comparison has been made between the performances of the men and women as an

indication that the ancient superstition that women have less scientific aptitude than men is or is not true and that the more modern superstition that women are the better students, is or is not correct.

For the purposes of this paper the group which had high school biology will be designated as "Hads" and the group which had no high school biology as "Had Nots." An elementary statistical treatment of the scores of these four groups in each of the five non-standardized objective college classroom tests in biology was used. The basic criterion for judgment was the usual formula for the differences between means from these classroom tests. In addition, the scores from the American Council on Education Psychological Examination for College Freshmen were collected in order that any marked differences in the mean scores of any of the four groups on this examination might be noted. Necessarily there were limitations to the study. The group completing this one quarter course was composed of 165 students who either had or had not had high school biology. Of these, five did not state that they had or had not had high school biology and could not be included in this comparison. The study comparing the men and women included the 165 students. The number of women included in the study was 113. The number of men varied from 58 on the first test to 52 on the fourth and fifth tests, as the scholastically poorest of the men withdrew from the course. The effect of tutoring between the first and second classroom tests influenced the comparison between the "Hads" and the "Had Nots" for the reason that, of the thirty-three students who were tutored, twenty-four were "Had Nots" and nine were "Hads." The tutoring consisted of a two hour session, given by a graduate student, on material to be covered in the second test.

The tests were drawn up by the teacher of the course and were composed of selections from among thousands of similar objective test items in a proportion believed by the instructor to parallel the emphasis given the various subtopics in the text, the lectures, and the laboratory. The test items were predominantly of the matching form. The remainder were of the simple (one word) completion form.

The following tabulation shows the results of the "Hads" and the "Had Nots" in this biology class:

In the study comparing the differences in the achievement of the "Hads" and the "Had Nots," the "Hads" showed what would appear to be significant superiority on four of these five tests according to a statistical table of chances of a true difference greater than zero, given the actual difference. The "Had Nots" scored higher on the second test.

TABLE I

COMPARISONS OF OBJECTIVE TESTS RESULTS BETWEEN THE "HADS" AND THE "HADNOTS"

Test	Group and No. of Students	Possible Points on Test	Mean Points Made	SD	Diff. between M's	PE Diff.	Chances in 100	Group Favored
No. 1	Had 118	50	36.8	7.3	0.4	0.3	64	Had
	Had Not 48		36.4	6.4				
No. 2	Had 117							
	Had Not	125	85.1	11.9	2.8	1.3	92	Had Not
			82.2	12.6				
No. 3	Had 115		51.3	8.3	1.8	1.0	86	Had
	Had Not 48	75	49.5	10.4				
No. 4	Had 113	50	38.3	7.2	0.9	1.0	86	Had
	Had Not 47		37.3	4.2				
No. 5	Had 113	200	166.8	13.7	3.5	1.5	93	Had
	Had Not 47		163.2	14.0				

In the second part of the study the differences in scores on these five tests between the men and the women taking these tests showed the women to be the superior group in four of the five tests. The men did better than did the women on the fourth test. The table that follows summarizes the comparative data between these men and women.

TABLE II

ACHIEVEMENT DIFFERENCES ON CLASSROOM BIOLOGY TESTS BETWEEN MEN AND WOMEN

Test	Group and No. of Students	Possible Points on Test	Mean Points Made	SD	Diff. between M's	PE Diff.	Chances in 100	Group Favored
No. 1	Women 113	50	37.3	5.7	2.1	2.2	99	Women
	Men 58		35.1	6.0				
No. 2	Women 113		85.8	15.0	5.4	2.5	99	Women
	Men 57	125	80.4	12.5				
No. 3	Women 113	75	51.6	7.4	1.9	1.1	87	Women
	Men 55		49.7	11.3				
No. 4	Women 113	50	37.5	4.1	0.6	0.5	73	Men
	Men 52		38.1	7.2				
No. 5	Women 113	200	166.0	14.2	0.6	0.3	64	Women
	Men 52		165.4	8.4				

Assuming the scores on the American Council on Education Psychological Examination to be in large part measures of ability to do college work, it was found that the "Hads" were the superior group. The mean score on this examination for the "Hads" was 94.3; that for the "Had Nots" was 88.9. The mean score for the men in this group was 94.4; the mean score for the women was 92.2. The difference between the mean scores on this examination between the "Hads" and the "Had Nots" is probably of some significance even though it is small. A reasonable conclusion would be that, to a limited extent, the more able students enroll in high school science courses. The difference between the mean scores of the men and the women is of very little or no significance.

While the differences between the scores of the "Hads" and the "Had Nots" in terms of the chances in one hundred that these differences are real differences, it is believed that several factors tend to reduce the seeming significance of these differences. First, the numbers of test items in all of the classroom tests except the final examination were small, thus making the influence of chance in their answering larger than it would have been in examinations containing larger number of test items. Second, the number of men in the class was small, increasing the factor of chance in the selection of these men as a representative group. Third, the poorest men in this class scholastically, withdrew from the class during the quarter, in this way narrowing the range of ability and interest in biology within the group of men in this class. Fourth, the scholastic ability of the "Hads" was slightly higher than that of the "Had Nots" as shown on the American Council on Education Psychological Examination. Fifth, it would appear to be a reasonable assumption that the "Hads" had greater interest in biology than the "Had Nots" by reason of their having chosen to enroll in this course in high school and to enroll in it again in college. Some few of the "Had Nots" might have attended high schools so small that there were no courses in biology offered. Some of the "Hads" might have been required to

enroll in biology in high school by reason of the nature of the curriculum offered. As a whole, however, the high schools of Oregon permit enough choices of classes by the pupils to make the numbers of members of this college course in biology so affected very limited, if they were affected at all. This interest in biology as a subject for study would, in all probability, affect the quality of the work done apart from the study of this subject in high school. And of course the number of students in the survey was small.

A review of the literature regarding the carry-over value of high school biology into college achievement is not conclusive. There is a conflict regarding its value and conflicting evidence from various research projects. In the opinion of the writer the carry-over value of high school biology to college is small if it is real. In a study comparing the differences in the achievements between the "Hads" and "Had Nots," the "Hads" showed slight superiority in four of the five classroom tests, from sixty-four to ninety-three chances in 100. As previously noted, the second test gave the "Had Nots" an apparent advantage which was evidently due to tutoring a relatively large number of "Had Nots." On the one hand, very few of the "Had Nots" had any science subjects in high school and, hence, had no acquaintance with science terminology, no training in the special ways of studying biology, no practice in the drawing and labeling of parts, no practice in assembling biological data under various headings, and no definite experience in keeping systematic notes. These are fundamental in the study of the sciences and should be definite values in the carry-over. This prior training, and the fact that recall or relearning of material once learned is easier than the initial learning plus some knowledge of how to study biology are the factors favoring the higher college achievement of the "Hads." On the other hand, alert and interested students can gain the relatively small amounts of these skills required in an elementary course in college biology rapidly during such a course. The quality of the instruction in the high school class would, without much doubt, be a noteworthy factor—if it could be measured—in any carry-over to college courses in biology which there might be.

The literature shows that women are superior to the men in linguistic or glossary work. The results of comparing the college classroom biology achievements of the men and women in the five tests showed a superiority of the women in four of the five tests but that, as the course progressed, the chances in favor of the women decreased. Since this course in general biology and the examinations thereon emphasize the acquiring of a considerable amount of terminology, this slight superiority of the women is in keeping with the greater linguistic interest and achievement of women as a group and their generally greater industry as students.

It is the conclusion of this writer that the influence of high school training in biology has, in general, little carry-over value in college courses in biology and that any superiority which men students may have in the study of the sciences is exceeded by the greater industry and verbal interests of the women students. To a limited extent, the more able high school pupils enroll in high school science courses, among which are the courses in biology. To a probably greater extent, the pupils more interested in biology enroll in biology courses in high school and, later, in college. It would appear, therefore, that the general practice of colleges and universities of placing all beginning students in biology, regardless of their having had or not having had high school biology courses, is justified.