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THE EFFECTS OF A PASS-FAIL GRADING SYSTEM ON THE ACADEMIC  
ACHIEVEMENT OF HIGH SCHOOL BIOLOGY STUDENTS

by 7214

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## CHAPTER I

### BACKGROUND FOR THE STUDY

The most common grading system in high schools in the United States today is the letter graded system. Grades provide information to the student and about the student. They are one of the most efficient methods of evaluation of student achievement by employers and educators. Many also feel that grades are invaluable as a motivating device (Kingston and Wash, 21).

Some educators, however, criticize our grading practices. Their arguments are summarized by Crooks (6) when he questions "... the reliability of marks, their purposes, the methods of their presentation and even their necessity." One proposed solution to the problem of grading is a pass-fail system. It is hoped this system will reduce many of the inequities of grading. However, one important question raised about a pass-fail system is whether students will achieve as well as when they had the motivation of grades. Some information about this is available at the elementary and university levels, but almost none is available at the high school level. Care must be exercised in applying research at the elementary and university levels to the high school situation, and yet high schools need some basis for making curricular decisions in this area. It was in this area that this study was conducted.

### Statement of Purpose and Limitations of the Study

The purpose of this study was to provide some objective data on the comparative effects of a pass-fail grading system and a letter graded system on academic achievement in high school biology as measured by an objective test. The study was conducted with the Biology I students at Luckey High School in Manhattan, Kansas. Luckey is a small parochial school with an enrollment of less than 150 students. Its students are drawn from Manhattan, a town of 25,000, and the surrounding farm community.

This study had several limitations which should be considered when attempting to extrapolate the results of this research to the general high school population. This study was conducted at a parochial school which tended to have a student body with an IQ slightly higher than average. This study also lacked a representative sampling of minority students and culturally deprived students.

### Definition of Terms

Pass-Fail Grading System- Any system where there are only two categories, one for acceptable work for which credit is given, and one for unacceptable work for which no credit is given.

Graded System- A system containing five categories, A, B, C, D, and F, with a hierarchy running from a high grade of A to a low grade of F or failing.

High School- For purposes of this study, grades 9-12.

Biology I- A first year, introductory biology course.

In this study, the BSCS Blue-Version, 1968 edition was used (3).

Academic Achievement- The score on an achievement test consisting of selected questions from the BSCS Biological Science: Molecules to Man: Blue-Version: Achievement Test 2 (4), and the BSCS Test Booklet for Molecules to Man (5).

Grading System- Any system with two or more categories of student achievement. This may also be referred to as a marking system.

## CHAPTER II

### A REVIEW OF RELATED RESEARCH AND LITERATURE

Some common grading schemes used are the pass-fail system, letter grades, check lists and rating scales, behavioral descriptions, correspondence with parents, and parent-teacher conferences. The frequency of the various grading schemes used in elementary and secondary schools is summarized in Table 2-1. Of these reporting alternatives, this paper concerns itself with the graded and the pass-fail systems. Grades are by far the older reporting system, although some universities have had a form of pass-fail grading for over 120 years (Quann, 31).

Table 2-1. FREQUENCY OF REPORTING SYSTEMS IN ELEMENTARY AND SECONDARY SCHOOLS. (NEA, 27)

Type System	Elementary	Secondary
Scale of letters	70%	82%
Conferences	60%	20%
Written descriptions	24%	12%
Scale of numbers	10%	10%
Percentages	2%	12%
Pass-fail	10%	2%

(Approximate percentages read from a histogram.)

Little research has been done at the high school level concerning grades and the pass-fail marking system. Much research has been done at the university level and some at the elementary level. This review lists various arguments for

and against grades and for and against the pass-fail system. It includes any research done at the high school level concerning these topics and also any related research at the university and elementary levels.

#### Grades Provide Needed Information: Pro and Con

One argument in favor of grades is that they provide much needed information for parents and students of the student's progress, as an evaluation of teaching, and as data for counseling (Smith, 38)(Trow, 46). Grades are also valued for their administrative efficiency. Warren (48) concludes that if there are to be such things as class rankings, etc., grades are the most efficient way to accomplish this.

College administrators seem to echo these conclusions. Graduate deans and college admissions officers indicated that a transcript containing a record of pass-fail courses had a negative effect on the admission of this person. The main reason given was the greater ease and accuracy of evaluating a student with a graded transcript. Studies supporting these ideas have been conducted by Hassler (16), Rossman (33), Warren (48), Cotlove (10), and Oberteuffer (29). Cotlove and Oberteuffer indicate that many high schools avoid pass-fail grading because college admissions officers frown on pass-fail transcripts.

Proponents of a pass-fail system do not debate these findings. They do argue, however, that the evaluative procedures that lead to the most effective feedback are often not those that lead to the most useful ranking of students.

### Grades Reinforce Learning: Pro and Con

The most frequently mentioned benefit of grades is that they motivate and reinforce learning. Miller (26) and Smith (38) both point to grading as one means of preparing students for the competitiveness of the "real world." Ebel (12) claims there is nothing wrong with working for a grade if grades are valid measure of achievement.

The proponents of pass-fail grading claim that grades become the goal of education, not merely the symbol of this goal (McGuire, 25). Little evidence was found by Warren (48) to support the idea that grades were a motivation to learn. He found that "...the student's desire for competence assessed by himself and revealed to him by teachers and others is not augmented appreciably by publication of formal grades." Warren further criticizes the idea that grades prepare students for the competition of real life. He claims this is not a valid argument as few jobs are evaluated by the use of tests. Most evaluation is informal and you either pass or fail. Stallings (40) found that most college students agree with Warren's conclusions.

The Council of Graduate Schools in the U.S. studied various student evaluation practices, and they found, as reported by Sparks (39), that grading actually impedes the learning process. Miller (26) and Smith (38) criticize grading because it discourages intellectual experimentation, and restricts the creative leisure of the student. This would counteract the idea that grades reinforce learning.

### Student Achievement: Pass-Fail vs. Grading

The research in the area of student achievement has been done at both the elementary and the collegiate levels with no research reported at the high school level. If students achieve more under a graded system than under a pass-fail system, this would tend to substantiate grades as a motivating influence. However, if there were no difference or students achieved higher under a pass-fail system, this would negate the idea of grades being a motivation to students.

At the elementary level, Louis (23) reports greater progress in language and math under a pass-fail system than under a graded system. Another study by Christensen (9) supported these findings, indicating that at the elementary level, grades are not a significant motivating device.

At the college level, Tragressor (45) found that a greater number of students who elected to take the pass-fail option received one or more failing grades than did the students not electing the option. He cautions, however, that this may be due to professors setting harder standards for passing pass-fail students. A study at Princeton supported these conclusions. Karlans, Kaplan, and Stuart (20) found that with equal ability, students achieve lower under the pass-fail option at the freshman, sophomore, and junior levels. However, he found no significant difference in the senior year.

Warren (48) found that under a complete pass-fail system there is no evidence that students learn less than they normally

would. Shontz (35) explains this difference in achievement under the pass-fail option and a total pass-fail system by stating that students are not able to take a pass-fail option seriously when all the other courses are graded. He concludes, as did Warren, that under a total pass-fail system, all the courses would be treated equally.

In a questionnaire of college students, Birney (2) found that achievement follows lines of interest rather than grade lines. According to students, failing or near failing grades will produce the greatest amount of study. In courses of high interest, high grades may stimulate more study.

#### Grades Are Inaccurate

Proponents of a pass-fail system offer several other criticisms of grades. One of the most prevalent is that present grading practices are not accurate. The way the teacher perceives a student, the manner in which he evaluates, the accuracy of the measuring device, the sex of the student, and the sex of the teacher all lead to inconsistencies in grades. Sparks (39) points out that grades are especially poor representatives of learning in areas with a high amount of subjectivity, such as the social sciences.

Another common criticism of grading systems is their lack of consistency. Terwilliger (44), Vredevoe (47), and Kirby (22) all have found that grading practices differ from school to school, among teachers in different areas in the same school, and finally among teachers in the same subject area in the same



school. Not only are school policies different, but Halliwell (15) found it impossible to evaluate grades using stated school policies because teachers did not adhere to the policies.

Continually being graded low tends to debase an individual's concept of his own worth is suggested by Simon (36). Warren (48) points out that grades tend to perpetuate social and economic levels.

Chalk (8) states that students having economically and culturally deprived backgrounds have considerable difficulty in completing high school. She contends that it is not necessarily true that low high school grades mean low achievement for the disadvantaged. These students are asked to demonstrate exceptional merit despite the environment of an inadequate diet, often disruptive family life, marginal self-esteem, and very little encouragement. Approximately 50% of all high school graduates enroll in college, while only 8% of the graduates from disadvantaged backgrounds continue their education past high school. These students can not afford college without a scholarship even when accepted, and few obtain scholarships since their grades are low. She concludes that these facts constitute another reason for a pass-fail system.

#### Reasons For Pass-Fail

Cotlove (10) and Warren (48) feel a pass-fail system would remove much of the pressure and anxiety of a graded system, and once again make the goal of education, knowledge itself. Tees (43) feels this would encourage a student to explore an area where

he was uncertain of his ability.

In addition to counteracting the negative aspects of grades, there are other advantages to a pass-fail system. One of the reasons given for the pass-fail option was to have students devote less time to these courses and have more time for their graded courses. This would account for the findings that students achieve lower in pass-fail option courses. However, Karlans, Kaplan, and Stuart (20) found no differences in the yearly grade point averages for pass-fail and non-pass-fail students. This would indicate that a student does study less in a pass-fail option course, but he does not use the released time to study for his other courses. Johnson (19) also found that students did a minimum of work on pass-fail option courses, however, he found they did devote the released time to their graded courses.

#### Student Attitudes Towards Pass-Fail

In a study done at the college level, Neidt and Hedlund (28) found that attitudes toward a course are significantly related to final course grades rather early in the period of instruction. Willoughby (49) supported this research. Thus, if a student's attitudes toward a course are affected by the pass-fail system, his academic achievement might be expected to vary also.

Louis (23) found Russian children favorably disposed towards the pass-fail system. Christensen (9) found the converse true for American elementary students.

At the college level, student's attitudes are generally positive towards pass-fail grading, and negative toward conventional grades. Burke (6) found 65.8% of the students felt grades hindered rather than helped learning.

In the most comprehensive college study to date, Karlans, Kaplan, and Stuart (20) found that only 3% of the students at Princeton felt the pass-fail option should be discontinued. Most felt that tension was lowered by the pass-fail option. Mannello (24) found similar results.

Students did, however, think they worked closer to capacity under a graded system. In general, students favored the pass-fail option despite the fact that grades stimulated harder work.

To support the idea that a pass-fail system reduces the tension of grades, Strong (18) found year end attrition down and isolated to the bottom quarter of the class at California Institute of Technology.

Students at Princeton felt the main reason for offering courses under a pass-fail option was to encourage course selection on the basis of interest, but only 28% took a course for this reason. Most took a course pass-fail either to reduce tension or to allow more time to devote to another course (Karlans, Kaplan, and Stuart, 20).

#### Administrative Attitudes Towards Pass-Fail

Hewitt (17) found administrative attitudes about the success of pass-fail grading systems to be cautious but optimistic.

Quann (32), in a survey of colleges, found that 68% of them have some form of pass-fail grading. Reasons given for adopting pass-fail options were: one, to encourage exploration outside the student's major area; two, to minimize the fear of failing; and three, to counteract the undesirability of the present grading system. Over 61% made pass-fail grading available to all underclassmen, however, 62.7% limit pass-fail to one course per semester, with 25% limiting pass-fail to electives only. Some 28.7% of administrators indicate a student must be in good academic standing. Eighty-seven percent indicate the D level is passing.

Whereas the major reason for having a pass-fail option was to encourage experimentation outside the major area, Johnson (19) found students hesitant to exercise the option, and when they did, they stayed close to their major discipline. Warren (48) and Kansas State University (30) both found that 75-85% of the students would have taken a particular course, even if it had not been offered pass-fail.

### Summary

Evidence has been found that elementary students achieve better academically under a pass-fail system. Children's attitudes towards a pass-fail system vary somewhat. At the college level, student attitudes very much favor both the pass-fail option and the complete pass-fail system in the freshman year. Academic achievement seems to be somewhat lower when a student exercises the pass-fail option. In general, results

seem to be much better under a total pass-fail system. Administrators approve of pass-fail grading in most aspects, however, they still retain grades, mainly for the ease of the evaluation of students' performances.

Little research has been reported at the high school level, with most research being conducted at the elementary and collegiate levels. No research was reported in the area of academic achievement at the high school level. This study was designed to partially bridge this gap.

## CHAPTER III

### PROCEDURE

The purpose of this research was to gather objective data comparing academic achievement for high school students under a pass-fail marking system and a graded system. The Biology I students of Luckey High School, Manhattan, Kansas, were selected as the subjects for this study.

The unit of study selected was Unit IV from the BSCS Blue Version, 1968 revised edition (3:284-371). This unit was approximately five weeks in length. This length was chosen so that quarterly grades could still be determined by a student's work after the research unit.

The two grading schemes were compared by an analysis of covariance because it provided statistical control for the variable of prior knowledge of the unit. Realizing that not all the students would be equal in knowledge of the unit, this prior knowledge had to be controlled. The analysis of covariance provided a means of statistical control, while providing an F-ratio comparing the two groups.

At Luckey High School there were three sections of biology. One section had six students, one ten, and one twenty-one. In order to balance the number of students in the experimental and control groups as closely as possible, the two small classes were considered as one group and the large class as another group.

As far as possible, the assignment of students to classes was random, however, scheduling problems in this small school resulted in the imbalance in class size. This scheduling difficulty resulted in the control group having a higher average IQ than the experimental group. This was determined to be significant at the .10 level by a t-test for independent samples.

Because of this difference in IQ between the two groups, intelligence had to be controlled. It was decided to implement another analysis of covariance, this time controlling intelligence. This would yield another F-ratio comparing the two marking systems.

A pretest was administered to both groups. The pretest was composed of 40 questions from the BSCS Biological Science: Molecules to Man: Blue Version: Achievement Test 2, 1968 revised edition (4), and the BSCS Test Booklet for Molecules to Man (5). The questions may be found in Appendix A. This was followed by the unit of instruction.

The same instruction was given both groups. The only difference was that group B was still graded A-F, and group A was told they would be graded pass-fail. Neither group was told they were part of an experiment. The students had been introduced to the idea of a pretest in an earlier unit so it was felt that this was not an indication that an experiment was being conducted.

At the end of the unit of instruction, the pretest was administered again as the criterion. The academic achievement

of the two groups was compared by two analyses of covariance while controlling IQ and prior knowledge of the unit. Student achievement was operationally defined to be a student's score on the criterion test. The student's prior knowledge was defined to be his score on the pretest. Intelligence was operationally defined to be the score a student made on the California Short-Form Test of Mental Maturity, Advance 1957 S-Form.

The reliability of the test was determined and an item analysis implemented for the test. To increase the sample size for the tests of reliability, 111 Biology I students of Junction City High School in Junction City, Kansas were administered the test. These students were not included in the experimental treatment due to problems of control.

Although the primary purpose of this research was to collect empirical data, this researcher did not want to overlook the valuable information to be gained from the subjective opinions of the students in the experiment. A four-question questionnaire was given to those who were in the experimental group, and this questionnaire can be found in Appendix B.



## CHAPTER IV

### RESULTS

This research was designed to provide objective data comparing academic achievement of high school students under a graded system with achievement under a pass-fail system. No significant difference was found between these two groups.

For the research, two variables were controlled statistically. Prior knowledge of the unit of study and intelligence were held constant by the use of an analysis of covariance. This left two variables to be compared. The class group, pass-fail or graded, was the independent variable, and student achievement was the dependent variable.

For the test controlling intelligence, the adjusted means were 19.826 for the pass-fail group and 20.704 for the graded group. This yielded an F-ratio of 0.200 which was not significant at the 0.05 level of significance (See Table 4-1). For the test controlling prior knowledge, the adjusted means were 19.757 for the pass-fail group, and 20.756 for the graded group. This yielded an F-ratio of 0.385 which was not significant at the 0.05 level of significance (See Table 4-2). Thus, for this research, there was no statistical evidence that the graded group achieved better academically than did a similar group graded pass-fail.

The criterion test was a forty question multiple choice

Table 4-1. ANALYSIS OF COVARIANCE INVOLVING IQ AND CRITERION SCORES.

TEST FOR EQUAL MEANS:  $F = 0.200$   $DF = 1, 34$ 

GROUP	X-MEAN	Y-MEAN	ADJ. Y-MEAN	N
A	103.313	19.125	19.826	16
B	108.381	21.238	20.704	21

Table 4-2. ANALYSIS OF COVARIANCE INVOLVING PRETEST AND CRITERION SCORES.

TEST FOR EQUAL MEANS:  $F = 0.385$   $DF = 1, 34$ 

GROUP	X-MEAN	Y-MEAN	ADJ. Y-MEAN	N
A	12.313	19.125	19.757	16
B	13.524	21.238	20.756	21

examination. It was administered to 148 high school sophomores. The mean score was 15.486 with a standard deviation of 5.779. The reliability was found to be remarkably constant between 0.73 and 0.74 by three separate tests (See Table 4-3).

An item analysis was also implemented for the test. A correlation with the total score of 0.200 or better was considered acceptable for the retention of the question on future administrations of the test. Using this criterion, 12 questions were found unacceptable. The criterion then was a fair evaluation of student achievement.

After the unit of study was completed, the pass-fail group was given a four question questionnaire to determine

Table 4-3. MEAN, STANDARD DEVIATION, AND RELIABILITY OF THE CRITERION.

MEAN- 15.486	STDV- 5.779	N-148
RELIABILITY: KR 20- 0.7404	KR 21- 0.7342	
UNCORRECTED ODD-EVEN- 0.5786	CORRECTED ODD-EVEN- 0.7330	

their attitudes towards the pass-fail experience. The results of this questionnaire are found in Table 4-4. The students were asked to answer yes, no, or no difference to the questions.

The attitudes were generally favorable to the pass-fail system. Sixty-two percent of the students felt the pass-fail system was reducing when compared with their graded courses. Seemingly in line with the research findings, 81.25% of the students felt they learned as much as they would if they had been graded.

Table 4-4. SUMMARY OF THE OPINION QUESTIONNAIRE ON PASS-FAIL GRADING.

QUESTION	NO		
	YES	DIFFERENCE	NO
Is the pass-fail system tension reducing?	62.50%	12.50%	25.00%
Did you learn more under the pass-fail system?	81.25%	12.50%	6.25%
Did you enjoy the pass-fail system more?	62.50%	12.50%	25.00%
Would you like all classes pass-fail?	56.25%	25.00%	18.75%

Sixty-two percent of the students felt they enjoyed the pass-fail more than they would have enjoyed the same unit had they been graded. While 56.25% of the students felt they would like to see all classes offered pass-fail, almost 19% definitely felt they did not want all classes to be offered pass-fail.

## CHAPTER V

### DISCUSSION

This was a simple study designed to answer a single question, do students achieve as well academically under a system of pass-fail grading where they are without any motivational influence from grades. This study found no significant difference between the two groups. Statistically it is incorrect to say that something has been proven. At best it can be said that there appears to be no significant difference. This would indicate that motivation should not be a consideration when choosing between a graded and a pass-fail system at the high school level.

In applying the results of this research, one is reminded that the sample was small and the reliability of the test not exceptionally high. If the test is to be used further, it can be improved by reworking the 12 questions found unacceptable by the item analysis.

Realizing these limitations, the statistical results of this research are worthy of note. These findings tend to reassert Warren's (48) conclusions that under a pass-fail system, there is no evidence that students do less than they normally would. This, Warren explains, is due to the fact that the publication of formal grades does not enhance a student's desire for competence. This would tend to disprove those who claim grades are an essential motivation to learning (Cotlove, 10) (Kingston, 21) (Smith, 38).

This study then would be in line with elementary school studies reported by Louis (23) and Christensen (9). It would not be supportive of the university studies reported by Sgan (34), Tragressor (45) and Karlans, Kaplan and Stuart (20). However, as has been mentioned, care must be taken in comparing high school studies with elementary and university studies. It was just this gap in information which this study bridged.

This study supplies information at the high school level indicating that grades are not a significant motivation. Knowing this, curricular decisions at the high school level as to whether or not to have pass-fail grading can be based on considerations other than motivation.

Considering the questionnaire on student attitudes toward pass-fail grading, the 62.5% who felt the system was tension reducing was supportive of college studies reported by Mannello (24) and Karlans (20). Once again it should be pointed out that 81.25% of the students felt they learned more, with 12.5% feeling the same, as under a graded system. Only 6.25% felt they learned less, which could well be accurate because not everyone showed significant improvement during the unit.

One interesting comparison should be considered. While 81% felt they learned more, only 62% felt less tension and enjoyed the class more. This might possibly be accounted for when one considers the novelty of the situation. The pass-fail system is a strange environment for one to learn in after being graded for ten years. Perhaps the 19% were those who did learn more or felt they did, but who did not adjust emotionally to the

absence of a grade. This situation might possibly have been anticipated when one considers the reliance of the human being on the formation of habits. With this present research, one can only speculate as to whether these students could later adapt to a pass-fail system, or not.

Here reference should be made again to research done by Neidt and Hedlund (28) and Willoughby (49). These men all found final course grades significantly related to students' attitudes toward the course. Accepting this, if those students indicating a liking for the pass-fail system continued to think this way, and if the others adjust to the system, one could expect the overall performance of the students to increase. This research was too short in duration to test this hypothesis; additional research is indicated.

One additional accomplishment of this research is the establishment of a format for continued study. This format can be used by someone to study a sample representative of the entire high school population, or it could be used by a school system (or an individual teacher) to study its own students' reactions.

This research provides objective evidence that motivation should not be a factor in adopting or not adopting a pass-fail grading system at the high school level. Further research would be desirable, and this project could serve as the format for such research.

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## APPENDIX

### A

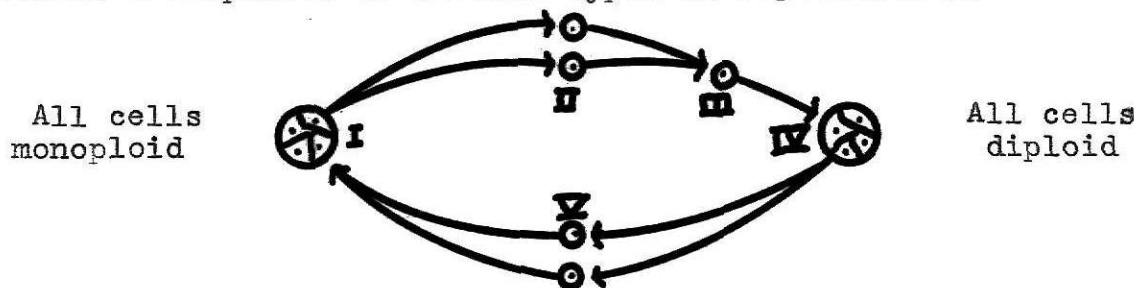
## APPENDIX A

### CRITERION TEST

1. The regions of growth in developing seed plants are known as
  - (A) plumules.
  - (B) meristems.
  - (C) cotyledons
  - (D) conducting tissues.
2. Multicellularity leads to greater differentiation of form and function which, in turn, leads to
  - (A) reduced bulk.
  - (B) less efficiency.
  - (C) greater complexity.
  - (D) a simpler genetic code.
3. Which of the following best describes the order of probable evolution in plants?
  - (A) Asexual reproduction-sexual reproduction-large monoploid/small diploid-large diploid/small monoploid.
  - (B) Large monoploid-small monoploid-one monoploid cell- asexual reproduction.
  - (C) Asexual reproduction- sexual reproduction - large diploid/small monoploid- large monoploid/small diploid.
  - (D) Large diploid- small diploid- one diploid cell- sexual reproduction.
4. In which of the following ways are the reproductive patterns of flowering plants and land mammals alike?
  - (A) Fertilization is internal.
  - (B) The monoploid generation is prominent.
  - (C) Ova contain a large amount of stored food.
  - (D) Individual organisms possess the reproductive organs of one sex only.
5. Sexual reproduction has evolutionary significance because it results in offspring that
  - (A) produce gametes by mitosis.
  - (B) introduce variety into a species.
  - (C) are independent of natural selection.
  - (D) are identical with one another and with the parent.
6. Multicellular animals are able to show specialization of body parts because of
  - (A) reduced efficiency.
  - (B) division of labor among cells.
  - (C) reduced amino acid requirements.
  - (D) increased ability to coordinate.
7. The two basic processes involved in sexual reproduction are
  - (A) mitosis and meiosis.
  - (B) mitosis and fertilization.
  - (C) meiosis and ovulation.
  - (D) meiosis and fertilization.

8. Chicken eggs have a large amount of yolk while most mammal eggs have practically none. Survival of most mammalian embryos is made possible by the fact that most of them
- (A) are milk fed.
  - (B) are nourished through a placenta.
  - (C) develop in the uterus where yolk concentration is high.
  - (D) have a short period of development.
9. The ovaries were removed from a mature female monkey which was then given injections of estrogen. Which of the following is most likely to occur?
- (A) Ovulation will take place.
  - (B) The ovaries will grow back.
  - (C) Menstruation will take place.
  - (D) The uterine wall will thicken.

Questions 10-14 are based on the following diagram which represents a composite of several types of reproduction.



10. Gametes are represented by the structure(s) at
- (A) II.
  - (B) III.
  - (C) V.
  - (D) II and V.
11. Where would meiosis occur?
- (A) Between I and II.
  - (B) Between II and III.
  - (C) Between III and IV.
  - (D) Between IV and I.
12. Where would fertilization occur?
- (A) Between II and III.
  - (B) Between IV and V.
  - (C) Between V and I.
  - (D) Between IV and I.
13. The sexual life cycle of the green alga, Ulothrix, can be represented by omitting the structure(s) at
- (A) I.
  - (B) II.
  - (C) III.
  - (D) IV.



14. The one cell remaining of the four monoploid cells formed within the ovule of a flowering plant corresponds to one of the cells in structure
- (A) I.
  - (B) II.
  - (C) IV.
  - (D) V.

Questions 15-18 are based on the following situation.

Assume that a study was made of the development of embryos of an unusual species of animal which had naturally pigmented tissues as follows.

TISSUE	PIGMENT COLOR
muscle	green
nerve	purple
skin (epidermis)	black
lining of digestive tract	yellow
all others	white

15. The mesoderm in the gastrula stage of these animals would probably contain which of the following colors?
- (A) green and white
  - (B) purple and yellow
  - (C) black and white
  - (D) yellow and green
16. A piece of ectoderm from one of these animals is grown in a culture; the cells undergo mitosis, but fail to differentiate. Of the following possible next steps, which one may cause differentiation and further development of the cells?
- (A) Warming the culture gently
  - (B) Adding more ectoderm to the culture
  - (C) Exposing the culture to X-rays
  - (D) Adding green-pigmented tissue to the culture.
17. Tissue is cut from another gastrula and placed in a special salt solution. This solution is filtered into a vessel. When ectoderm is placed in the solution, it develops into specialized nerve tissue. This is an illustration of
- (A) induction
  - (B) gastrulation
  - (C) fertilization
  - (D) transformation
18. Which of the following observations could best be accounted for by the preformation hypothesis?
- (A) A piece of green pigmented tissue from a gastrula develops into a leg muscle.
  - (B) A piece of unpigmented tissue from the back of a developing embryo placed over exposed mesoderm in the head region develops into brain tissue.
  - (C) One of the two cells in an early embryo grows separately to form only the left half of an embryo.
  - (D) Separation of the two cells of a developing zygote results in each of the two cells developing into a complete organism.



19. The factor which will have the LEAST effect in insuring the success of external fertilization is the
- (A) presence of a liquid.
  - (B) number of gametes produced.
  - (C) ability of the egg to move about.
  - (D) timing of the release of the gametes.
20. What is the evidence for coordinated activity of the cells in a Volvox colony?
- (A) All flagella beating at the same time
  - (B) Photosynthesis activity in all cells is due to presence of chlorophyll.
  - (C) Injury of one or several of the cells does not cause the death of the colony.
  - (D) Movement of flagellae allows the colony to move in a particular direction.
21. Both plants and animals are made of tiny units called cells. They use oxygen to release energy from their food and they store food reserves as fat. These facts
- (A) prove all life had a common origin.
  - (B) support the idea that being alive is about the same in all living things.
  - (C) indicate that plants evolved from animals.
  - (D) support the idea that animals have gradually evolved from plants.
22. The principle of division of labor in biology involves
- (A) the production of varied agricultural crops.
  - (B) competition among organisms.
  - (C) differentiation of cells into tissues having different functions.
  - (D) growth, so there are more cells to do the work.
23. Life involves the whole organism, for if one functions fails, the whole organism fails. We can classify this statement as an example of
- (A) division of labor.
  - (B) specialization.
  - (C) cooperation.
  - (D) interdependency.
24. The main method that mammals have evolved which helps insure the effectiveness of reproduction is
- (A) storage of yolk as food supply for the embryo.
  - (B) retention of developing embryo within the female.
  - (C) reduction in number of eggs produced.
  - (D) development of mammary glands.
25. The significance of the greater amount of yolk in the bird's egg as compared to the mammalian egg is that
- (A) birds need more energy for development.
  - (B) mammals do not use the yolk for development.
  - (C) birds develop slower and therefore need a greater supply of yolk.
  - (D) the yolk of mammals is more concentrated.

26. Flowers act as organs of  
 (A) sexual reproduction. (C) spontaneous generation.  
 (B) asexual reproduction. (D) food supply.

Questions 27 and 28 are based on the following information.

In order to study a possible interaction between germination seeds of different species, a biologist planted seeds of species A and species B in the same tray. Upon germination it was found that A seeds grew faster than B seeds.

27. The most satisfactory explanation of the observed phenomena would be that  
 (A) A seeds had a shorter germination period than B seeds.  
 (B) B seeds produced a substance which stimulated A seeds.  
 (C) A seeds produced a substance which inhibited B seeds.  
 (D) any of the above
28. In order for the results to be interpreted meaningfully, the biologist also should germinate  
 (A) A and B seeds in the dark.  
 (B) A and B seeds in separate trays.  
 (C) A and B seeds at various temperatures.  
 (D) the same number of A seeds as B seeds.

MATCHING: Questions 29-33 are statements. Match each statement with one of the following terms which they refer to. Terms may be used more than once and not all terms must be used.

TERMS: (A) mitosis (C) mitosis and meiosis  
 (B) meiosis (D) neither mitosis nor meiosis

29. \_\_\_\_\_ Monoploid cells are formed.
30. \_\_\_\_\_ The resulting cell contains one chromosome of each pair.
31. \_\_\_\_\_ Each chromosome duplicates itself.
32. \_\_\_\_\_ Each daughter cell contains the same number of chromosomes as the parent cell.
33. \_\_\_\_\_ Diploid cells are formed.
34. In a germination experiment 80 of 100 corn grains that had been soaked 24 hours germinated in 2 days; 95 of 100 corn grains that had not been soaked required 5 days to germinate. Which of these conclusions is not substantiated by the results?  
 (A) Water decreased germination time.  
 (B) 87% of all seeds germinated.  
 (C) Water influenced germination.  
 (D) Different species react differently to soaking.

35. Unlike sexual reproduction, asexual reproduction means to the species that
- (A) the species will continue.
  - (B) the offspring will be different.
  - (C) the offspring will be a duplication of its parents.
  - (D) a great deal of genetic material is available to the evolutionary process.
36. In some placental mammals the ovaries can be removed during pregnancy without affecting the embryo's development. This suggests that
- (A) something other than the ovary produces a hormone which maintains the uterus during pregnancy.
  - (B) the ovaries need not be present for an animal to become pregnant.
  - (C) the ovaries exert an influence on the uterus through the secretion of hormones.
  - (D) pituitary glands exert an important influence during the period of pregnancy.
37. Small fragments of ectodermal tissue from a frog embryo can survive in a salt solution. When mesoderm from a particular region of the embryo (dorsal lip) is placed in contact with the ectodermal tissue, differentiation of ectoderm into nerve cells can occur. No such differentiation occurs in the presence of any other parts of the embryo. On the basis of this evidence alone, which of these hypotheses is supported?
- (A) Ectoderm cells differentiate into nerve cells when activated by material from the mesoderm.
  - (B) Mesoderm destroys a substance in ectoderm cells, preventing their differentiation.
  - (C) In order to differentiate ectoderm cells do not need nutrient substances from other embryonic cells.
  - (D) In order to differentiate ectoderm cells need physical support from other cells.
38. A nuclear change that is necessary for sexual reproduction is
- (A) the development of a new individual from a single cell.
  - (B) the separation of chromosomes through mitosis.
  - (C) the fusion of two gametes' nuclei.
  - (D) the creation of a new individual through meiosis from the doubling of the number of chromosomes.
39. In a normal body cell of a dogfish or shark there are 24 chromosomes. How many chromosomes are found in each gamete?
- (A) 6 (B) 12 (C) 24 (D) 48
40. The fact that a boy's initials were carved in a tree four feet above the ground and after 12 years will be found at the same height shows that
- (A) the meristem was damaged and therefore prevented any vertical growth.
  - (B) once plant cells are formed they do not change.
  - (C) if necessary, mature tissues can develop into new organs.
  - (D) tissue used for vertical growth is found at the tips of roots and stems.

## APPENDIX

B

## APPENDIX B

### PASS-FAIL QUESTIONNAIRE

Yes	No Dif.	No	
—	—	—	Do you feel that a pass-fail grading system is tension reducing compared to a graded system?
—	—	—	Do you feel you learned as much under the pass-fail system as you would have under a graded system?
—	—	—	Do you enjoy the pass-fail system more?
—	—	—	Would you like to see all classes offered pass-fail?

THE EFFECTS OF A PASS-FAIL GRADING SYSTEM OF THE ACADEMIC  
ACHIEVEMENT OF HIGH SCHOOL BIOLOGY STUDENTS

by

HARRY E. MCDONALD III

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AN ABSTRACT OF A MASTERS REPORT  
submitted in partial fulfillment of the  
requirements for the degree

MASTER OF SCIENCE

COLLEGE OF EDUCATION

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## ABSTRACT

The marking system employed by 82% of all high schools is the five letter scale from A through F. Many educators criticize this system as being inaccurate, and emphasizing working for a grade rather than knowledge itself. One alternative proposed by many is the pass-fail system of grading. This system has been criticized as not being representative of the real world competitiveness, and as lacking in motivation for the learner. Some research has been done to reconcile these diverging opinions, but most of it has been done at the elementary and collegiate levels.

This research attempted to provide objective data on the comparative effects of a pass-fail grading system and a letter graded system on academic achievement at the high school level. Two groups from the sophomore biology classes of Luckey High School, Manhattan, Kansas, were used. One group was taught a unit pass-fail, while the control group was graded for the same unit. A pretest was administered prior to the unit to determine prior knowledge of the students. This score and the criterion scores taken from the post-test were used in an analysis of covariance to determine a comparison of the achievement of the two groups. The pretest and criterion were the same. IQ scores were also combined with the post-test scores in an analysis of covariance designed to control the effect of intelligence on the research. Both of the analyses yielded non-significant F-scores, indicating that there is no difference in achievement under the two systems.

An opinion questionnaire was given to students after they completed the pass-fail experience. The students indicated more enjoyment, less tension, and more learning than under a graded system. Some 56% of the students indicated a desire for all courses to be offered pass-fail.