AN ABSTRACT OF THE THESIS OF

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Title: AN EVALUATION OF EXPRESSED LEVEL OF ASPIRATION

AS A DETERMINANT OF PERFORMANCE IN AN UNDER-

GRADUATE BIOLOGY COURSE

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/ Stanely E. Williamson

The purpose of this investigation was to determine if the level
of aspiration procedure consisting of knowledge of results plus goal-
setting possesses a motivational property as reflected in performance
on subject matter criterion instruments above that of knowledge of
results alone in an undergraduate biology course. In addition the
study was designed to ascertain whether the motivational property of
the level of aspiration procedure was affected by the student's
scholastic orientation as measured by the Brown-Holtzman Survey of
Study Habits and Attitudes.

The investigation was conducted at Oregon State University
during the 1968-1969 academic year using students who were complet-
ing a three-term sequence of college general biology (GS 101, 102,
103). A total of 255 students were included in the final analysis of
this investigation.
During the spring term measurements of student performance in general biology (GS 103) from five subject matter criterion instruments were taken in addition to data of students' scholastic orientation as measured by the Brown-Holtzman instrument. Previous performance scores in general biology (GS 101, 102) were used to classify the students included in this study into four performance groups (A, B, C, D), based on their average past performance. Analysis of the criterion instrument scores in terms of group sample means was made for each of the four performance classifications for both experimental and control groups.

Findings

The findings from this research were based on results of one-tailed t-tests comparing the differences between performance means of experimental and control groups on criterion instruments. Resultant t values were tested at the 5 percent level.

1. There was a significant statistical difference between the mean performance on departmental criterion instruments of the experimental and control groups of the C performance classification only.

2. There was no significant statistical difference between the mean performance on Tolman's Principles of Biology Test of the experimental and control groups of any of the performance
classifications. It was concluded that the insignificant results may have been caused by the short experimental period and conditions under which the treatment was administered.

3. There was no positive relationship between the amount of improvement over past performance for students exposed to the level of aspiration treatment. Analysis indicated that improvement in performance is independent of scholastic orientation in both experimental and control groups. Further research will be necessary for the development of an indicator for susceptibility to level of aspiration treatment as it was concluded that the *Brown-Holtzman Survey of Study Habits and Attitudes* does not serve this purpose.
An Evaluation of Expressed Level of Aspiration as a Determinant of Performance in an Undergraduate Biology Course

by

Richard Mott Pearce

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AN EVALUATION OF EXPRESSED LEVEL OF ASPIRATION
AS A DETERMINANT OF PERFORMANCE IN AN
UNDERGRADUATE BIOLOGY COURSE

I. INTRODUCTION

Scholastic performance has long been, and continues to be, a
central measure of success in educational situations. Development
and establishment of effective teaching techniques to insure scholastic
success constitutes one of the domains of education. Many general
principles of learning are relevant to instructional techniques and play
an important role in effecting the student's achievement of the objec-
tives of education.

One of the integral components of learning and a critical prob-
lem in the educational climate is motivation. Educators and educa-
tional psychologists use such terms as needs, interests, and goals in
discussing the motivational aspects of teaching-learning processes.
Relating needs to goals Klausmeier (37, p. 348) states that "unsatis-
fied needs, with accompanying tensions, arouse and direct activity
toward goals which the individual perceives as satisfying those
needs." In an educational setting scholastic success is one of the
goals which the individual seeks.

In situations where students are required to learn material for
which they perceive little or low need gratification and in which they
have little or no interest, the teacher may rely on a variety of
motivational procedures. Techniques used to increase motivation in group situations include focusing student attention on desired learning outcomes, providing for realistic goal-setting, and aiding learners in making and evaluating progress through goals. Thus goals and goal-directed behavior are important constructs in motivational theory.

The manner in which a person sets and adjusts his goals relative to his abilities and past experience has attracted considerable attention as an important aspect of behavior. Until recently, however, little formal attempt had been made to study goals as phenomena in themselves and the effects of attainment or nonattainment of goals on the behavior of the individual.

The term generally used in the research literature to describe an immediate goal is "level of aspiration" which is the level of performance in a familiar task which an individual tries for or thinks he can accomplish on the next performance. It is an immediate goal as opposed to a remote goal such as ultimate success in some aspect of the professional world.

In a typical sequence of events in level of aspiration experiments, the individual is informed of his performance score from a preceding task and is asked to indicate the score he expects to receive on his next performance. This level of future performance which an individual explicitly undertakes to reach is known as his level of aspiration. It is generally acknowledged that reaching this goal or
aspiration relieves tension and not reaching it results in disappointment.

It has been found that nearly all individuals, when first exposed to a level of aspiration situation, give initially a level of aspiration which is above the previous performance score, and under most conditions tend to keep this pattern stable. What, then, are the factors which determine the level of aspiration which the individual sets?

The level of aspiration has been interpreted as being an expression of certain needs: the need to do well or to appear to be wanting to do well; the need to approximate the future performance; and the need to avoid failure. These needs are in turn regarded as reflections of variables including the importance of the task as seen by the individual involved, past performance, and general cultural pressures toward improvement in performance.

Originally the level of aspiration experiment was conceived as a technique for studying dynamic psychological factors which operate in the production of feelings of success and failure. Until recently research in this area has been mainly concerned with the analysis of factors which influence the operation of these needs in the determination of the level of aspiration. The vast majority of level of aspiration studies used level of aspiration as a dependent variable and focused on independent factors such as previous success and failure, amount
of experience with the task, age, and personality variables. As will be discussed in the next chapter the level of aspiration experiment has become a popular topic of research activity for those interested in the experimental investigation of goal-setting behavior both as a clinical instrument and as a research method.

**Importance of the Study**

Over the years psychological research has isolated a number of principles of learning felt to be important as manipulatable factors in the classroom situations of schools and colleges. Although a number of learning principles have been utilized in educational settings the incorporation of others into classroom procedures for the purpose of manipulating behavior remains to be done. To date, little has been published that concerns the incorporation of the principle of level of aspiration into classroom settings in order to affect scholastic performance. There is need for studies whose focus of interest is on classroom application rather than on analysis of aspiration scores for further elucidation of the process itself.

A variety of tasks have been utilized in level of aspiration studies. These include psychomotor tasks such as dart throwing or card sorting, manipulation tasks and athletic participation. Most of the studies tend to be laboratory rather than applied research in real-life situations; this constitutes one of the limitations in the research on level of aspiration.
Many studies have attempted to relate numerical differences between aspiration scores and actual performance scores to some personality trait or scale and have met with disappointing results. This study attempts to evaluate goals by stating levels of aspiration and whether this action can produce a degree of motivation as reflected by an increase in performance. Thus the individual's increase in performance is of central interest rather than his expressed level of aspiration.

Since the importance of the task from the viewpoint of the individual expressing levels of aspiration has been noted as a factor influencing the level of aspiration expressed and the following performance, it would seem reasonable to study goal-setting behavior in situations where the individuals viewed success in the task in question as an important part of their daily life. Similarly, the effects of ego-involvement on level of aspiration have been investigated. Frank (19) indicated that ego-involvement in a task may arouse in an individual a desire to do well, leading him to set his level of aspiration higher than his past performance. Thus in a study which evaluates the motivational properties of expressing the level of aspiration in an educational setting some indicator of the importance of the task and the attitude of the student toward the task might provide insight regarding the level of aspiration expressed and subsequent levels of performance.
Until recently little information existed concerning the relationship between level of aspiration and subsequent level of performance on educational tasks with the result that little was known about the effects of level of aspiration expression as an independent motivational variable. However, in 1966 Locke (42) found a strong relationship between the level of the performance goal (level of aspiration) and the level of actual performance. Fryer (20), in a study of learning Morse Code, claimed support for his hypothesis that having subjects set levels of aspiration would lead to a higher performance level than given knowledge of scores alone. The positive influence of knowledge of results on learning and performance has been well established in the research literature by Ammons (1). Since the typical classroom situation involves knowledge of results of past performance it is important to determine to what degree level of aspiration procedures (consisting of knowledge of results plus setting a goal) affect performance beyond that of knowledge of results alone.

Thus to focus on a classroom application of level of aspiration procedures, to provide an important and realistic task for the student, and to determine if level of aspiration procedures possess a motivational property in this setting are considerations of the present study.

Statement of the Problem

One of the purposes of this study is to determine if the level of
aspiration procedure consisting of knowledge of results plus goal-setting possesses a motivational property as reflected in performance above that of knowledge of results alone in an undergraduate biology course.

In addition, this study attempts to further demonstrate the motivational property of the level of aspiration procedure using Tolman's Principles of Biology Test, a subject matter criterion instrument developed independently of the departmental instruments but specifically designed to measure the objectives covered in the general biology (GS 101, 102, 103) sequence.

This study also is designed to ascertain whether the motivational property of the level of aspiration procedure is affected by the student's scholastic orientation as measured by the Brown-Holtzman Survey of Study Habits and Attitudes (6). This effect could be demonstrated if it could be established that a significant positive relationship exists between scholastic orientation and improvement in performance of students exposed to the level of aspiration procedure in the undergraduate biology course.

Hypotheses

In order to determine answers to the specific investigations discussed in the preceding section of this chapter, the following hypotheses are formulated to be tested:
1. that the mean performance scores on departmental examinations of students grouped according to past performance and exposed to the level of aspiration procedure will be significantly greater than the mean performance scores of students similarly grouped having knowledge of test results alone;

2. that the mean performance scores on the GS 103 portion of _Tolman's Principles of Biology Test_ of students grouped according to past performance and exposed to the level of aspiration procedure will be significantly greater than the mean performance scores of students similarly grouped and exposed to the control procedures;

3. that the amount of improvement in GS 103 over past performance in general biology for students exposed to the level of aspiration procedure will have a significantly positive relationship to their scholastic orientation scores compared to the same relationship of scores for students exposed to the control procedures.

**Definition of Terms**

Although many of the terms used in this study are defined when they are first used, the following terms are defined to assist the reader.
Level of Aspiration - The level of future performance in a familiar task which an individual explicitly undertakes to reach (17, p. 119). It includes a knowledge of the results of past performance.

Performance Scores - Multiple-choice midterm and final departmental examination scores of students in general biology (GS 101, 102, 103).

Student - Any individual enrolled in general biology (GS 103) who has taken general biology (GS 101 and 102) during the fall and winter terms of the 1968-1969 academic year. Only students exposed to all phases of experimental and control procedures will be included in the present study.

Tasks - The multiple-choice midterms and final examination in general biology (GS 103) constructed by the department of General Science at Oregon State University (O. S. U.) during the spring term of the 1968-1969 academic year.

Familiar - Operationally defined as the experience possessed by a student who has previously enrolled in general biology (GS 101 and 102) at O. S. U. during the fall and winter terms of 1968-1969.

Tolman's Principles of Biology Test - A 65 multiple-choice item test developed by Richard R. Tolman composed of items selected from Testing and Evaluation in the Biological Sciences (12) to measure the specific course objectives for the general biology (GS 101, 102, 103) program.
Brown-Holtzman Survey of Study Habits and Attitudes (SSHA) -

Copyrighted in 1965 and designated as Form C, this 100-item inventory was developed by William F. Brown and Wayne H. Holtzman to assess student work habits and study attitudes toward academic work. The test consists of four subscales: delay avoidance, work habits, teacher approval and educational acceptance. The sum of the first two subscales is termed a student's study habits while the sum of the second two subscales is referred to as a student's study attitudes. The summation of the study habits and attitudes is termed scholastic orientation. The SSHA manual (7) defines the subscales and their summations in the following way:

**Delay Avoidance** - promptness in completing academic assignments, lack of procrastination, and freedom from wasteful delay and distraction.

**Work Methods** - use of effective study procedures, efficiency in doing academic assignments, and how-to-study skills.

**Teacher Approval** - opinions of teachers and their classroom behavior and methods.

**Education Acceptance** - approval of educational objectives, practices, and requirements.

**Study Habits** - combines the scores on the Delay Avoidance and Work Methods scales to provide a measure of academic behavior.
Study Attitudes - combines the scores on the Teacher Approval and Education Acceptance scales to provide a measure of scholastic beliefs.

Scholastic Orientation - combines the scores on all four subscales to provide an overall measure of study habits and attitudes.

Basic Assumptions

In this study it was assumed that:

1. Students completing general biology (GS 103) at O.S. U. are representative of other students who complete general education biology courses for non-science majors at other state institutions of higher education with regard to learning ability, study habits and attitudes.

2. The items used in the departmental examinations and Tolman's Test measure the GS 103 objectives with adequate validity and reliability.

3. The Brown-Holtzman SSHA measures the students' scholastic orientation in terms of study habits and study attitudes with adequate validity and reliability.

Limitations of the Study

Although numerous studies have focused on the determinants of
level of aspiration treating the latter as a dependent variable, the present study confines itself to an experimental design employing level of aspiration as an independent variable and is subjected to the following limitations:

1. The population was limited to a sample of those students enrolled in GS 103 during the spring term of the 1968-1969 academic year who had completed GS 101 and 102 during the previous fall and winter terms of 1968-1969.

2. The administration of the level of aspiration procedures, and other evaluating instruments particular to this study was limited to the spring term of 1969.

3. The conditions for expressing levels of aspiration were limited to the private recording of expectations on identified cards during preselected times in large group recitation periods in general biology (GS 103).

4. The interpretation of the findings was limited by the validity and reliability of the evaluating instruments used: the three departmental midterm examinations, the departmental final examination, Tolman's Principles of Biology Test, and the Brown-Holtzman SSHA.

Design of the Study

In the spring term of 1969 at O.S.U., all students enrolling in
General Biology 103 were placed in regular recitation sections. Using tables of random numbers experimental and control groups within the section were identified. Throughout the term the experimental group received the level of aspiration treatment while the control group experienced a placebo treatment described in the third chapter of the dissertation.

Performance scores from midterm examinations and levels of aspirations were collected during the term. One week before the conclusion of the term each student in the course took Tolman's Principles of Biology Test and the Brown-Holtzman Survey of Study Habits and Attitudes. Scores from these instruments and the departmental final examination were recorded at the end of the quarter.

The statistical treatment of the data consisted of classifying the experimental and control groups on the basis of their average past performance in GS 101, 102 in order to analyze the treatment on similar groups. One-tailed t-tests were performed to compare the differences in means of scores on the criterion instruments. A chi-square test based on a contingency table was performed to determine if improvement in performance is dependent upon scholastic orientation.

The independent variables with which this study is chiefly concerned were the level of aspiration procedure and past performance. The dependent variables consisted of the mean performance scores on
the three departmental midterms, the departmental final, Tolman's Principles of Biology Test, and scholastic orientation. Statistical information was compiled for each instrument indicating the index of difficulty and discrimination for each item.

Organization of the Remainder of the Study

The remainder of the dissertation includes a chapter devoted to a review of related literature on level of aspiration studies. The historical development, major lines of research, and the findings of specific level of aspiration studies related to the dissertation are presented.

The third chapter, titled "Design of the Study," describes the experimental design utilized in this study followed by a description of the population and level of aspiration treatment employed. The evaluation instruments are identified and discussed as are the procedures used in collecting and analysing the data.

The fourth chapter of the dissertation presents and interprets the findings of the study while the summary, conclusions and recommendations comprise the final chapter. Copies of all evaluation instruments are provided in the appendices.
II. BACKGROUND AND REVIEW OF RELATED LITERATURE

Historical Development of Level of Aspiration Studies

The term "level of aspiration" was introduced into the literature in Germany by Dembo (14) in 1930 in connection with a study of the dynamics of anger. Utilizing Dembo's hypothesis that the presence of a particular "level of aspiration" determined whether or not the subjects felt satisfied or dissatisfied with themselves after performance on a task, Hoppe (32) investigated the concept in an empirical study. It is important to note that Hoppe's conclusions were based upon the subjects' spontaneous remarks concerning their reactions to the various situations, the manner in which they worked at the tasks, and their statements relative to success and failure. Thus the subjects' implicit level of aspiration was inferred chiefly on the basis of whether the performance appeared to be followed by feelings of success or failure.

Five years later, Frank (17) reported a quantitative technique for the experimental study of level of aspiration which became the standard technique in the field. In Frank's technique, the subject was informed of his performance score from the preceding trial and was asked to indicate how well he intended to do on the next trial. Thus an explicit level of aspiration was operationally defined as "the level of
future performance in a familiar task which an individual, knowing his level of past performance in that task, explicitly undertakes to reach" (17, p. 119).

Gould (24, p. 275) employed Frank's method, but made clear her conviction that there was "no one-to-one relationship between what we might call 'true aspiration-level' and the quantitative measures of aspiration-level." She concluded that the nature of the relationship between implicit goal-strivings and the expressed level of aspiration was yet to be discovered. Gardner (22) and Rotter (64) expressed this same doubt about the use of expressed level of aspiration as a measure of the true amount of inner striving.

Gardner (22, p. 65) asks:

Might not an individual in a task such as dart-throwing entertain at one and the same time a wild hope that he will make a perfect hit and a more prudent hope that he will at least hit the target, with perhaps an additional, self-conscious hope that he will not appear too awkward in the eyes of the experimenter? In other words, is there not considerable likelihood that an individual's aims on a given trial are manifold, fluctuant, ephemeral, and differing qualitatively as well as quantitatively, with those aims which involve a specific score often giving way to aims which cannot possibly be described in terms of score values?

**Major Lines of Research on Level of Aspiration**

Most of the subsequent research in the area of level of aspiration was concerned with an analysis of the sources, the tension-systems, or the needs from which the level of aspiration develops.
Pertinent reviews include an elaborate theoretical article by Lewin, Dembo, Festinger and Sears (41) as well as methodological reviews by Ricciuti (59) and Rotter (61). However, subsequent research on the problem of level of aspiration can also be viewed as falling into two other distinct groups--diagnostic and success prediction. The diagnostic category is represented by the attempts to use level of aspiration in describing stutterers (40, 51, 69); deaf children (65); delinquents (70); and peptic ulcer patients (27). Similar attempts have been directed to the study of behavior patterns of schizophrenics (35), extroverts-introverts (56), as well as general cultural comparisons (5, 8).

The success prediction category of level of aspiration studies is represented by Heller (28) who predicted success in a training program in a hosiery operation, and by Klein (38) who predicted success in flight training by the use of level of aspiration.

Related Topics in Level of Aspiration Research Literature

Even though the determinants of level of aspiration have been a popular source of experimental investigation, this section will review only selected studies in the area. The choice of studies under the major headings which follow was made on the basis of relevance to the present study.
Initial Setting of Level of Aspiration

In a study involving six tasks including steadiness, addition, and cancellation by fairly homogeneous groups of undergraduates, Gould (24) reported that most subjects, when first exposed to a level of aspiration situation, set an initial level of aspiration higher than the previous performance score (defined as a positive goal discrepancy) and tended to keep it positive under most conditions.

Success or Failure

Many studies have centered on the effect of success or failure on aspiration level and general support is given to Levin's (41) contention that success and failure directly affect the level of aspiration. The majority of studies reveal that the level of aspiration is raised and lowered in accordance with the attained or unattained level of aspiration represented by the past performance.

Gardner (22) found that if the performance equals the level of aspiration, the level of aspiration is likely to swing upward. Conversely, an unattained desired level of performance leads to lowering the level of aspiration.

Klugman (39) observed that subjects who failed half or more times to attain their level of aspiration on the Rotter Aspiration Board tended to have lower goal discrepancy scores than those subjects who succeeded more than half the time.
Child and Whitney (11) reported that success generally led to raising of the level of aspiration, whereas failure had the opposite effect. Further, the greater the degree of success, the more likely the inflation of the level of aspiration. The effects of failure were more varied than were the effects of success.

Bayton and Whyte (4) studied success-failure sequences using contrived scores on the Minnesota Rate of Manipulation Test. It was found that the differences between the aspiration level and the performance were much lower for subjects experiencing success-following-failure than for subjects experiencing failure-following-success. Actual performance was better for those subjects working under initial success rather than initial failure.

There have been only a few studies indicating that success experience does not raise the level of aspiration. Hilgard, Sait and Margaret (30) concluded that successful subjects are more cautious in goal-setting than unsuccessful subjects. The successful subjects tended to set goals at a lower level with succeeding performances, while unsuccessful subjects persisted in estimations of improved scores. In addition, the point was made that, despite the lowered level of aspiration with successful performances, the subjects who had experienced success continued to perform in a superior manner unlike the unsuccessful persons.
Pennington (55), studying the effects of passing or failing grades in the classroom, found that success did not produce marked upswings in the level of aspiration. However, it was found that failure in the examination deflated subsequent levels of aspiration and that this tendency toward lower levels of aspiration was greater with numerous failures.

Although several studies are not in clear support of Pennington's findings, the majority of reviewed studies indicated that the level of aspiration was generally raised and lowered as performance attained or did not attain the level of aspiration.

**Instructional Variations of Expect vs. Hope**

Both Dembo (14) and Hoppe (32) in their initial studies of level of aspiration defined the concept with clear reference to the GOALS or HOPES of the individual, but later work has frequently departed from this definition and has instead invoked EXPECTATIONS or PREDICTIONS. An example of an estimate of future performance in terms of goals would be "What will you try to do"? By contrast, a statement in terms of expectations would be "What do you expect to do"?

Irwin (33) pointed out that level of aspiration involves both cognitive and affective factors and consequently he prefers to use level of expectation, except in cases where goals are clearly implied.
Irwin distinguished between realistic and unrealistic aspirations in terms of expectations and goals. **Realistic aspirations** were viewed as those aspirations based upon an appraisal of the extent to which the individual is capable of meeting the demands of the situation with which he is confronted. In this respect, realistic aspirations were seen as evoked by "expect" instructions. On the other hand, **unrealistic aspirations** were viewed as those aspirations which are based upon hopes, fears, and wishes originating in the individual and evoked more directly by "hope" instructions.

Irwin and Mintzer (34) demonstrated the effect that instructional variables have on levels of aspiration. A group exposed to "hope" instructions for stating the aspiration level was compared to a group given "expect" instructions. The mean goal discrepancy score of the "hope" group was significantly larger than the mean goal discrepancy score of the "expect" group. The instructional variables also resulted in two other differences in goal-setting behavior. The "expect" group had twice as many negative goal discrepancy scores as the "hope" group, and to a significant degree changed their aspiration level from trial to trial more frequently than the "hope" group.

Preston, Spiers and Trasoff (58), using dart throwing as a task, studied the effect of "hope" versus "expect" instructions as well as various difficulty levels and incentive conditions. The levels of aspiration for the "hope" group were significantly higher (at the
0.01 level) than those of the "expect" group. The performance scores of the "expect" group tended to be higher than the "hope" group in the minimum practice condition (ten trials), while the "hope" group tended to have higher performance scores under extensive practice (50 trials). These differences were not statistically significant, however, and no statistical controls for initial ability were employed.

Preston and Bayton (57) systematically compared three levels of aspirations: (1) Maximum Level - the score which the subject feels represents his ultimate ability (using "hope" instructions), (2) Actual Level - the score which the subject expects to make on the next trial, estimated as accurately as possible (using "expect" instructions), and (3) Least Level - the score below which the subject is certain he will not fall. All three instructions elicited different levels of aspiration, with a very substantial correlation between Maximum and Actual Levels, but the Least Level had a low correlation with the other two. In brief, there was a tendency to place Actual Levels closer to Maximum than to Least Levels. Utilizing three dissimilar tasks, MacIntosh (49) has confirmed this relationship.

Holt (31), asking some subjects for expectations and others for goals in a college course examination situation, found that the discrepancy scores for "goal" instructions were significantly larger than the discrepancy scores for "expect" instructions.
Another indication of the importance of particular instructions is reflected by Sears' (67) experiment in which improvement in performance over a sequence of trials was dependent upon the degree to which the subjects set realistic goals. Further indication that unrealistic goals (striving for perfect performance at once) are less effective than realistic goals (involving gradual and stepwise increments of level of aspiration) is presented by Lockette (48). Having high school students work on the manual skill task of planing wooden blocks to pre-set dimensions, he found that students using realistic goals clearly performed more effectively than those using unrealistic goals.

Yacorzynski's (73) study reported that an unrealistically high level of aspiration was not related to heightened motivation or incentive, and achievement. A more realistic level of aspiration was, however, related to those factors.

In summarizing the effectiveness of "expect" versus "hope" instructions, no clear pattern is apparent. The study of Preston, Spiers and Trasoff (58) reflects an interaction with preliminary practice. "Expect" instructions have been shown to be superior (in terms of subsequent performance) in the studies of Lockette (48), Sears (67), and Yacorzynski (73). It is possible that a factor underlying the conflicting findings has been the extent to which the instruction is emphasized and restated throughout a study. Lockette (48), for
instance, verbally verified the type of instruction by repeated references to examples between trials. Most of the other studies merely asked the subjects for their expectation or hope, with little or no clarification of what the instructions meant.

**Ego-Involvement**

The effects of ego-involvement on level of aspiration have been investigated in several studies.

Frank (19) indicated that ego-involvement in a task may arouse in the individual a desire to do well, leading him to set his level of aspiration too high. But on the other hand, Frank also indicated that ego-involvement might arouse fear of failing, causing the individual to set his level of aspiration too cautiously, perhaps below his level of performance.

Harvey and Sherif (26) found that estimating performances on an objective task showed no significant effects if two subjects are strongly ego-involved in a positive way. If competition, however friendly, existed, small discrepancies appeared in the estimation of the future performances of both competitors. However, if two subjects were antagonistically involved, wide and significant discrepancies were noted both in setting goals and in estimating future performances.
The effect of other people upon the level of aspiration was explored in a study by Rosenthal and Cofer (60) where a group level of aspiration was obtained. Here, a deliberately indifferent and neglectful attitude by one member of the group resulted in a significant decrease both in belief in goal attainability and in belief that other group members would wholeheartedly participate to achieve the goal. Furthermore, there was a parallel decrease in ease of agreement in setting the group level of aspiration through discussion. Both individual and group levels of aspiration were similarly affected by success and failure.

Reference Groups

Another area of study in level of aspiration has been the influence of subjects being told the level of aspiration estimates and/or performances of various reference groups. These groups may consist of individuals of similar or varying age, education, ability, or other characteristics whose aspiration or performance scores whether real or fictitious are made known to the subject.

Festinger (16), studying undergraduates working on synonym lists and information tests, explored the effects of three different reference groups on estimates of level of aspiration. In addition to being told his score after each trial, each undergraduate was also told the average level of aspiration and average performance of one
of three groups--either high school students, college freshmen, or graduate students--before making his own estimate for the subsequent trial. In general, the undergraduates raised their estimates when told they were scoring below the reference group (especially for the high school reference group), and they lowered their estimates when scoring above a group (particularly the reference group of graduate students). Thus there was tendency to conform to the estimation level of the reference group. Furthermore, a contrast of "expect" and "hope" instructions in this study showed that the variability of goal discrepancy scores was lower under "expect" instructions.

Hertzman and Festinger (29) found that when subjects were told the aspirations and the performances of their own group, the general trend was to change subsequent estimates of level of aspiration in the direction of the group's estimate. The majority of subjects shifted their explicit goals from their own previous estimates to those of the group estimates.

MacIntosh (49) studied the effects of hypothetical scores of Negroes on levels of aspiration of Caucasians. The subjects tended to raise the Actual and Maximum Levels and to hold the Least Level constant when they were told they were doing as well as Negroes. This is the opposite to what Preston and Bayton (57) had found when Negroes were told they were doing as well as Caucasians.
Anderson and Brandt (2) exposed a class of fifth grade school children to different cancellation tests for six times over a three-week period. Before the second testing program, the experimental group was told both their own score on the previous test as well as the average score for the entire class. The control group merely took the tests with no knowledge of their own scores or the scores of the class. The class had been separated previously into high and low achievers--the high achievers being more advanced in age and school work. The low achievers set goals considerably above their own achievement, and the high achievers did the reverse. It was noted that irrespective of the achievement level, the goals of the children tended to converge on what represented average performance for the entire group. In this study also, the experimental group performed significantly better than the control group, with the control group showing decreases in mean performance scores after the first test. However, the actual advantage of goal-setting is not readily determined in this study since the control group did not have knowledge of their own previous results before each testing session.

In a more recent study, Kausler (36) studied the effect of reference group performance scores. Three groups of subjects performed on a simple arithmetic test under the three following conditions: Group C - without instructions to express a level of aspiration; Group L - with instructions to express a level of
aspiration; Group LR - similar to Group L but with the additional information of a reference score (the average performance achieved by Group L). Kausler reports that the reference score increased the level of expressed aspirations, since the level of aspiration group means were significantly higher, at the 0.05 level, for Group LR than Group L. The performance means for Group L were significantly higher than Group C at the 0.01 level. The performance means for Group LR were also significantly higher than Group C at the 0.01 level, but not significantly different from the performance means for Group L. Although expressing the level of aspiration served to increase the performance level on the subsequent task, the increase in level of aspiration between Group L and Group LR was not followed by a similar increase in performance.

Conditions for Expressing Level of Aspiration

Studies in level of aspiration vary in terms of the conditions under which the level of aspiration is solicited. In some cases the subject verbally reports his estimate to the experimenter in an individual testing situation. In other cases, he announces his estimate in front of a group, while in still other studies the subject might record it on either an identified or unidentified paper.

Several investigators have highlighted the dangers in varying the conditions of expressing the level of aspiration. Gardner (22)
cautioned that the level of aspiration obtained in studies is no more than what the individual is willing to make public concerning his aims. He further stated that the public indication of what the subject aims to achieve may be true or false in terms of his actual aims. Holt (31) differentiated between private goals and public goals. Differences in expressing levels of aspiration are also indicated in a study by Hanawalt, Hamilton and Morris (25) where nonleaders in an academic situation later reported having higher private goals which they did not report during the experiment itself.

Mischel (53) demonstrated that the public-private nature of the situation in which expectancy statements are elicited can significantly affect the subsequent altering of such statements. The subjects, following failure, were offered another opportunity to try the task. Subjects were found more likely to lower their estimates to their next scores if their first estimate had been private than if it had been public. Under both private and public conditions, the subjects wrote their estimates on a paper. However, the public condition was a direct, face-to-face relationship with the experimenter who saw the estimates written in an individual testing situation. The private condition was testing of groups in which the subjects, ranging in number from 5 to 15, were seated at desks widely separated from each other and the experimenter. It was found, to a statistically significant degree, that estimates of levels of aspiration were more
resistant to change when the subject was in direct, face-to-face contact with the experimenter or when the subject inferred that the experimenter could view his performance.

Margaret (50) reported a study in which subjects were first exposed to a condition of private recording of performances and goals written on a paper seen only by the experimenter. The subjects were then exposed to a second condition of posting both performances and goals in full view of a group of four. The tasks were quoit tossing and dart throwing. The effect of active participation in the social group was to alter the discrepancy scores so that they more nearly matched the reported group performance.

The methodological importance of the commitment aspects of the situation in which the subject sets his goal is supported by the aforementioned studies. A public level of aspiration statement appears to result in a greater need to succeed, since failure could mean ego deflation, loss of status, and loss of prestige in the opinion of another person.

**Level of Aspiration as a Determinant of Performance**

As noted the experimental study of the effects of performance goals on performance level has been given very little attention by psychologists. Fryer (20) in a study of learning Morse Code found
that requiring subjects to set levels of aspiration before each trial enhanced their performance as compared with subjects given knowledge of their scores but not required to set aspiration levels. Locke (43), in a reanalysis of Fryer's data, proposed the hypothesis that the superiority of the level of aspiration procedure would depend upon the level at which the goals were set. He found that in three out of four comparisons subjects who set high goals performed better than subjects given knowledge of score alone. Locke found that the higher the level of the goals in relation to the individual's initial ability, the greater the improvement. Thus, a blanket statement to the effect that goal setting is more effective than knowledge of score alone would not seem to be justified unless the level at which the goals are set is specified.

Locke and Bryan (46) reported that subjects with specific goals performed better than those told to "do their best." The latter is a typical instruction in most industrial, military, and educational training situations and these results indicate that such instructions (or goals) may not result in the highest possible level of performance. In a series of six experiments, Locke and Bryan (45) reported results that strongly support the idea that performance goals are related to and can be used to account for the level of performance on a number of different tasks.
In view of the few studies that exist which focus on goal setting as a motivational device affecting performance in an educational setting, further research is needed in this area.

Summary

This chapter presented a review of related literature of the research and background on the level of aspiration. Beginning with the historical development of level of aspiration studies, the major lines of research were described. The major portion of the chapter was devoted to the presentation of the findings of studies in level of aspiration related to this investigation. These topics included the initial setting of aspiration levels, the effect of previous success or failure on aspiration level, variations in instructions for level of aspiration procedures, the effects of ego-involvement and reference group scores on the level of aspiration, and finally the conditions for expressing aspiration levels. The last portion of the chapter cited studies concerned with the use of level of aspiration as a determinant of performance.
III. DESIGN OF THE STUDY

The design of this study was directed toward investigating the effect of expressing levels of aspiration on the performance of students who were completing a three-term sequence in general biology (GS 101, 102, 103) at Oregon State University. Performance was measured by three midterms and one final examination constructed and administered by the General Science Department at O.S.U. and by Tolman's Principles of Biology Test.

The Experimental Design

The research design was a Post-Test-Only Group model suggested by Campbell and Stanley (21, p. 195). They state that:

While the pretest is a concept deeply embedded in the thinking of research workers in education, it is not actually essential to true experimental designs...many problems exist for which pretests are unavailable, inconvenient, or likely to be reactive, and for which (this) design is greatly underused in educational and psychological research.

The research design described by Campbell and Stanley may be designated:

\[
R_{1, 2, 3, 4} \times 0_1 0_2 0_3 0_4 0_5 0_6 0_7
\]

\[
R_{5, 6, 7, 8} \times 0_1 0_2 0_3 0_4 0_5 0_6 0_7
\]

where \( R_{1, 2, 3, 4} \) represent students grouped according to past performance in general biology (GS 101-102) exposed to the level of
aspiration procedures and $R_5, 6, 7, 8$ represent students similarly grouped serving as controls. The experimental variable, $X$, was the level of aspiration procedure. $0_1$, $0_2$, $0_3$, $0_4$, $0_5$, $0_6$ and $0_7$ represent the three departmental midterms, final examination, total course points, the Tolman Principles of Biology Test, and the Brown-Holtzman Survey of Study Habits and Attitudes.

The Population

The population for this investigation consisted of undergraduate students who were completing a three-term sequence of college general biology (GS 101, 102, 103) at Oregon State University. The initial enrollment in GS 103 was approximately 800 students. At the beginning of the spring term of the 1968-1969 academic year at O.S.U., students registered in each of the eight large recitation sections of GS 103 were divided into two groups by using random number tables. One was designated as the experimental group; the other was termed the control group.

In order to be included in this study a student must have fulfilled all of the following criteria by the end of the experimental period:

1. successfully completed GS 101 and 102 during the 1968-1969 academic year;

2. been present for all treatment and control procedures;
3. completed three midterm and one departmental final examination;
4. completed the Brown-Holtzman and Tolman instruments;
5. elected to participate in this study.

At the conclusion of the experimental period a total of 255 students were eligible for inclusion in this study. The samples used for statistical inference consisted of 108 students in the experimental group and 147 students in the control group.

**Classification Within Experimental and Control Groups**

Ranges of scores representing average performance for four letter grades (A, B, C, D) in general biology (GS 101, 102) were calculated using the General Science Department's records. Students in both experimental and control groups were classified on this basis in order to analyze the treatment effects on groups with similar performance ratings. This technique was chosen in preference to using high school G.P.A. as a means of classifying as it provided a more reliable measure of the student's past performance in the subject matter and educational setting being examined in this study. The A, B, C, D classification further provided a means of observing if the level of aspiration procedure had a differential effect on different groups rather than simply examining the effect between the
experimental and control groups. Table 2 (page 56) presents a summary of this past performance classification for individuals included in the analysis of data.

The Treatment and Its Setting

Weekly classroom participation in general biology consisted of two 45-minute T.V. lectures, a two-hour laboratory period and a 50-minute recitation period. It was during these spring term recitation periods that level of aspiration and control procedures were administered.

Table 1 (page 37) summarizes the general biology (GS 103) spring term schedule illustrating the relationship between the experimental and control procedures and the departmental testing program. During the regularly scheduled two-hour laboratory periods in the tenth week of the term all students completed the Brown-Holtzman and Tolman instruments.

To provide as uniform a treatment for all of the eight recitation sections, the instructors were provided with identical written instructions regarding the administration of the treatment and control procedures. Briefly, the students were requested to pick up an envelope bearing their name from the lecture desk, return to their seats, complete the enclosed card, and return the completed card within the envelope to the instructor. As students were requested not
Table 1. Weekly Schedule for Administration of Departmental Examinations and Level of Aspiration Procedures in General Biology (GS 103) in the Spring Term, 1969.

<table>
<thead>
<tr>
<th>Week</th>
<th>Examinations</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25-point Midterm I</td>
<td>Experimental and Control Cards I</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>25-point Midterm II</td>
<td>Experimental and Control Cards II</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>25-point Midterm III</td>
<td>Experimental and Control Cards III</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>25-point Midterm IV</td>
<td>Experimental and Control Cards IV</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>120-point Final</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Examination</td>
<td></td>
</tr>
</tbody>
</table>

It was essential that in all aspects other than the content of the cards the treatment would be identical for all individuals.

The Evaluation Instruments

Description of Experimental and Control Cards

The front sides of both the experimental and control cards were identical to add further similarity to the treatments (Figure 1).
The study in which you are about to participate is being conducted by the General Science Department of O.S.U. All information given by you will be held in confidence and in no way will it be used by your instructor to alter the grade you receive for this course.

At intervals throughout this term, you will receive additional cards to be completed in a similar manner. At the end of the term, when the study is completed and the data have been analyzed, the results will be available to you upon request.

Please do not discuss this study or your responses with your classmates, since comparison to other groups will be affected.

Carefully read the questions on the reverse side of this card; after you have considered each question, record your answer in the space provided.

Our thanks for your participation and cooperation in this study.

Figure 1. Front View of Experimental and Control Cards.
The reverse side of the four experimental cards instructed the student to reveal his level of aspiration by indicating the letter grade he expected to make in the course and the exact score he expected to make on the next test. As can be seen in Figure 2, the distinction between the score the student "wished" to make and the score the student "expected" to make was emphasized. As noted in the review of related literature, Irwin (33) demonstrated that "expect" instructions evoke more realistic levels of aspiration whereas "hope" instructions yield unrealistic aspirations.

The reverse side of the four control cards, given at the same intervals as the experimental cards, contained the following 12 questions specifically designed not to possess a motivational property but to furnish information about the student of interest to the department.

Card I

1. At what hours do you usually watch the T. V. lectures?
2. Of the three T. V. lectures presented so far, how many have you watched?
3. Please circle the numbers of the chapters you have thoroughly read at this point in the course.

   Ch. 18 Principles of Classification
   Ch. 19 Protists and Simple Plants
   Ch. 20 More Complex Plants
   xx Additional chapters
As you know, the grade you receive for GS 103 is determined by three, 25-point tests and a 120-point final examination. Letter grades are assigned on the approximate basis of 90% being an A; 80% being a B; and so on.

Knowing your previous grades and considering your present classload and extra-curricular activities this term,

1. State the LETTER GRADE you expect to make in GS 103. Remember, not the grade you "wish" to make, but the grade you expect to make.
   Write your expectation in this space ______

2. Not considering the second test next week, state the EXACT SCORE (maximum is 25 points) you expect to make. Not the score you "wish" to make, but the score you expect to make. Write your expectation in this space ______

Please do not discuss this information with your classmates.

Figure 2. Reverse Side of Experimental Cards.
4. Comparing other courses you have experienced and considering all aspects of GS 103, do you consider the course to be
   A. Relatively difficult
   B. Not particularly difficult
   C. Relatively easy

Card II

5. How would you evaluate your INTEREST in:

<table>
<thead>
<tr>
<th>Circle</th>
<th>(low)</th>
<th>(high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content of T. V. lectures</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Laboratory activities</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Recitation sessions</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>

6. Is this course providing an academic challenge to you?
   1. No. It is too difficult.
   2. No. It is too easy.
   3. Somewhat. About the same as my other courses.
   4. Definitely. More than most of my other courses.

7. How would you describe your feelings (reactions) about your score on the last 25-point test? Considering your amount of preparation.
   2. Neutral - indifference.
   3. Negative - disappointment.

Card III

8. Considering your university experience to date, how relevant is the content and activities of general biology
to you as a person?

1. Very relevant
2. Moderately relevant
3. Only slightly relevant
4. Not relevant

9. During the last six weeks of term, have you sought assistance, guidance, or discussion outside of regular class time from any of the recitation or laboratory staff?

10. Would you consider the results you received on the last two tests to be representative of the effort you have invested in the course over the past six weeks? (circle) YES or NO (written comment in space provided if you wish)

Card IV

11. In comparison to your other courses this term, how would you evaluate GS 103 in each of the following:

<table>
<thead>
<tr>
<th></th>
<th>(low)</th>
<th>(medium)</th>
<th>(high)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Amount of study time required</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Difficulty of the subject matter</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Interest the course holds for you</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Contribution to your education</td>
<td>1 2 3 4 5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

12. In addition to taking GS 103 midterm examinations and receiving your corrected papers, how would you rate the importance of the role that your recitation periods have served you during this term?
-receiving directions, "hints" and points to emphasize for studying

Circle one (low) (medium) (high)

- developing and sustaining interest

1 2 3 4 5

-providing clarification of specific points in subject matter

1 2 3 4 5

-relating laboratory, text, and T. V. concepts meaningfully

1 2 3 4 5

-total effect of recitation on your attitude toward GS 103

1 2 3 4 5

-total effect of recitation on your performance in the course

1 2 3 4 5

Departmental Examinations

The three 25-item departmental midterms and the 120-item final examination were developed by those members of the General Science Department who were instructing general biology (GS 103). Each of these tests consisted of carefully selected multiple-choice questions specifically designed to measure the objects of particular portions of the GS 103 program.

The selection procedure followed in identifying the questions for each examination consisted of instructors initially submitting selected questions to a committee composed of instructors who evaluated, modified where necessary, and made the final selection of
the items. Thus agreement within the department's teaching staff existed regarding the use of examination items for the GS 103 program.

**Tolman's Principles of Biology Test**

This subject matter test was selected as an independent instrument to further demonstrate the effectiveness of the level of aspiration procedures of this study. It was developed by Richard R. Tolman for a recent study investigating Student Performance in Lower Division Collegiate General Biology Programs in Selected Community Colleges and Four-Year Institutions in Oregon (71). The GS 101, 102, 103 sequence in general biology at O.S.U. was one of the programs in the five institutions used in Tolman's study.

The test consisted of 65 multiple-choice items from Testing and Evaluation in the Biological Sciences (12) which had been selected by and approved by a critique jury from the participating institutions in terms of their applicability to their institutions' biological programs.

Tolman's test was designed to cover the objectives of the general biology programs in the five cooperating schools for the 1967-1968 academic year. The departmental examinations used in this study were based on the objectives of the general biology program at O.S.U. for the 1968-1969 academic year. Thus a comparison of Tolman's test with the departmental examinations used in this study
had to be conducted in order to determine whether the two instruments measured the same objectives.

The comparison of the instruments and of the objectives of the GS 101, 102, 103 program at O.S.U. for the 1967-1968 and 1968-1969 academic years was made by the researcher and Dr. Henry Van Dyke of the General Science Department, O.S.U., who had served on the critique jury for Tolman's study and who had taught in the general biology program for both of the years in question. After a thorough examination of the instruments and of the program as conducted in both years, it was the consideration of both individuals that the objectives for 1967-1968 and for 1968-1969 in general biology were the same and that Tolman's test consisted of items which measured the same objectives as did the departmental instruments for 1968-1969 used in this study.

Brown-Holtzman Survey of Study Habits and Attitudes (SSHA)

This instrument was selected to assess student motivation in terms of study habits and attitudes toward academic work with specific emphasis on General Biology. Form C, copyrighted in 1965, consists of four subscales: delay avoidance, work habits, teacher approval, and educational acceptance. The sum of the first two subscales indicate a measure of a student's study habits while the sum of
the last two subscales reflects a student's study attitudes. The summation of the study habits and study attitudes is termed scholastic orientation. The SSHA manual (7) provides the following description:

**Delay Avoidance** - promptness in completing academic assignments, lack of procrastination, and freedom from wasteful delay and distraction.

**Work Methods** - use of effective study procedures, efficiency in doing academic assignments, and how-to-study skills.

**Teacher Approval** - opinions of teachers and their classroom behavior and methods.

**Education Acceptance** - approval of educational objectives, practices, and requirements.

**Study Habits** - combines the scores on the Delay Avoidance and Work Methods scales to provide a measure of academic behavior.

**Study Attitudes** - combines the scores on the Teacher Approval and Education Acceptance scales to provide a measure of scholastic beliefs.

**Scholastic Orientation** - combines the scores on all four subscales to provide an overall measure of study habits and attitudes.

The SSHA questionnaire requests the student to rate himself on each of the 100 statements by selecting one of the following choices:

R - RARELY means from 0 to 15 percent of the time.

S - SOMETIMES means from 16 to 35 percent of the time.
F - FREQUENTLY means from 36 to 65 percent of the time.

G - GENERALLY means from 66 to 85 percent of the time.

A - ALMOST ALWAYS means from 86 to 100 percent of the time.

Wrenn (10, p. 783) states that the development of the SSHA was extremely well conceived. Items were chosen on the basis of interviews with students and each item was then empirically validated as to its applicability to the problem. In general, this instrument is well-grounded, easy to understand, and can be an excellent source of study habit and attitude information.

Deese (10, p. 782) notes that this instrument is a unique and valuable contribution to the techniques for assessing student habits of work and motivation for study. It is more suited to uncovering attitudinal and motivational difficulties than any other published study inventory.

As reported in the SSHA Manual (7), the 1965 version of the SSHA has been validated in a number of colleges throughout the United States. In all of these studies the criterion used was the one-semester grade-point average. While admittedly somewhat unreliable, one-semester grades provide the only realistic estimate of scholastic achievement over a short period of time. The validity coefficients vary from .25 to .45 with a weighted average of .36. The correlations between SSHA scores and grade-point averages are statistically significant and positive for all schools.
The SSHA Manual also supplied internal consistency and test-retest reliability data for the four basic SSHA subscales. Internal consistency coefficients obtained for the four basic SSHA subscales ranged from .87 to .89 whereas the stability coefficients representing test-retest studies at Southwest Texas State College ranged from .88 to .93 for a four-week interval and from .83 to .88 for a 14-week interval.

The SSHA Manual reported subscale intercorrelations between the two Study Habits scales, delay avoidance and work methods, as .70 and the two Study Attitude scales, teacher approval and educational acceptance, as .69 yielding support to the two derived scores, study habits and study attitudes, as being justified. The intercorrelation between study habits and study attitudes is indicated as .69.

Although the test must assume both complete frankness of response and a fairly high degree of memory accuracy on the part of the student, the SSHA provides a systematic, standardized way of indicating feelings and practices regarding schoolwork. As previously noted, this study employed the SSHA in order to determine whether a significantly positive relationship existed between student improvement scores in GS 103 over past performance in GS 101, 102 and scholastic orientation scores in both experimental and control groups.
Procedures Used in Collecting the Data

Experimental and Control Cards

The four experimental and control cards were administered to their respective groups in GS 103 during the spring term of 1968-1969. The schedule indicating the issuing of these cards is shown in Table 1 (page 37). The data on the completed cards were recorded by the researcher.

Departmental Examinations

The three midterms and final examination were also administered during the spring term of 1968-1969 to all students enrolled in GS 103. Table 1 (page 37) illustrates the times of administration. The answer sheets were scored and double-checked by the secretarial staff of the General Science Department and then recorded by the researcher. The number of correct responses served as the raw score for each midterm and the final examination.

Tolman's Principles of Biology Test

This test was administered to the GS 103 population in their regularly scheduled laboratory periods during the week before the conclusion of the spring term. Sixty minutes were allotted for this task after which the reusable test booklets and answer sheets were
collected. The answer sheets were scored and double-checked by the researcher. The number of correct responses served as the raw score for this instrument.

**Brown-Holtzman Survey of Study Habits and Attitudes**

This 100-item questionnaire was administered in the same laboratory periods as the Tolman Test for a period of 60 minutes. The completed answer sheets were scored according to the instructions given in the SSHA Manual and the results recorded.

**Past Performance Scores in General Biology (GS 101 and 102)**

The total point scores for all individuals in the study from general biology (GS 101 and 102) were obtained from the General Science Department's records and recorded for use in the analysis of the data.

**Statistics Utilized in Analysis of the Data**

In testing out the assumptions for a multivariate form of analysis of variance, it was found that this assumption of normality was not met. The experimental group had skewed residuals which resulted in utilizing a robust test procedure for testing the first two hypotheses and a non parametric procedure for the third hypothesis. As
previously noted, the experimental and control groups were classified on the basis of their average past performance in GS 101, 102 and designated as A, B, C, D. Group sample means from criterion instruments for experimental and control groups for each performance classification were used as the units of analysis.

To test the first and second hypotheses, one-tailed t-tests were employed to test for the differences in performance means on criterion instruments between experimental and control groups. Although the experimental group was found to have skewed residuals the utilization of the t-test was acceptable as this is a robust testing procedure capable of being used with samples with other than normal distributions.

To test the third hypothesis a contingency table for both experimental and control groups was designed. The range of scholastic orientation scores was divided into three approximately equal parts and operationally defined as high, medium, and low and plotted against the range of scores indicating improvement in performance over past performance. This range was also divided into three approximately equal parts and operationally defined as high, medium, and low. A chi-square test based on this contingency table was performed to determine if improvement in performance scores was dependent on scholastic orientation scores.
The index of discrimination (D) for each item in each criterion instrument was computed using the formula described by Nedelsky (54, p. 97):

\[ D = \frac{H - L}{N} \]

where,

D = discrimination index

H = average number of correct responses by members of high group

L = average number of correct responses by members of low group

N = maximum possible score (= 1 when using single items)

A difficulty index (d) was also computed for each individual item (54, p. 97):

\[ d = \frac{H + L}{2N} \]

where,

d = difficulty

H = average number of correct responses by members of high group

L = average number of correct responses by members of low group

N = maximum possible score (= 1 when using single items)

**Processing of the Data**

Data from the departmental records of past performance,
treatment and control cards, subject matter criterion tests, and the Brown-Holtzman SSHA were tabulated and then punched on I. B. M. cards for analysis. Using the statistical designs cited in the previous section, a program was written and punched and processed at the Oregon State University Computer Center.

**Summary**

The first portion of this chapter presented the Post-Test-Only Group model suggested by Campbell and Stanley (21, p. 195) as the research design for this study. The population for this investigation and the method of classifying experimental and control groups was discussed followed by a description of the level of aspiration treatment and its setting.

The second portion of the chapter described the evaluation instruments which included a description of the experimental and control cards, departmental examinations, *Tolman's Principles of Biology Test*, and the *Brown-Holtzman Survey of Study Habits and Attitudes*.

The last portion of the chapter indicated the procedures used in collecting the data and the statistics utilized in analyzing the data. A final paragraph reported the processing of the data.
IV. PRESENTATION AND INTERPRETATION OF THE FINDINGS

The purpose of this study was to determine if the level of aspiration procedure consisting of knowledge of results plus goal-setting possesses a motivational property as reflected in performance above that of knowledge of results alone in an undergraduate biology course. The study was also designed to ascertain whether the motivational property of the level of aspiration procedure was affected by the student's scholastic orientation as measured by the Brown-Holtzman Survey of Study Habits and Attitudes.

The investigation was conducted at Oregon State University during the 1968-1969 academic year using students who were completing a three-term sequence of college general biology (GS 101, 102, 103). During the spring term measurements of student performance from five criterion instruments were taken in addition to data from a scholastic orientation inventory and experimental and control group questionnaires. Previous performance scores in general biology 101-102 were obtained from the files of the General Science Department. All data were tabulated and then punched on I.B.M. cards for processing.

The data collected in this study were used in the following ways: (1) previous performance scores in general biology 101-102 were used to classify the students included in this study into four
performance groups (A, B, C, D), based on their average past performance; and (2) analysis of the criterion scores was used to compute experimental and control group sample means for each of the four performance groups.

In testing hypotheses one and two of this study, one-tailed t-tests were used to determine whether differences in student performance existed between experimental and control group classifications. Significance was measured at the 5 percent level. In testing hypothesis three of this study, a chi-square test based on a contingency table was performed to determine if improvement in performance under experimental and control settings was independent of scholastic orientation.

Conclusions were made on the basis of the data and information in the study and recommendations are presented at the conclusion of the dissertation.

**Presentation of the Data**

The level of aspiration and control procedures were administered to approximately 800 students registered in general biology (GS 103) at Oregon State University. The size of the sample was reduced to 255 for the following reasons:

1. did not successfully complete GS 101 and 102 during the 1968-1969 academic year;
2. was not present for all treatment and control procedures;
3. did not complete three midterm and one departmental final examinations;
4. did not complete the Brown-Holtzman and Tolman instruments;
5. did not elect to participate in the study.

Table 2 presents a summary of the classification according to past performance of the experimental and control groups. The sample size of each of the classified groups and its past performance mean is included.

Table 2. Summary of Past Performance Classification with Experimental and Control Groups' Past Performance Means for Individuals Included in Analysis of Data.

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<th>Control Group</th>
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Data from Experimental and Control Cards

Since this investigation was concerned with evaluating the effect of expressing aspiration levels on performance, the mean performance
scores on the criterion instruments of the experimental and control groups for each of the past performance classifications were used in the analysis rather than the actual expressed aspirations. The mean scores with their standard deviations from the criterion instruments are presented in Tables 6 and 7. Although the tabulated responses from the control cards were not directly related to the hypotheses they were of interest to the General Science Department and are included at the conclusion of this chapter.

Data from Criterion Instruments

Three 25-item multiple-choice departmental midterms, one 120-item multiple-choice departmental final and the 65-item multiple-choice Tolman Principles of Biology Test covering the objectives of general biology (GS 103) were the criterion instruments used in this investigation.

An index of discrimination (D) was computed for each individual item on each examination (54, p. 97):

\[ D = \frac{H - L}{N} \]

where,

\[ D = \text{discrimination} \]
\[ H = \text{average number of correct responses by members of high group} \]
\[ L = \text{average number of correct responses by members of low group} \]
N = maximum possible score (= 1 when using single items)

An estimate of difficulty was also computed for each individual item on each of the examinations (54, p. 97):

\[ d = \frac{H + L}{2N} \]

where,

- \( d \) = difficulty
- \( H \) = average number of correct responses by members of high group
- \( L \) = average number of correct responses by members of low group
- \( N \) = maximum possible score (= 1 when using single items)

For each subject matter criterion instrument all of the answer sheets were ranked from highest score to lowest score and divided into a high and low group. Numbers were assigned to each answer sheet and a random sample of 50 was chosen from the top 27 percent (over 200 papers) of the high group and 50 from the bottom 27 percent of the low group (over 200 papers), using a random numbers table constructed by Croxton and Cowden (13). The discrimination index and difficulty were then calculated in the manner prescribed by Nedelsky, who states (54, p. 97):

- The contribution of an item to the test's reliability is considered low if \( D \) is less than .2 and high if \( D \) is greater than .4 . . . a difficulty equal to 1 means a very easy test.

Tables 3, 4 and 5 provide a summary of the discrimination index and difficulty estimations for each item of each of the criterion
Table 3. Discrimination Index (D) and Difficulty (d) Calculations for the Three 25-Item Departmental Midterm Examinations.

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*Eliminated before final analysis.
Table 4. Discrimination Index (D) and Difficulty (d) Calculations for 120-Item Departmental Final Examination.

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* Eliminated before final analysis.
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</tbody>
</table>

*Eliminated before final analysis.
instruments. Numbers marked with an asterisk (*) were eliminated from the final analysis due to low discrimination.

Table 6 summarizes the mean performance scores with their standard deviations of the departmental midterms and final examination for the four performance classifications (A, B, C, D) for both the experimental and control groups. The column headed "n" to the right of the experimental/control group column indicates the number of individuals included in the analysis in each experimental and control group for each performance classification.

As previously stated, each midterm consisted of 25 items and the final examination contained 120 items thus bringing the total to 195 items. At the bottom of the table performance means for the entire experimental and control groups are indicated.

Horizontally the mean performance scores for each of the three midterms and the final examination together with the total items in GS 103 can be identified. Experimental and control groups in the same performance classification can be compared as they appear directly over one another. The standard deviations of the mean are presented to the right of each performance mean to assist in statistical interpretation.

The statistical analysis and interpretation of these data found in Table 6 is presented in the second half of this chapter along with a discussion of the first hypothesis. Conclusions based on these data
<table>
<thead>
<tr>
<th>Performance Classification</th>
<th>Group</th>
<th>n</th>
<th>Midterm 1</th>
<th>Midterm 2</th>
<th>Midterm 3</th>
<th>Final</th>
<th>GS 103 Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>$\bar{X}$</td>
<td>$s$</td>
<td>$\bar{X}$</td>
<td>$s$</td>
<td>$\bar{X}$</td>
</tr>
<tr>
<td></td>
<td>A</td>
<td>12</td>
<td>21.33</td>
<td>.42</td>
<td>20.92</td>
<td>.54</td>
<td>21.50</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>21</td>
<td>21.57</td>
<td>.46</td>
<td>21.14</td>
<td>.38</td>
<td>22.66</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>47</td>
<td>20.40</td>
<td>.31</td>
<td>19.74</td>
<td>.39</td>
<td>20.94</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>55</td>
<td>20.36</td>
<td>.26</td>
<td>19.87</td>
<td>.30</td>
<td>20.98</td>
</tr>
<tr>
<td></td>
<td>C</td>
<td>38</td>
<td>18.47</td>
<td>.36</td>
<td>18.50</td>
<td>.40</td>
<td>20.08</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>52</td>
<td>18.52</td>
<td>.33</td>
<td>17.23</td>
<td>.44</td>
<td>19.81</td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>11</td>
<td>17.79</td>
<td>.64</td>
<td>17.00</td>
<td>.60</td>
<td>18.74</td>
</tr>
<tr>
<td></td>
<td>Experimental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>19</td>
<td>16.00</td>
<td>1.01</td>
<td>16.09</td>
<td>.80</td>
<td>18.27</td>
</tr>
<tr>
<td></td>
<td>Experimental Total</td>
<td>108</td>
<td>19.38</td>
<td>.26</td>
<td>19.06</td>
<td>.27</td>
<td>20.43</td>
</tr>
<tr>
<td></td>
<td>Control Total</td>
<td>147</td>
<td>19.55</td>
<td>.20</td>
<td>18.75</td>
<td>.25</td>
<td>20.52</td>
</tr>
</tbody>
</table>
appear in the fifth chapter of the dissertation. Copies of the three departmental midterms and the final examination are located in Appendix B.

Table 7 summarizes the mean performance scores with their standard deviations of the three parts (GS 101, 102 and 103) of Tolman's Principles of Biology Test for the four performance classifications (A, B, C, D) for both the experimental and control groups. The column headed "n" to the right of the experimental/control group column indicates the number of individuals included in the analysis for experimental and control groups of each performance classification.

Of the total 65 items in the test, 21 items made up the GS 101 portion, 22 items comprised the GS 102 portion, and 22 items composed the GS 103 portion. At the bottom of the table performance means for the entire experimental and control groups are indicated.

Horizontally the mean performance scores for each of the three portions of Tolman's test can be identified. Experimental and control groups in the same performance classification can be compared as they appear directly over one another. The standard deviations of the mean are presented to the right of each performance mean to assist in statistical interpretation.

The statistical analysis and interpretation of these data found in Table 7 is presented in the second half of this chapter along with a
Table 7. Summary of Mean Scores with Their Standard Deviations of Tolman's Test Scores for Performance Classifications of Experimental and Control Groups.

<table>
<thead>
<tr>
<th>Performance Classification</th>
<th>Group</th>
<th>n</th>
<th>GS 101 Part</th>
<th>GS 102 Part</th>
<th>GS 103 Part</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>$\bar{x}$</td>
<td>$s/\sqrt{n}$</td>
<td>$\bar{x}$</td>
</tr>
<tr>
<td>A</td>
<td>Experimental</td>
<td>12</td>
<td>15.00</td>
<td>.64</td>
<td>15.25</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>21</td>
<td>14.14</td>
<td>.47</td>
<td>15.52</td>
</tr>
<tr>
<td>B</td>
<td>Experimental</td>
<td>47</td>
<td>12.98</td>
<td>.32</td>
<td>14.13</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>55</td>
<td>12.90</td>
<td>.30</td>
<td>14.18</td>
</tr>
<tr>
<td>C</td>
<td>Experimental</td>
<td>38</td>
<td>11.45</td>
<td>.40</td>
<td>12.26</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>52</td>
<td>11.50</td>
<td>.31</td>
<td>12.59</td>
</tr>
<tr>
<td>D</td>
<td>Experimental</td>
<td>11</td>
<td>11.27</td>
<td>.80</td>
<td>11.73</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>19</td>
<td>9.32</td>
<td>.49</td>
<td>11.26</td>
</tr>
<tr>
<td></td>
<td>Experimental Total</td>
<td>108</td>
<td>12.49</td>
<td>.25</td>
<td>13.35</td>
</tr>
<tr>
<td></td>
<td>Control Total</td>
<td>147</td>
<td>12.12</td>
<td>.22</td>
<td>13.44</td>
</tr>
</tbody>
</table>
discussion of the second hypothesis. Conclusions based on these data appear in the fifth chapter of the dissertation. A copy of Tolman's test is located in Appendix C.

Data from the Brown-Holtzman Survey of Study Habits and Attitudes (SSHA)

Table 8 summarizes the mean scores with their standard deviations of the Brown-Holtzman SSHA for the four performance classifications (A, B, C, D) for both experimental and control groups. The column headed "n" to the right of the experimental/control group column indicates the number of individuals included in the analysis in each experimental and control group for each performance classification.

The scholastic orientation column contains group mean scores obtained from combining scores on the two subscales: study habits and study attitudes. The maximum score for scholastic orientation is 200. The next column, study habits, combines the scores on the delay avoidance and work methods scales to provide a measure of academic behavior referred to as study habits. The last major column, study attitudes, combines the scores on the teacher approval and educational acceptance scales to provide a measure of scholastic beliefs referred to as study attitudes.

Horizontally the mean scores for scholastic orientation, study habits, and study attitudes can be identified. Experimental and control
Table 8. Summary of Study Habits, Study Attitudes, and Scholastic Orientation Means with Their Standard Deviations for Performance Classifications of Experimental and Control Means.

<table>
<thead>
<tr>
<th>Performance Classification</th>
<th>Group</th>
<th>n</th>
<th>Scholastic Orientation</th>
<th>Study Habits</th>
<th>Study Attitudes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>$\bar{x}$</td>
<td>$s/\sqrt{n}$</td>
<td>$\bar{x}$</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>Experimental</td>
<td>12</td>
<td>103.42</td>
<td>7.16</td>
<td>45.67</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>21</td>
<td>106.29</td>
<td>5.10</td>
<td>51.76</td>
</tr>
<tr>
<td>B</td>
<td>Experimental</td>
<td>47</td>
<td>100.91</td>
<td>3.44</td>
<td>48.96</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>55</td>
<td>99.85</td>
<td>3.36</td>
<td>47.10</td>
</tr>
<tr>
<td>C</td>
<td>Experimental</td>
<td>38</td>
<td>88.03</td>
<td>4.00</td>
<td>40.61</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>52</td>
<td>93.90</td>
<td>2.63</td>
<td>42.86</td>
</tr>
<tr>
<td>D</td>
<td>Experimental</td>
<td>11</td>
<td>88.91</td>
<td>2.99</td>
<td>40.82</td>
</tr>
<tr>
<td></td>
<td>Control</td>
<td>19</td>
<td>87.79</td>
<td>6.06</td>
<td>40.42</td>
</tr>
<tr>
<td>Experimental Total</td>
<td></td>
<td>108</td>
<td>95.44</td>
<td>2.34</td>
<td>44.82</td>
</tr>
<tr>
<td>Control Total</td>
<td></td>
<td>147</td>
<td>97.11</td>
<td>1.93</td>
<td>45.41</td>
</tr>
</tbody>
</table>
groups in the same performance classification can be compared as they appear directly one another. The standard deviations of the mean are presented to the right of each performance mean to assist in statistical interpretation. At the bottom of the table means for the entire experimental and control groups are presented.

The interpretation of these data contained in Table 8 is presented in the second half of this chapter with a discussion of the third hypothesis. Conclusions based on these data appear in the fifth chapter of the dissertation. A copy of the Brown-Holtzman SSHA is located in Appendix D.

Table 9 presents a contingency table for the experimental group showing the distribution of observed and expected scores for the range of scholastic orientation scores compared to the range of performance improvement scores. The range of scholastic orientation scores was divided into three approximately equal parts and operationally defined as high, medium, and low. Similarly the range of improvement in performance in GS 103 over past performance in GS 101-102 was also divided into three approximately equal parts and operationally defined as high, medium, and low.

The observed scores, presented above the diagonal line for each division in the table, are preceded by the letter O while the expected scores, presented below the diagonal, are preceded by the letter E. Comparisons of the observed and expected scores can be
Table 9. Contingency Table for Experimental Group.

<table>
<thead>
<tr>
<th>Improvement in Performance</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>O-9</td>
<td>E-8.4</td>
<td>O-13</td>
</tr>
<tr>
<td>High</td>
<td>E-11.0</td>
<td>E-12.6</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>O-11</td>
<td>O-16</td>
<td>O-19</td>
</tr>
<tr>
<td>Medium</td>
<td>E-12.0</td>
<td>E-15.9</td>
<td>E-18.1</td>
</tr>
<tr>
<td>Low</td>
<td>O-8</td>
<td>O-11</td>
<td>O-10</td>
</tr>
<tr>
<td>Low</td>
<td>E-7.6</td>
<td>E-10.0</td>
<td>E-11.4</td>
</tr>
</tbody>
</table>

can be made as they appear directly over one another for each division in the table.

Table 10 presents a contingency table for the control group showing the distribution of observed and expected scores for the range of scholastic orientation compared to the range of performance improvement. The ranges for both of these scales were divided into three parts by methods described in the preceding section on the experimental group.

Observed scores designated by the letter O appear above diagonal lines in each division of the table while expected scores designated by the letter E appear directly below the observed scores. Thus comparisons of observed and expected scores can easily be made.
Table 10. Contingency Table for Control Group.

<table>
<thead>
<tr>
<th>Improvement in Performance</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>O-8</td>
<td>O-8</td>
<td>O-13</td>
</tr>
<tr>
<td></td>
<td>E-8.1</td>
<td>E-8.7</td>
<td>E-12.2</td>
</tr>
<tr>
<td>Medium</td>
<td>O-16</td>
<td>O-15</td>
<td>O-21</td>
</tr>
<tr>
<td></td>
<td>E-14.6</td>
<td>E-15.6</td>
<td>E-21.8</td>
</tr>
<tr>
<td>Low</td>
<td>O-4</td>
<td>O-7</td>
<td>O-8</td>
</tr>
<tr>
<td></td>
<td>E-5.3</td>
<td>E-5.7</td>
<td>E-8.0</td>
</tr>
</tbody>
</table>

The interpretation of these data contained in Tables 9 and 10 is presented in the second half of this chapter with a discussion of the third hypothesis. Conclusions based on these data appear in the fifth chapter of the dissertation.

Tests of Hypotheses Under Investigation

1. That the mean performance scores on departmental examinations of students grouped according to past performance and exposed to the level of aspiration procedure will be significantly greater than the scores of the students similarly grouped having knowledge of test results alone.

Table 11 shows the comparison of mean scores on the departmental criterion instruments' totals for experimental and
control groups for performance classifications together with t-values from one-tailed t-tests.

Table 11. Comparison of Mean Scores Between Experimental and Control Groups on Departmental Criterion Instruments' Totals with Accompanying t-Values from One-tailed t-Tests.

<table>
<thead>
<tr>
<th>Performance Classification</th>
<th>Experimental Group</th>
<th>Control Group</th>
<th>t-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>x</td>
<td>n</td>
</tr>
<tr>
<td>A</td>
<td>12</td>
<td>172.25</td>
<td>21</td>
</tr>
<tr>
<td>B</td>
<td>47</td>
<td>162.55</td>
<td>55</td>
</tr>
<tr>
<td>C</td>
<td>38</td>
<td>152.11</td>
<td>52</td>
</tr>
<tr>
<td>D</td>
<td>11</td>
<td>141.63</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>108</td>
<td>157.58</td>
<td>147</td>
</tr>
</tbody>
</table>

*Significant at the .05 level of significance.

The critical value of the .05 significance level with 88 degrees of freedom is 1.67 for a one-tailed t-test. Thus for departmental criterion instruments' totals there is a significant statistical difference at the .05 significance level between the mean performance of the experimental and control groups of the C performance classification only.
2. That the mean performance scores on the GS 103 portion of Tolman's Principles of Biology Test of students grouped according to past performance and exposed to the level of aspiration procedure will be significantly greater than the mean performance scores of students similarly grouped and exposed to the control procedures.

Table 12 shows a comparison of mean scores on the GS 103 part of Tolman's Test for experimental and control groups for performance classifications together with t-values from one-tailed t-tests.

Table 12. Comparison of Mean Scores Between Experimental and Control Groups on GS 103 Part of Tolman's Test with Accompanying t-Values from One-tailed t-Tests.

<table>
<thead>
<tr>
<th>Performance Classification</th>
<th>Experimental Group</th>
<th>Control Group</th>
<th>t-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>X</td>
<td>n</td>
</tr>
<tr>
<td>A</td>
<td>12</td>
<td>14.75</td>
<td>21</td>
</tr>
<tr>
<td>B</td>
<td>47</td>
<td>12.28</td>
<td>55</td>
</tr>
<tr>
<td>C</td>
<td>38</td>
<td>11.13</td>
<td>52</td>
</tr>
<tr>
<td>D</td>
<td>11</td>
<td>9.82</td>
<td>19</td>
</tr>
<tr>
<td>Total</td>
<td>108</td>
<td>11.90</td>
<td>147</td>
</tr>
</tbody>
</table>

None of the computed t-values exceeded the critical values at the .05 level for one-tailed t-tests. Therefore for the GS 103 portion of Tolman's Principles of Biology Test there is no significant statistical difference at the .05 level between the mean performance of the experimental and control groups of any performance classification.
3. That the amount of improvement in GS 103 over past performance in general biology for students exposed to the level of aspiration procedure will have a significantly positive relationship to their scholastic orientation scores compared to the same relationship of scores for students exposed to the control procedures.

Before discussing the relationship between the amount of improvement in GS 103 over past performance in general biology and scholastic orientation, data indicating the scholastic orientation of each of the four performance classifications is presented in order to give an indication of the scholastic orientation means of the four performance classifications for both experimental and control groups.

Figure 3 illustrates the scholastic orientation means with their standard deviations for the four performance classifications of the experimental group. As Figure 3 indicates, scholastic orientation means appear to decrease with decreasing performance classifications. There is a small difference between the A and B performance classifications and a small difference between the C and D performance classifications compared with the large difference which occurs between the B and C performance classifications.

It should be noted that the overall difference in scholastic orientation means (103.42-88.91) between the A and D classifications is very small compared with the total range possible in scholastic orientation scores (0-200).
Figure 3. Scholastic Orientation Means with Their Standard Deviations for Performance Classifications of the Experimental Group.

Figure 4. Scholastic Orientation Means with Their Standard Deviations for Performance Classifications of the Control Group.
Figure 4 illustrates the scholastic orientation means with their standard deviations for the four performance classifications of the control group. As Figure 4 indicates, scholastic orientation means appear to decrease with decreasing performance classifications. The differences between the means between each adjacent performance classification is small and of the same magnitude. Again it should be noted that the overall difference in scholastic orientation means of the control group between the A and D classifications (106.29-87.79) is very small compared with the total possible range in scholastic orientation scores (0-200).

To provide additional comparison between the experimental and control groups with regard to scholastic orientation means, one-tailed t-tests were performed on the scholastic orientation means of each of the four performance classifications. None of the computed t-values exceeded the critical values at the .05 level of significance. Thus it appears that there is no significant statistical difference between the scholastic orientation means of the experimental and control groups for any of the performance classifications.

In order to test the third hypothesis regarding the amount of improvement in GS 103 over past performance and its relationship to scholastic orientation for both experimental and control groups, contingency tables (pages 69 and 70) were developed. These two tables showed the distribution of observed and expected scores for
the range of scholastic orientation compared with the range of performance improvement.

To test whether the two scales were independent of each other a chi-square test was utilized for the experimental and control tables. The chi-square values obtained from the tables were 0.56 and 0.91 for experimental and control groups respectively. The critical value at the .05 significance level for 4 degrees of freedom was 9.49 which indicated that the distribution of observed scores was very close to an expected distribution under a null hypothesis that improvement in performance is independent of scholastic orientation.

If a particular scholastic orientation is susceptible to the level of aspiration treatment the distribution of the observations in the contingency table for the experimental group would be different than expected. It seems plausible to conclude from these observations and interpretations that improvement in performance in GS 103 over past performance in general biology is independent of scholastic orientation in both experimental and control groups.

Tabulated Data from Control Cards

Although the tabulated responses from the control cards were not directly related to the hypotheses being investigated in this study, they were of interest to the General Science Department and are therefore included at this point in this chapter.
The control cards were given at the same intervals as the experimental cards to provide as uniform as possible conditions surrounding the level of aspiration procedures. The contents of the four cards were specifically designed not to possess any motivational property as were the experimental cards but to furnish the department with information of interest about the student. Table 1 (page 37) presents the GS 103 weekly schedule for the administration of both the control and experimental cards.

Control card I administered in the second week of the spring term asked four questions concerning the student's T. V. viewing hours, the number of T. V. lectures watched, the number of chapters read, and the student's opinion of the relative difficulty of the GS 103 program compared to other courses experienced. The tabulated responses following each question are presented below.

Card I

Question 1: At what hours do you usually watch the T. V. lectures?

<table>
<thead>
<tr>
<th>Performance Group</th>
<th>M &amp; W 9-9:45 am</th>
<th>T &amp; Th 2-2:45 pm</th>
<th>M &amp; W 7-7:45 pm</th>
<th>Variable</th>
<th>Don't Watch</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>15</td>
<td>8</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>B</td>
<td>29</td>
<td>14</td>
<td>5</td>
<td>13</td>
<td>4</td>
<td>65</td>
</tr>
<tr>
<td>C</td>
<td>17</td>
<td>7</td>
<td>7</td>
<td>18</td>
<td>2</td>
<td>51</td>
</tr>
<tr>
<td>D</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Totals</td>
<td>63</td>
<td>30</td>
<td>12</td>
<td>34</td>
<td>8</td>
<td>147</td>
</tr>
</tbody>
</table>
Question 2: Of the three T. V. lectures presented so far, how many have you watched?

<table>
<thead>
<tr>
<th>Performance Group</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
<th>Don't Watch</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>19</td>
<td>6</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>27</td>
</tr>
<tr>
<td>B</td>
<td>37</td>
<td>10</td>
<td>8</td>
<td>6</td>
<td>4</td>
<td>65</td>
</tr>
<tr>
<td>C</td>
<td>19</td>
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Question 3: Please circle the numbers of the chapters you thoroughly read at this point in the course.

Ch. 18 Principles of Classification
Ch. 19 Protists and Simple Plants
Ch. 20 More Complex Plants
xx Additional chapters

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Question 4: Comparing other courses you have experienced and considering all aspects of GS 103, do you consider the course to be:

A. Relatively difficult
B. Not particularly difficult
C. Relatively easy

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Control card II administered in the fourth week of the spring term asked three questions. The questions and tabulated responses are as follows:

Card II

Question 5: How would you evaluate your INTEREST in:

Circle

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Question 6: Is this course providing an academic challenge to you?

1. No. It is too difficult.
2. No. It is too easy.
3. Somewhat. About the same as my other courses.
4. Definitely. More than most of my other courses.

<table>
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Question 7: How would you describe your feelings (reactions) about your score on the last 25-point test? Considering your amount of preparation.

1. Positive - Success
2. Neutral - Indifference
3. Negative - Disappointment

<table>
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Control card III was administered in the sixth week of the
spring term. The three questions and the tabulated responses are as
follows:

Card III

Question 8: Considering your university experience to date, how
relevant is the content and activities of general biology
to you as a person?

1. Very relevant
2. Moderately relevant
3. Only slightly relevant
4. Not relevant

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Question 9: During the last six weeks of term, have you sought assis-
tance, guidance or discussion outside of regular class
time from any of the recitation or laboratory staff?

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Question 10: Would you consider the results you received on the last two tests to be representative of the effort you have invested in the course over the past six weeks?

(circle) YES or NO

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Control card IV was administered in the ninth week of the spring term. The two questions and the tabulated responses are as follows:

Card IV

Question 11: In comparison to your other courses this term, how would you evaluate GS 103 in each of the following:

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(low) (medium) (high)
Question 12: In addition to taking GS 103 midterm examinations and receiving your corrected papers, how would you rate the importance of the role that your recitation periods have served you during this term? (low) (medium) (high)  

- receiving directions, "hints" and points to emphasize for studying  
- developing and sustaining interest  
- providing clarification of specific points in subject matter  
- relating laboratory, text, and T.V. concepts meaningfully  
- total effect of recitation on your attitude toward GS 103  
- total effect of recitation on your performance in the course

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Summary

This chapter presented and interpreted the findings of this study. The first section of the chapter briefly reviewed the objectives, indicated the nature of the treatment and its setting, and discussed the manner in which the hypotheses would be tested.

The next section of the chapter presented the data from the evaluating instruments. Index of discrimination data were given for each criterion instrument: the three departmental midterm examinations, the final examination, and Tolman's Principles of Biology Test. Summaries of mean scores with their standard deviations of each of the criterion instruments were presented in tabular form. Data from the Brown-Holtzman SSHA were presented in terms of a summary of scholastic orientation, study habits, and study attitudes means with their standard deviations. Two contingency tables were shown comparing the distributions of improvement in performance with scholastic orientation.

The following section of the chapter presented the tests of the three hypotheses under investigation. Tables of comparisons of mean scores between experimental and control groups for criterion instruments were presented. Two figures illustrating scholastic orientation means for performance classifications were shown.
The last section of the chapter presented tabulated data from the control cards which were of interest to the Department of General Science but not directly connected with the hypotheses under investigation.
V. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The objectives of this investigation were (1) to determine if the level of aspiration procedure consisting of knowledge of results plus goal-setting possesses a motivational property as reflected in performance above that of knowledge of results alone in an undergraduate biology course, (2) to further demonstrate the motivational property of the level of aspiration procedure using Tolman's Principles of Biology Test, and (3) to ascertain whether the amount of improvement in general biology over past performance is significantly positive in its relationship to scholastic orientation scores as measured by the Brown-Holtzman Survey of Study Habits and Attitudes.

The first two of these objectives were accomplished by a statistical analysis comparing the performance scores on criterion instruments of students in experimental and control groups that were classified according to past performance in general biology. The third objective was achieved by analyzing the distribution of scholastic orientation scores from the Brown-Holtzman SSHA and improvement in performance scores from criterion instruments in a contingency table for both experimental and control groups.

All criterion instruments were administered at Oregon State University during the spring term of the 1968-1969 academic year.
All of the students whose scores were used in the final analysis had successfully completed GS 101 and 102 during the 1968-1969 academic year, had been present for all treatment and control procedures, and had completed all midterms, final examinations, Tolman and Brown-Holtzman instruments.

The criterion instruments were three midterms and a final examination developed by the General Science Department of O.S. U. and a Principles of Biology Test developed by Richard T. Tolman formerly of O.S. U. The instrument measuring scholastic orientation was developed by William F. Brown and Wayne H. Holtzman of the Psychological Corporation, New York.

The reliability of the criterion instruments was estimated by computing discrimination and difficulty indices for each individual item. On the basis of a low discrimination index, some items were eliminated before the final analysis. The reliability data of the Brown-Holtzman instrument furnished by the SSHA Manual indicates stability coefficients from test-retest studies ranging from .83 to .93 (7, p. 11).

In the test of the first two hypotheses under investigation, one-tailed t-tests were computed on group sample means for all performance classifications of experimental and control groups. Computer output data yielded standard deviations of the means which were used to aid in the interpretation of significant differences in the t-values
among the sample groups. In the test of the third hypothesis, chi-square tests were performed on the contingency tables. Computational procedures yielded simple correlation coefficients between variables which were of assistance in interpretation of the data.

The t-values at the 5 percent level of significance for the first hypothesis under consideration indicated no significant difference among experimental and control groups except for the C performance classification for the departmental criterion instruments. For the second hypothesis there were no significant differences among groups for any performance classification for the Tolman's Principles of Biology Test.

The chi-square values at the 5 percent level of significance for the third hypothesis under investigation indicated no statistically significant relationship between scholastic orientation and improvement in performance in either experimental or control groups.

Conclusions

The conclusions drawn from the results of this research are presented following a discussion of each hypothesis under investigation.

1. That the mean performance scores on departmental examinations of students grouped according to past performance and exposed to the level of aspiration procedure will be significantly
greater than the scores of the students similarly grouped having knowledge of test results alone.

The results of this study indicate that there is a statistically significant difference between the mean performance of experimental and control groups for only the C performance classification.

Therefore, considering the assumptions in Chapter I, the inference can be made that the level of aspiration procedure as conducted in this investigation possessed a limited motivational property only for those students whose past performance in general biology classified them as C performance students.

It is the conclusion of the researcher that the generally insignificant treatment effect may be attributed to the influence of the following factors operating on all performance classifications. First, the amount of goal-setting performed by the control groups independent of the treatment should be considered. It would be useful to determine if implicit goals were set by these groups. Although they could not have been asked during the treatment, they might have been given some form of post experimental goal questionnaires in order to determine the extent of this phenomenon. Secondly, the private conditions of expressing the level of aspiration may not produce as strong a commitment on the part of the student to aspire as would a public expression in which failure could mean ego deflation, loss of status, and loss of prestige in the opinion of another person. The
implementation of public expressions of aspiration levels was not possible in the present study nor was the use of a post experimental questionnaire. Both of these factors could be considered in subsequent research in this area. Finally, the length of the experimental period and the number of treatment administrations may be insufficient to produce significant results. A study extended over an academic year for a three-term sequence might provide data to resolve this question.

In comparing the treatment's effectiveness on specific performance classifications the observed decrease in effect when comparing C, B, and A classes may be due to the difference in the difficulty that a similar task poses a C student compared to a B or an A student. Locke (42) found that the greatest increases in performance were noted in students attempting to achieve the hardest tasks. Fryer (20) found a strong relationship between the level of the goal and performance level with high goals leading to a higher level of performance than low goals.

With regard to the D performance classification the treatment effect was positive but insignificant. It is the belief of the researcher that this group's past performance of weakness and failure in this subject area over two previous terms may have negatively influenced the effectiveness of the level of aspiration treatment. Clearly further research is needed to provide answers to these questions.
2. That the mean performance scores on the GS 103 portion of Tolman's Principles of Biology Test of students grouped according to past performance and exposed to the level of aspiration procedure will be significantly greater than the mean performance scores of students similarly grouped and exposed to the control procedures.

The results from this portion of the study indicate that there is no statistically significant difference between the experimental and control groups for any performance classification on Tolman's Principles of Biology Test.

Considering the assumptions in Chapter I, the inference can be made that the level of aspiration procedure as conducted in this investigation possesses no significant increase in performance when using the Tolman instrument.

The conclusions reached by the researcher concerning these results parallel those discussed under the first hypothesis. First, the amount of goal-setting performed by the control groups independent of the treatment should be considered. Secondly, the private conditions of expressing the level of aspiration may not produce as strong a commitment on the part of the student to aspire as would a public expression in which failure could mean ego deflation, loss of status, and loss of prestige in the opinion of another person. Finally, the length of the experimental period and the number of treatment administrations may be insufficient to produce significant results.
It should also be noted that the students had no previous notification that the Tolman’s Principles of Biology Test was to be administered whereas notification of all departmental examinations was given.

3. That the amount of improvement in GS 103 over past performance in general biology for students exposed to the level of aspiration procedure will have a significantly positive relationship to their scholastic orientation scores compared to the same relationship of scores for students exposed to the control procedures.

The results of this portion of the investigation indicate that there is no significant statistical difference between the scholastic orientation means of the experimental and control groups for any of the four performance classifications. Results also indicated that the amount of improvement over past performance for students exposed to the level of aspiration procedure is independent of their scholastic orientation scores.

If the level of aspiration treatment did change the distribution of scores in the contingency table then on the basis of scholastic orientation one could predict to some degree which students would be most influenced by the treatment. However, on the basis of the results of this study the researcher concludes that the scholastic orientation score is not suitable for designating which students would be most affected by the level of aspiration procedures. The reason for
scholastic orientation failing to serve as a predictor of level of aspiration effectiveness is undoubtedly complex and further investigation will be necessary for a satisfactory explanation.

Recommendations

On the basis of this study, the investigator recommends that:

1. Further investigation concerning the role of level of aspiration procedures as a motivational device be done in educational settings.

2. A study similar to this investigation be conducted to determine if the present results are replicable.

3. Other investigations similar to this be conducted over an extended period of time such as an academic year in cases of three-term sequential courses.

4. Further research on level of aspiration procedures be carried out in educational settings to answer the following questions:

   A. Does expressing level of aspiration publicly in a group setting result in greater increases in performance than expressing them privately?

   B. Does the use of reference scores of other groups influence the setting of levels of aspirations and subsequent performance?
C. Does the importance of the task as viewed by the student affect the motivational property of level of aspiration procedures for him?

D. In what other academic areas can the findings of this study be generalized?

E. Is the level of aspiration procedure as effective with elective compared to required undergraduate courses?

5. Where level of aspiration procedures produce increased performance in educational settings, that they be incorporated into the regular classroom procedures in order to provide another means of increasing scholastic success.
BIBLIOGRAPHY


APPENDICES
<table>
<thead>
<tr>
<th>Performance Classification</th>
<th>Past Performance and Scholastic Orientation</th>
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Items 1 and 2: By means of the key given below determine the names of the numbered organisms. When you have keyed out each numbered organism match its name with the number of the appropriate response and mark in that response number opposite the test item number (which is also the number of the organism to be identified).

1. [Diagram of an organism with Green and Brown labels]

2. [Diagram of an organism with Golden-brown label]

[Diagram of an organism with Green label]

[Diagram of an organism with Yellow-green label]

[Diagram of an organism with Green label]
KEY

1a. Cell(s) flagellated 2
1b. Cell(s) not flagellated 5

2a. Cells occurring in a group 3
2b. Cells occurring singly

3a. One flagellum per cell 4
3b. More than one flagellum per cell

4a. Cell spherical, chloroplast green 5
4b. Cell elongate, chloroplast brown

5a. Cell wall of two overlapping sections 6
5b. Cell wall of one piece 7

6a. Chloroplasts yellow-green 8
6b. Chloroplasts golden-brown

7a. Plant a branching tube with continuous protoplasm not divided into cells, green, elongate chloroplasts 9
7b. Plant a strand or filament of cells, green, spiral chloroplast

Response No. Name
1. Chlamydomonas 10
2. Euglena 11
3. Gonium 12
4. Melosira 13
5. Rhodomonas 14
6. Spirogyra 15
7. Tribonema 16
8. Vaucheria 17

3. The flagellate group of protists includes organisms metabolically capable of
   1. photosynthesis 3. parasitism
   2. absorption of nutrient molecules through the body surface 4. 2 and 3 above
   5. 1, 2 and 3 above

4. A high degree of differentiation within a microorganism is illustrated by the
   1. bacteria 4. amebas
   2. blue-green algae 5. ciliates
   3. flagellates
5. Which of the following pairs illustrate convergent evolution?
1. ocean fish: whales
2. hummingbird: hummingmoth
3. flying squirrel (placenta mammal); flying phalenger (marsupial mammal)
4. all of the above
5. none of the above

6. Which of the following is the most important reason for the use of a scientific name for each species?
1. The name provides a clear idea of the most important anatomical characteristic of the species.
2. The name provides a useful picture of the place (habitat) where the species lives.
3. The name is reserved for one species and is the only name used for that species by all biologists regardless of time and place.
4. The name maintains the use of Latin, an important, primary, European language.
5. All of the above.

7. A contemporary view of the category of organisms called species includes the idea that it is a population of individuals
1. of common descent
2. with similar ecological requirements and relationships
3. having a continuing evolutionary role distinct from that of adjacent populations
4. all of the above
5. none of the above

8. Classification of organisms on the basis of comparative study of form and function includes the
1. analysis of degrees of resemblance
2. selection and interpretation of anatomical and physiological characters
3. determination of the abstract type or archetype of each group
4. 1 and 2 above
5. 2 and 3 above

9. Which of the following is the most exclusive category of the biological classification scheme?
1. phylum
2. class
3. family
4. genus
5. species
10. Which of the following conclusions requires the biologist to make an interpretation after he has observed structural similarity?

1. that structures are homologous
2. that structures are homoplastic
3. that structures are analogous
4. all of the above
5. 1 and 2 above

COMPARISONS (Items 11-14)

11. Generally the number of cell-surface, whiplike appendages of a flagellate is the number of cell-surface, whiplike appendages of a ciliate

   1. greater than
   2. less than
   3. the same as

12. Generally the number of individual diatoms in a certain large volume of surface ocean water is the number of individual herring in the same place and same volume of ocean water

   1. greater than
   2. less than
   3. the same as

13. The Phylum Chordata has classified in it a number of species that is the number of species classified in the Class Mammalia

   1. greater than
   2. less than
   3. the same as

14. A corn plant is likely to produce seeds in numbers the number of seeds produced by a bracken fern plant of about the same size

   1. greater than
   2. less than
   3. the same as

MATCHING (Items 15-19)

15. Heterotrophic cells lacking organized nuclei

   Responses
   1. Algae
   2. Bacteria
   3. Ciliates
   4. Diatoms
   5. Flagellates
   6. Fungi
   7. Lichen
   8. Virus

16. Agents responsible for nitrogen fixation in soil

17. Protozoan ancestors of sarcodines and ciliates

18. Photosynthetic creatures living within glass (silicate)houses

19. Close obligatory association of an autotrophic and a heterotrophic plant
20. The gymnosperms, angiosperms, and ferns are alike in that they all
1. have well-developed vascular tissue
2. have flowers during some part of their life cycles
3. lack a gametophyte generation in their life cycles
4. lack a sporophyte generation in their life cycles
5. produce seeds

21. Angiosperms differ from gymnosperms in that they (the angiosperms)
1. possess vascular tissue
2. produce seeds encased within an ovary
3. are all woody perennials
4. possess a dominant sporophyte generation
5. are mainly photosynthetic autotrophs

22. Which of the following conditions pose problems for the life cycle of the land-dwelling, seed-producing plants?
1. relative scarcity of water
2. low density of the air
3. relative abundance of sunlight
4. 1 and 2 above
5. 2 and 3 above

23. The supporting tissues of plants carry on several functions. These include
1. transport of water and minerals
2. prevent water loss from the plant
3. support of the plant
4. all of the above
5. 1 and 3 above

24. Which of the following is not a means for the dispersal of seed-producing plants?
1. seed
2. pollen
3. spore
4. bacteria
5. fungi

25. Which of the following is not present in the environment of the root of an Oregon alder tree?
1. sunlight
2. water
3. minerals
4. bacteria
5. fungi
Midterm II

Select the best answer to each of the following statements and Black In the corresponding letter on your answer sheet.

1. The body plan of the spider is best characterized by
   1. head, thorax and abdomen
   2. head and trunk
   3. 3 pair of legs
   4. 4 pair of legs
   5. 10 pair of legs

2. Radial symmetry is characteristic of
   1. Coelenterata
   2. Echinodermata
   3. Platyhelminthes
   3. two of the above
   4. three of the above

3. Some animals possess both male and female reproductive organs, and as such are said to be
   1. dioecious
   2. hermaphroditic
   3. morphogenic
   4. parthenogenic
   5. viviparous

4. The blood fluke that lives as an adult in veins of the bladder or colon of man
   1. passes part of its life in a specific species of snail
   2. is a member of the class Trematoda
   3. produces a number of individuals of several different forms during its life within the snail
   4. answers 2 and 3 apply
   5. answers 1, 2 and 3 apply

5. The crayfish and lobster belong to the class
   1. Arachnida
   2. Chilopoda
   3. Crustacea
   4. Diplopoda
   5. Trilobita

6. The presence of a skeleton is characteristic of which of these phyla?
   1. Annelida
   2. Arthropoda
   3. Chordata
   4. 2 and 3 of the above
   5. all of the above

7. In which of the major habitats are living insects virtually absent?
   1. Aerial
   2. Estuaries
   3. Fresh water
   4. Marine
   5. Terrestrial
8. Which one of the following arthropod groups with its accompanying type example, is mismatched?
1. Crustacea - crab
2. Arachnida - flea
3. Insecta - grasshopper
4. Chilopoda - centipede
5. Diplopoda - millipede

9. Which of the following features apparently restricts the upper limit of size for the insect body plan?
1. circulatory system
2. digestive system
3. nervous system
4. reproductory system
5. skeletal system

10. Free living Platyhelminthes are similar to the Coelenterates in which of the following respects?
1. They have one opening into the digestive cavity.
2. They are bilaterally symmetrical.
3. They have a mesodermal layer
4. They have a definite and permanent anterior end.
5. They have a dorsal and ventral surface.

11. Which of the following groups is not considered to represent a culmination of the evolutionary process in respect to complexity, coordination, diversity and success of adaptation?
1. Arthropods
2. Echinoderms
3. Mollusks
4. Vertebrates
5. 2 and 3 above

12. Animals are distinguished from plants by a number of characteristics. Which of those listed is not an "animal" characteristic?
1. Heterotrophic
2. Possess a mobile stage, in some instances as a developmental form
3. New elements are added to the living structure throughout life
4. Special receptors to receive stimuli exist
5. The reproductive process lacks a developed haplophase

13. In your observations of the Paramecium in lab
1. it was noted that the contractile vacuoles usually filled and emptied alternately
2. the food vacuoles were formed from materials taken in at any point of the body surface
3. the body rotates about the long axis (an axis running from anterior to posterior end)
4. 1 and 3 above
5. 1, 2 and 3 above
14. In lab, you used two kinds of media on which you cultured protists.
   1. Bacteria were most common on the potato dextrose agar media
   2. Fungi were most plentiful on the nutrient agar media
   3. Bacteria require a media relatively high in protein
   4. 1 and 2 above
   5. 2 and 3 above

15. Characteristics which would be more commonly associated with cocci
   1. rod shaped
   2. spherical shaped
   3. motile
   4. 1 and 2 above
   5. 1 and 3 above

16. Observations of the fungi grown in lab, indicated
   1. the colony size to be larger than the colony size of the bacteria
   2. the colonies are composed of strands or filaments
   3. many are brightly colored, pink, yellow, orange, etc.
   4. 1 and 2 above
   5. 1, 2 and 3 above

FOR TEST ITEMS 17-20, use the key terms below.
   1. Annelida
   2. Arthropods
   3. Coelenterata
   4. Echinodermata
   5. Molluska
   6. Platyhelminthes
   7. Vertebrata

17. A group possessing tube-feet operated by a water vascular system

18. Members of this group are segmented and many use setae to accomplish locomotion.

19. A group characterized by having a mantle and a foot

20. A group whose phyletic name denotes "jointed feet."

FOR TEST ITEMS 21-23, use the key terms below
   1. Cephalization
   2. Coelom
   3. Exoskeleton
   4. Ganglion
   5. Notochord
   6. Segmentation
   7. Symmetry

21. The concentration of brain and receptors into the anterior end of the organism
22. What anatomical feature distinguishes the phylum acclaimed by most biologists as the "most advanced," from all other phyla?

23. The arrangement of an organism's body in such a manner that each half is a mirror image of the other.

FOR TEST ITEMS 24-25, use the key terms below.

1. Agnaths
2. Aves (birds)
3. Chondrichthyes
4. Mammals
5. Osteichthyes
6. Placoderms
7. Reptiles

24. The group known as the cartilaginous fishes, such as the sharks.

25. Terrestrial animals with 3 chambered hearts and that produce leathery covered eggs.
Midterm III

FOR TEST ITEMS 1-3, apply the key terms below.

1. Ecosystem
2. Niche
3. Substratum
4. Symbiosis
5. Mutualism
6. Commensalism
7. Ecology

1. The complete way of life of a species, its particular environment and its behavior.

2. The study of communities and populations in relation to their environment.

3. Protozoans living in the gut of a termite.

4. Which of the following could be regarded as the least changing major environment?
   1. The rocky seashore
   2. The dense litter on the floor of a temperate forest
   3. A fresh-water lake
   4. The deep sea bottom
   5. A mountain peak above timberline
   6. A very sandy desert

5. The major limitation on the abundance of life in the surface waters of the sea is the availability of
   1. water
   2. sunlight
   3. mineral salts
   4. hiding places
   5. oxygen
   6. carbon dioxide

6. Which of these pyramid relationships is a direct illustration of the second law of thermodynamics?
   1. Pyramid of mass
   2. Pyramid of numbers
   3. Pyramid of energy
   4. all of the above
   5. none of the above

7. The basic unit in the study of ecology is the
   1. Atmosphere
   2. Environment
   3. Community
   4. Ecosystem
   5. Biosphere

8. Competition in nature can
   1. be between the same species
   2. be between different species
   3. limit population size
   4. only 2 of the above
   5. 1, 2 and 3 above
9. The ecological process of succession affects
   1. animals only  
   2. plants only  
   3. the environment only
   4. only two of the above
   5. all of the above

10. Energy is transferred through food chains - which of the following is the most correct example of such an energy transfer?
   1. green plant - carnivore - herbivore - bacteria
   2. green plant - herbivore - carnivore - bacteria
   3. consumer - reducer - producer
   4. reducer - 1st level consumer - producer
   5. 1 and 4 above

11. In an ecosystem, the flow of energy differs from the minerals present in which of the following ways?
   1. minerals are cycled while energy is not
   2. both minerals and energy are cycled
   3. neither energy nor minerals are cycled
   4. energy is progressively increased
   5. none of the above

12. All of the following may be members of the biotic environment of a bird except
   1. insects
   2. trees
   3. sunlight
   4. cats
   5. all of the above

13. The components of a food chain are generally greater than, less than, or equal to components of a food web.
   1. greater than
   2. less than
   3. equal to

14. According to the English clergyman Thomas Malthus, natural populations
   1. always remain in balance and harmony with their food resources
   2. increase arithmetically, while their resources increase geometrically
   3. increase arithmetically, as do their available food resources
   4. increase geometrically, while their resources increase arithmetically
   5. increase geometrically, as do their available food resources
15. Which of the following natural resources would not be regarded as renewable?
1. salmon runs up coastal rivers
2. timber forests
3. a supply of fresh water
4. hydroelectric power for lighting cities
5. uranium as a source for nuclear power

16. In laboratory, early germinating seeds of barley or corn and seeds with emergent shoots and roots were cut into halves and the embryos removed. Endosperm from early germinating stages was placed in tube 1, endosperm from emergent root and shoot stages was placed in tube 2. To each Benedict's solution was added and a test was made. What was observed?
1. Tube contents in tube #1 turned from blue to pink or pinkish red.
2. Tube contents in tube #1 turned from blue to a green to yellow or orange red color.
3. Tube contents in tube #2 turned from blue to a violet or blue black color.
4. Tube contents in tube #2 changed from blue to a green to yellow or orange red color.
5. No change occurred.

17. In the above test the Benedict's solution was used to test for
1. the presence of a reducing sugar--thus indicating some starch digestion
2. respiratory activity in the developing embryo
3. determination of whether the seed is a dicot or a monocot
4. the presence or absence of the coleoptile
5. determination of whether the seed is heterotrophic or autotrophic

18. Which one of the following statements is correct?
1. The lima bean seed has two cotyledons and endosperm to provide an abundant nutritional reserve for the sporophyte embryo.
2. The corn seed has endosperm but no cotyledons to serve as nutritive material for the embryo.
3. The pea seed has two cotyledons but no endosperm to serve as a nutrient source for the embryo.
4. The barley seed has only one cotyledon and no endosperm to serve as nutrient.
5. None of the above.
19. One of the following is not a characteristic of monocotyledonous plants. Which one?
   1. one cotyledon
   2. vascular bundles scattered throughout stem
   3. leaves - parallel veined
   4. floral parts in fours or fives or multiples thereof

20. When natural predators were destroyed in the Kaibab Plateau of Utah the resident deer herd
   1. increased in a spectacular fashion from less than 30,000 to 100,000 in about 15 years
   2. remained at a steady level of about 30,000 which is the carrying capacity of the range
   3. decreased in a spectacular fashion from a high of 30,000 to a low of 10,000 in less than 10 years
   4. held its numbers relatively constant by decreasing the birth rate of the herd
   5. none of the above

21. A lesson to be learned from an analysis of the predator-prey relationship as exemplified by the populations on the Kaibab Plateau includes
   1. There is no danger in disturbing the balance of nature in a community.
   2. There is real danger in disturbing the balance of nature in a community.
   3. Man can adjust the predator-prey relationship in a community with impunity since he is the dominant species in the community.
   4. Man should not attempt to adjust predator-prey relationships in communities without a thorough knowledge of those relationships
   5. 2 and 4 above
   6. 1 and 3 above

22. Which one of the following most nearly explains the reason for the great increase in human members during the past 200 years?
   1. The rate of births/unit of population has markedly increased.
   2. The rate of births/unit of population has remained the same.
   3. The rate of births/unit of population has markedly decreased.
   4. The rate of deaths/unit of population has markedly increased.
   5. The rate of deaths/unit of population has remained the same.
   6. The rate of deaths/unit of population has markedly decreased.
23. All life is ultimately limited by
   1. the predator-prey relationship existing on earth
   2. the curve of survivorship
   3. the usable energy received from the sun
   4. the stored energy found in green plants
   5. competition between members of the same and different
      species for available space

24. In predator-prey relationships such as revealed by an analysis of
the trapping records of the Hudson Bay Company it appears that
   1. animals may be eaten by their natural enemies at roughly
      the same ratio as they can reproduce themselves
   2. under certain conditions a population may increase to such
      numbers that a food shortage is created, resulting in starva-
      tion and a subsequent reduction in population size
   3. both mechanisms mentioned above may result in predator-  
      prey interactions that serve to regulate the numbers of both
      the predator and the prey over the long run
   4. no significant fluctuations in population size of either preda-
      tors or prey was indicated from trapping records—the
      community appears to remain nicely balanced from year to
      year
   5. 1, 2 and 3 above
   6. 1 and 4 above

25. Intraspecific competition may be significantly lessened by such
behavior patterns as
   1. territoriality
   2. pecking order
   3. division of roles in a society
   4. all of the above
   5. none of the above
1. The scientific name of the human species fits the rules of biological nomenclature in
   1. consisting of two words or two terms
   2. being written in Latin or Latinized form
   3. naming the Order and Family to which man belongs
   4. 1 and 2 above
   5. 1, 2 and 3 above

2. Which term best describes the scheme of biological classification?
   1. hierarchy
   2. homoplastic
   3. convergent
   4. descent
   5. transformation

3. Examination via use of the light microscope shows that the number of internal parts of a bacillus (bacterium) is
   1. greater than
   2. less than
   3. the same as
   the number of internal parts of a ciliate.

4. Generally the number of different kinds of organisms composing a leafy lichen growing on a tree branch is
   1. greater than
   2. less than
   3. the same as
   the number of different kinds of organisms composing a crustose lichen growing on the same or a nearby tree branch.

5. Generally the number of wings on a fly (order Diptera) is
   1. greater than
   2. less than
   3. the same as
   the number of wings on a bee (order Hymenoptera).

6. The rose bush flower is likely to produce free-air-borne spores in numbers
   1. greater than
   2. less than
   3. the same as
   the numbers of free-air-borne spores produced by a bracken fern plant of about the same size.

7. Which of the following groups exhibits, among its members, the greatest diversity of niches?
   1. amphibians
   2. reptiles
   3. insects
   4. birds
   5. mammals
8. A contemporary view of the category of organisms called species includes the idea that it is a population of individuals
1. whose appearance fits the "type" of that species
2. whose appearance is unchanging through the passage of time
3. of common descent
4. 2 and 3 above
5. 1 and 2 above

9. The modern classification of organisms is based upon
1. the concept of fixed, unchanging species
2. the idea that one specimen is an adequate type (representative) for the species
3. the concept of changing species and evolution
4. 1 and 3 above
5. 2 and 3 above

10. Which of the following is the most important reason for the use of a scientific name for each species?
1. The name provides a useful picture of the place (habitat) where the species lives.
2. The name is reserved for one species and is the only name used for that species by all biologists regardless of time and place.
3. The name provides a clear picture of the most important anatomical characteristic of the species.
4. The name keeps alive the use of Latin which is an important and primary European language.
5. All of the above

11. Which of the following is common to green algae, ciliates, bacilli (bacteria), mosses, ferns, apple trees, man?
1. photosynthesis
2. transpires water
3. converts the energy of carbohydrates to the energy-form the cells can use
4. reproduces via use of spores
5. does not require the uptake of energy from outside its body

12. To hold the developing embryo on or within the body of the parent in order to provide protection and food materials is an adaptation to life on land. These procedures are characteristic of the reproductive process of
1. mammals
2. seed-producing plants
3. birds
4. 1, 2 and 3 above
5. 1 and 2 above
13. The gymnosperms, angiosperms and ferns are alike in that they all
1. produce seeds at some time in the life cycle
2. have well-developed vascular tissues
3. lack a gametophyte generation in their life cycle
4. 1 and 2 above
5. 2 and 3 above

14. Which of the following conditions pose problems for the life of the land-dwelling, seed-producing plants?
1. relative abundance of sunlight
2. relative scarcity of water
3. low density of the atmosphere
4. 1 and 2 above
5. 2 and 3 above

15. The use of wings for flight by insects, birds and mammals is said to be an illustration of
1. hierarchy
2. homology
3. analogy
4. transformation
5. special creation

16. Which of the following do the leaf and root of the land-dwelling plant have in common?
1. photosynthesis
2. storage of water
3. uptake of minerals from the environment
4. support of the plant
5. all of the above

17. Which of the following is the most inclusive category of the biological classification scheme?
1. phylum
2. class
3. family
4. genus
5. species

18. The classification of organisms on the basis of comparative study of form and function includes the
1. analysis of degrees of resemblance
2. selection and interpretation of anatomical and physiological characters
3. determination of the abstract type or archetype of each group
4. 1 and 2 above
5. 1, 2 and 3 above

19. A small rose bush is likely to produce seeds in numbers
1. greater than
2. less than
3. the same as
the numbers of seeds produced by a sword fern plant of about the same size.
20. The supporting tissues of land-dwelling plants carry on several functions. These include
1. transport of water and minerals
2. storage of some unused chemical substances
3. support of the plant
4. all of the above
5. none of the above

21. Which of the following is a means of dispersal for flowering plants?
1. seed
2. pollen
3. spore
4. 1 and 2 above
5. 1, 2 and 3 above

22. Which of the following is present in the environment of the roots of an Oregon alder tree growing on the east side of Mary's Peak?
1. water and minerals
2. bacteria
3. fungi
4. 1 and 2 above
5. 1, 2 and 3 above

23. Generally the number of developed vascular tissues in a moss plant is
1. greater than
2. less than
3. the same as
4. the number of developed vascular tissues in a nearby fern plant.

24. Which of the following pairs illustrate divergent evolution?
1. ocean fish : whales
2. hummingbird : hummingmoth
3. placental flying squirrel : marsupial flying phalanger
4. Galapagos insect-eating fish : Galapagos seed-eating finch
5. Tasmanian wolf : North American wolf

25. The ciliate group of protists includes organisms metabolically capable of
1. photosynthesis
2. transfer of energy from captured protists to the protoplasm of the predator ciliate
3. synthesis of ciliate organelles and cell structures from the materials of captured (eaten) protists
4. 1, 2 and 3 above
5. 2 and 3 above

26. Generally the number of cell-surface whiplike appendages of a flagellate is
1. greater than
2. less than
3. the same as
4. the number of hairlike appendages of a ciliate.
27. Generally the number of individual diatoms in a certain large volume of surface ocean water is
   1. greater than  2. less than  3. the same as the number of individual shrimplike crustaceans in the same place and same volume of ocean water, that feed upon the diatoms.

28. The Class Mammal has classified in it a number of species that is
   1. greater than  2. less than  3. the same as the number of species classified in the Order of Rodents.

29. The number of homologous structures evident in a comparison of one kind of mammal with another is likely to be
   1. greater than  2. less than  3. the same as the number of homologous structures evident in a comparison of one kind of mammal with one kind of reptile.

30. The blood fluke that lives as an adult in veins of the bladder or colon of man
   1. passes part of its life in a specific species of snail
   2. is a member of the class Trematoda
   3. produces a number of individuals of several different forms during its life within the snail
   4. answers 2 and 3 apply
   5. answers 1, 2 and 3 apply

31. Some animals possess both male and female reproductive organs, and as such are said to be
   1. dioecious
   2. hermaphroditic
   3. morphogenic
   4. parthenogenic
   5. viviparous

32. Radial symmetry is characteristic of
   1. Coelenterata
   2. Echinodermata
   3. Platyhelminthes
   4. two of the above
   5. three of the above

33. Characteristics which would be more commonly associated with cocci
   1. rod shaped
   2. spherical shaped
   3. motile
   4. 1 and 2 above
   5. 1 and 3 above

34. What cephalopod feature shows striking convergence with that of vertebrates?
   1. eye
   2. jaw
   3. method of locomotion
   4. shell skeleton
   5. tentacles
35. The bread mold observed in lab
   1. consists of numerous filaments growing over the food source
   2. has upright hyphae bearing sporangia on their upper ends
   3. is green in color, due to the presence of chloroplasts
   4. have sporangia that turn a bright yellow color when mature
   5. 1 and 2 above

36. The body plan of the spider is best characterized by
   1. head, thorax and abdomen
   2. three pairs of legs
   3. four pairs of legs
   4. ten pairs of legs
   5. 1 and 3 above

FOR TEST ITEMS 37-40, use the key terms below
   1. Annelida
   2. Arthropoda
   3. Coelenterata
   4. Echinodermata
   5. Mollusks

37. A group possessing tube-feet operated by a water vascular system

38. Members of this group are segmented and many use setae to accomplish locomotion

39. A group characterized by having a mantle and a foot

40. A group whose phyletic name denotes "jointed feet"

FOR TEST ITEMS 41-42, use the key terms below
   1. Agnaths
   2. Aves (birds)
   3. Chondrichthyes
   4. Mammals
   5. Reptiles

41. The group known as the cartilaginous fishes, such as the sharks

42. Terrestrial animals with three chambered hearts and the produce leathery covered eggs

43. The crayfish and lobster belong to the class
   1. Arachnida
   2. Chilopoda
   3. Crustacea
   4. Diplopoda
   5. Trilobita

44. In which of the major habitats are living insects virtually absent?
   1. aerial
   2. estuaries
   3. fresh water
   4. marine
   5. terrestrial
45. Which one of the following animals has a sac-like digestive tract?
1. clam
2. frog
3. grasshopper
4. hydra
5. starfish

46. In lab, you used two kinds of media on which you cultured protists.
1. Bacteria were most common on the potato dextrose agar media
2. Fungi were most plentiful on the nutrient agar media
3. Bacteria requires media relatively high in protein
4. 1 and 2 above
5. 2 and 3 above

47. Reptiles are considered the early ancestor of mammals. In what way do they differ?
1. Environmental conditions under which they are active
2. Position of the appendages. At side in reptiles, directly under in mammals.
3. Skull and jaw bones more numerous in reptiles
4. 1 and 2 above
5. 1, 2 and 3 above

48. An animal is classified as a Coelenterate if it possesses
1. nematocysts
2. mesoderm
3. jaws
4. hollow gut
5. 1 and 4 above

49. Which of the following features apparently restricts the upper limit of size for the insect body plan?
1. circulatory system
2. digestive system
3. nervous system
4. reproductive system
5. skeletal system

50. Observations of the fungi grown in lab indicated
1. the colony size to be larger than the colony size of the bacteria
2. the colonies are composed of strands or filaments
3. many are brightly colored, pink, yellow, orange, etc.
4. 1 and 2 above
5. 1, 2 and 3 above

51. Which one of the following arthropod groups with its accompanying example is mismatched?
1. Crustacea - crab
2. Arachnida - flea
3. Insecta - grasshopper
4. Chilopoda - centipede
5. Diplopoda - millipede
52. Which of the characteristics tends to set the phylum Echinodermata apart from the rest of the animal phyla?
1. calcareous plates embedded in the tissue
2. skin gills, little balloon-like projections, which permit gas exchange by osmosis
3. tube feet, operated by a water vascular system which permits slow motion
4. 1 and 3 above
5. 1, 2 and 3 above

53. The presence of a skeleton is characteristic of which of these phyla?
1. Annelida
2. Arthropoda
3. Chordata
4. 2 and 3 above
5. all of the above

54. Of the characteristics listed, which belong to the vertebrates alone?
1. axial and appendicular skeletons
2. homeothermous (warm blooded)
3. a covering of hair
4. possession of mammary glands
5. active at all times, cold or warm temperatures

55. Eyes capable of light reception and image formation originated in three (3) separate animal phyla. In which phyla do image-forming eyes occur?
1. Platyhelminths, Coelenterates, Vertebrates
2. Echinoderms, Mollusks, Arthropods
3. Coelenterates, Arthropods, Mollusks
4. Arthropods, Mollusks, Vertebrates
5. Arthropods, Echinoderms, Vertebrates

56. Which of the following phyla have no species adapted to life on land?
1. Arthropods
2. Chordata
3. Mollusks
4. Vertebrates
5. 2 and 3 above

57. Free living Platyhelminthes are similar to the Coelenterates in which of the following respects?
1. they have one opening into the digestive cavity
2. they are bilaterally symmetrical
3. they have a mesodermal layer
4. they have a definite and permanent anterior end
5. they have a dorsal and ventral surface
58. In your observations of the Paramecium in lab
1. it was noted that the contractile vacuoles usually filled and emptied alternately
2. the food vacuoles were formed from materials taken in at any point of the body surface
3. the body rotates about the long axis (an axis running from anterior to posterior end)
4. 1 and 3 above
5. 1, 2 and 3 above

59. Which of the following are characteristic of birds?
1. hollow bones
2. rapid metabolic rate
3. body covering of feathers
4. 2 and 3 above
5. 1, 2 and 3 above

60. Human societies differ from insect societies in that
1. societal roles are learned in human societies, but not learned and thus subject to little modification in insect societies
2. castes in insect societies are determined by the interplay of genetic and developmental factors, while in human societies caste status may be changed as the culture changes
3. human societies have their basis in a flexible determination of behavior while in insect societies behavior is relatively inflexible
4. all of the above
5. 1 and 3 above

61. When rabbits were introduced into Australia
1. competitors derived from the resident marsupial fauna soon limited their numbers
2. since rabbits were not native to the "land down under" they were unable to survive
3. predators were present in Australia that utilized rabbits for prey and held their numbers in check
4. rabbits did what comes naturally and with no natural enemies present, increased their numbers to epidemic proportions
5. none of the above

62. Cyclic fluctuations of populations of animals (e.g., the varying hare or the Canada lynx) can best be correlated with
1. climatic changes
2. sunspots
3. biological reactions within communities
4. moon phases
5. no good explanation exists
63. All life is ultimately limited by
   1. the predator-prey relationship existing on earth
   2. the curve of survivorship
   3. the usable energy received from the sun
   4. the stored energy found in green plants
   5. competition between members of the same and different species for available space

64. Which of these pyramid relationships is a direct illustration of the second law of thermodynamics?
   1. Pyramid of Mass
   2. Pyramid of Numbers
   3. Pyramid of Energy
   4. all of the above
   5. none of the above

65. Intraspecific competition may be significantly lessened by such behavior patterns as
   1. territoriality
   2. pecking order
   3. division of roles in a society
   4. all of the above
   5. none of the above

66. Which of the following is considered as the basic unit in the study of Ecology?
   1. the population
   2. the ecosystem
   3. the biosphere
   4. the community
   5. the species

67. The amount of potential energy available to a consumer organism is
   1. greater than
   2. less than
   3. equal to
   4. the amount of potential energy available to a reducer organism.

68. Which of the following is not a member of your biotic environment?
   1. flowers
   2. a tree
   3. a friend
   4. the atmosphere
   5. none of the above

69. According to the English clergyman Thomas Malthus, natural populations
   1. always remain in balance and harmony with their food resources
   2. increase arithmetically, while their resources increase geometrically
   3. increase arithmetically, as do their available food resources
   4. increase geometrically, while their resources increase arithmetically
   5. increase geometrically, as do their available food resources
70. Competition can lead to
1. extinction of species 4. all of the above
2. divergence of species 5. only 2 and 3 above
3. change in community composition

71. One of the following is not characteristic of dicotyledonous plants. Which one?
1. Two cotyledons
2. Vascular bundles scattered throughout stem
3. Leaves—netted veined
4. Floral parts in fours or fives or multiples thereof

72. Which of the following could be regarded as the most slowly changing major environment?
1. the rocky seashore 4. a mountain peak above timberline
2. a fresh-water lake 5. a very sandy desert
3. the deep sea bottom

73. A lesson to be learned from an analysis of the predator-prey relationship as exemplified by the populations on the Kaibab Plateau includes
1. there is no danger in disturbing the balance of nature in a community
2. there is real danger in disturbing the balance of nature in a community
3. man can adjust the predator-prey relationship in a community with impunity since he is the dominant species in the community
4. man should not attempt to adjust predator-prey relationships in communities without a thorough knowledge of those relationships
5. 2 and 4 above

74. "Living together"

75. Photosynthetic algae living in gut cells of the animal hydra

76. The rock surface to which marine mussels are attached
77. When natural predators were destroyed in the Kaibab Plateau area of Arizona the resident deer herd
1. increased in a spectacular fashion from less than 10,000 to 100,000 in about 15 years
2. remained at a steady level of about 30,000 which is the carrying capacity of the range
3. decreased in a spectacular fashion from a maximum population size of 30,000 to 10,000 in less than 10 years
4. held its numbers relatively constant by decreasing the birth rate of the herd
5. none of the above

78. The ecological process of succession can take place
1. on bare rocks
2. on a shore of a lake
3. in fresh water
4. in marine water
5. all of the above

79. In predator-prey relationships such as revealed by an analysis of the trapping records of the Hudson Bay Company it appears that
1. animals may be eaten by their natural enemies roughly as fast as they can reproduce themselves
2. under certain conditions a population may increase to such numbers that a food shortage is created, resulting in starvation and a subsequent reduction in population size
3. predator-prey interactions serve to regulate the numbers of both the predators and the prey over the long run
4. no significant fluctuations in population size of either predators or prey were indicated from trapping records--the community appears to remain nicely balanced from year to year
5. 1, 2 and 3 above

80. The major limitation on the abundance of life in the surface waters of the sea is the availability of
1. water
2. sunlight
3. mineral salts
4. hiding places
5. oxygen

81. A correct example of a food chain is
1. producer - 1st level consumer - 2nd level consumer - reducer
2. green plant - herbivore - carnivore - bacteria
3. shrub - rabbit - fox - bacteria
4. all of the above
5. only 2 and 3 above
82. Which one of the following statements is correct?
   1. The lima bean seed has two cotyledons and endosperm to provide an abundant nutritional reserve for the sporophyte embryo
   2. The corn seed has endosperm but no cotyledons to serve as nutritive material for the embryo
   3. The pea seed has two cotyledons but no endosperm to serve as a nutrient source for the embryo
   4. The barley seed has only one cotyledon and no endosperm to serve as nutrient
   5. none of the above

83. Which one of the following most nearly explains the reason for the great increase in human numbers during the past 200 years?
   1. The rate of births/unit of population has markedly increased
   2. The rate of births/unit of population has remained the same
   3. The rate of deaths/unit of population has markedly increased
   4. The rate of deaths/unit of population has remained the same
   5. The rate of deaths/unit of population has markedly decreased

84. In laboratory, early germinating seeds of peas, corn, barley and lima beans were cut into halves and immersed in a tetrazolium solution. After 25 to 30 minutes the cut half of the seeds were examined. What was observed?
   1. A part of the seed had turned from blue to a green to yellow or orange-red color.
   2. A part of the seed had turned to a violet or blue-black color
   3. A part of the seed had turned pink or pinkish-red
   4. 1 and 2 above
   5. No change occurred

85. In the above experiment the tetrazolium was used to test for
   1. the presence of a reducing sugar—thus indicating some starch digestion
   2. respiratory activity in the developing embryo
   3. determination of whether the seed is a dicot or a monocot
   4. the presence or absence of the coleoptile
   5. determination of whether the seed is heterotrophic or autotropic

86. In relation to an ecosystem, which of the following are characteristic of minerals and energy?
   1. the minerals are cycled
   2. the energy is not cycled
   3. the amount of usable energy becomes less
   4. all of the above
   5. only 1 and 3 above
87. Which of the following natural resources would not be regarded as renewable?
   1. gasoline to power engines
   2. salmon runs up coastal rivers
   3. timber forests
   4. a supply of fresh water
   5. hydroelectric power for lighting cities

88. Generally, the number of components in a food web is
   1. greater than
   2. less than
   3. equal to
   the number of components in a food chain.

89. Which of the following living animals is most distantly related to modern man?
   1. chimpanzee
   2. lemur
   3. old world monkey
   4. new world monkey
   5. gorilla

90. Which anatomical feature of modern man has evolved most recently?
   1. upright posture
   2. stereoscopic vision
   3. fingernails
   4. opposable thumb
   5. expanded brain

91. Heterotrophs appeared on the earth
   1. before
   2. after
   3. at about the same time as
   the first appearance of autotrophs.

92. Which of the following organisms would you expect to find in a taiga environment?
   1. kangaroo rat
   2. spruce tree
   3. oak tree
   4. pronghorn antelope
   5. all of the above

Please continue on next page.
The accompanying graph shows the changes which have occurred in the numbers of species of ferns, flowering plants, conifers and algae throughout the history of these groups on earth. Questions 93 through 97 are based on this graph.

1. algae
2. ferns
3. conifers
4. flowering plants
5. 1 & 2 above

93. Plants which experienced great initial success, then a decline in the number of species, are the ________.

94. The most abundant species of plants today are the ________.

95. The plants which have appeared most recently in the history of life are the ________.

96. Judging from the fossil record, the plants most likely to go extinct in the next few hundred million years are the ________.

97. Plants which apparently experienced no great adaptive radiation since their origins are the ________.

98. The chance of the sweepstakes dispersal of a fern plant is
   1. greater than
   2. less than
   3. the same as

   the chance of the sweepstakes dispersal of an elephant.

99. Which of the following pairs is mismatched?
   1. filter - Isthmus of Panama
   2. corridor - Bering Straits land bridge
   3. barrier - Sahara desert
   4. all of the above
   5. none of the above

100. The Nearctic biogeographic region covers an area that is
    1. greater than
    2. less than
    3. the same as

    the Holarctic biogeographic region.
101. North America lies within which of the following faunal zones?
1. Nearctic
2. Neotropical
3. Palaearctic
4. Ethiopian
5. Oriental

102. Temperature fluctuation in a terrestrial environment would be
1. greater than
2. less than
3. about the same as temperature fluctuation in an aquatic environment.

103. Historical changes within any biotic region can develop
1. through evolutionary changes taking place within each of the species present
2. by the proportionate numbers of the various species changing
3. through one or more species becoming extinct or at least disappearing locally
4. by new species moving into the region from elsewhere
5. all of the above

104. If you were to travel north in latitude, you might expect to find environmental changes occurring that would be similar to the changes you would find in
1. moving to a lower altitude
2. moving southward in latitude
3. moving upward in altitude
4. 1 and 2 above
5. 2 and 3 above

<table>
<thead>
<tr>
<th>Number of families of land mammals in</th>
<th>North America</th>
<th>South America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before land bridge</td>
<td>27</td>
<td>23</td>
</tr>
<tr>
<td>At the height of interchange between NA and SA</td>
<td>34</td>
<td>36</td>
</tr>
<tr>
<td>At present</td>
<td>23</td>
<td>30</td>
</tr>
</tbody>
</table>

Which of the following statements are correct according to the figures given in the chart above? Mark 1 for correct and 2 for incorrect (Items 105-108).

105. The land bridge between North America and South America provided an access way for the dispersal of mammals between the two continents.

106. Insects were much more successful in their dispersal over the land bridge since they could fly as well as walk.
107. The land bridge between North and South America provided a corridor over which each land mammal could easily pass and survive in the new territory.

108. North American land mammals were more successful in their dispersal than South American land mammals.

109. The great prehistoric forests of ferns, horsetails and club mosses which deposited much of today's coal supply grew during which era?
   1. Paleozoic   4. Cenozoic
   2. Pre-Cambrian   5. 2 and 4 above
   3. Mesozoic

110. The invasion of land by plants occurred
   1. before   2. after   3. at about the same time as
   the accumulation of oxygen in the earth's atmosphere.

111. Insects appeared on the earth
   1. before   2. after   3. at about the same time as
   the first appearance of birds.

112. Australopithecus is the genus name of an animal which
   1. lives in Southeast Asia
   2. occurs as fossils in Paleozoic rocks
   3. is ancestral to modern man
   4. 2 and 3 above
   5. 1 and 3 above

113. Which of the following faunal regions has the most distinctive animals including families of mammals which occur nowhere else?
   1. Palearctic   4. Ethiopian
   2. Australian   5. Oriental
   3. Neotropical

114. Organisms that live on the bottom of deep oceans obtain their food ultimately from
   1. other animals that live in association with them
   2. green surface plants that capture light energy in the process of photosynthesis
   3. small organisms that live in the mud at the bottom of the ocean
   4. fish that happen to swim down near enough to be captured
   5. detritus that settles to the bottom from the surface
115. The oldest vertebrate fossils known are those of
1. squids 4. mammals
2. fishes 5. reptiles
3. birds

116. Dinosaurs flourished on earth
1. before 2. after 3. at about the same time as the appearance of the first mammals.

117. Animals which were far more abundant in the Mesozoic era than they are today are the
1. marine lizards 4. humans
2. birds 5. 1 and 3 above
3. mammoths

118. Which of the following organisms would be most likely to become fossilized?
1. hydra 4. clam
2. flatworm 5. tapeworm
3. ameba

119. Which of the following physical factors influence the distribution of plants?
1. temperature 4. 1 and 2 above
2. precipitation 5. 1, 2 and 3 above
3. solar radiation

120. Which of the following most strongly influences the distribution of animals?
1. rainfall 4. kind of soil
2. distribution of plants 5. other animal associations
3. precipitation as snow
APPENDIX C

TOLMAN'S PRINCIPLES OF BIOLOGY TEST

This test is part of a study which is being conducted by this department.

All information will be held in confidence and in no way will it be used to affect the grade you receive for this course.

There is only one correct answer for each of the 65 questions. Mark your answer sheets carefully. Pencils with erasers are provided; make all corrections carefully. Please attempt all questions but avoid wild guessing.

Our thanks for your participation and cooperation in this study.

1. The "first step" in photosynthesis is the
   1. formation of ATP
   2. ionization of water
   3. excitement of an electron of chlorophyll a by a photon of light
   4. attachment of CO₂ to a 5-carbon sugar
   5. joining of two 3-carbon compounds to form glucose

2. Within the cell, the site of respiration is the
   1. Golgi bodies
   2. ribosomes
   3. mitochondria
   4. nucleus
   5. nucleolus

3. The use of energy entering an organism from the outside is 100% efficient in
   1. unicellular green plants only
   2. all green plants
   3. unicellular animals
   4. bacteria
   5. no organisms

4. A theater audience applauds following a performance. The room immediately seems to become warmer. Which is probably the major reason for this change?
   1. This is a psychological effect—during the performance the audience ignores the heat.
   2. Body temperatures are lower during the performance due to inactivity.
   3. Everyone puts on his coat.
   4. Heat is released as a result of muscular activity and increased glucose oxidation.
   5. The lights are turned on, giving off heat.
5. A biology teacher has sealed a balanced aquarium and a quantity of air into a large glass carboy. After three months, the plants and animals in the aquarium appear alive and healthy. Which of the following statements about the experiment is wrong?
1. No energy has entered the carboy from the outside during the three months.
2. Potential energy in one organism in the aquarium has entered another organism during the three months.
3. Some atoms from water molecules have become parts of organic molecules.
4. The air above the water in the carboy contains carbon dioxide.
5. During the three months, the biomass of plant life was greater than the biomass of animal life.

6. Which best supports the belief that CO\textsubscript{2} fixation does not require light?
1. ATP is made from ADP by green plants in the light but CO\textsubscript{2} fixation doesn't require ATP.
2. Motile aerobic bacteria move faster when placed with green algae in the dark than when placed with green algae in the light.
3. Plants give off CO\textsubscript{2} in the dark.
4. Radioactive C*O\textsubscript{2} can be traced to phosphoglyceraldehyde (PGA) in green plants.
5. Radioactive (C*) carbon compounds are found in animals grown in darkness in an atmosphere containing radioactive C*O\textsubscript{2}.

7. In a fairly deep body of water, there is apt to be more biomass on or near the bottom than at most other levels. Yet, the energy of sunlight on which living organisms depend, diminishes rapidly in being passed through the water. The best of the following ways of accounting for this apparent paradox is
1. all photosynthetic plants must be rooted in the bottom to obtain minerals.
2. organic materials continually drop to the bottom of the water.
3. the animal population on the bottom converts enough carbon dioxide to organic compounds to supply all nutritive needs.
4. all organisms must have a solid substratum to support them.
5. temperature is more uniform at the bottom than elsewhere.

8. Transpiration rate in a maple tree is controlled by
1. mitochondria
2. stomata
3. meristem
4. phloem
5. cambium
9. Seed plant leaves are known to carry on all of the following except
1. nerve impulse conduction
2. asexual reproduction
3. transpiration
4. starch synthesis
5. mitotic spindle formation

10. Compound X breaks down the mitotic spindle but does not interfere with growth or with duplication of cell organelles. An application of compound X should result in which of the following (assuming the cells are alive)?
1. haploids
2. cells without nuclei
3. identical daughter cells
4. polyploids
5. synchronous dividing cells

11. If the Golgi apparatus functions in secretion, then we would expect to find the most abundant Golgi apparatus in
1. muscle cells
2. egg cells
3. gland cells
4. bone cells
5. blood cells

Items 12-13 are based on the following information about three new species of animals which fit into our existing classification system:

<table>
<thead>
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<th></th>
<th>I</th>
<th>II</th>
<th>III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Habitat is:</td>
<td>terrestrial</td>
<td>marine</td>
<td>terrestrial</td>
</tr>
<tr>
<td>Embryo develops in:</td>
<td>water</td>
<td>mother</td>
<td>egg</td>
</tr>
<tr>
<td>Mates:</td>
<td>in water</td>
<td>in water</td>
<td>on land</td>
</tr>
<tr>
<td>Skeleton is:</td>
<td>internal</td>
<td>internal</td>
<td>internal</td>
</tr>
<tr>
<td>Epidermis covered with:</td>
<td>slime or mucus</td>
<td>hair</td>
<td>scales</td>
</tr>
</tbody>
</table>

12. If we arrange the animals according to the proportion of yolk in their eggs, the most likely sequence (least to most yolk) is
1. I, II, III
2. I, III, II
3. II, III, I
4. II, I, III
5. III, II, I

13. Which animal(s) most likely has (have) gills at some stage in the life cycle?
1. Species I only
2. Species II only
3. Species I and II only
4. Species I and III only
5. None of the above species
14. If living cells similar to those found on earth were found on another planet where there was no O₂, which cell organelle would most likely be absent?
   1. cell membrane
   2. chromosomes (or DNA)
   3. nucleus
   4. mitochondria
   5. ribosomes

15. Which of the following is not functionally analogous with the others in the list?
   1. Archegonium
   2. oogonium
   3. spermatogonium
   4. ovary
   5. ovule

16. A biologist plans to study the group behavior of monkeys. In order to avoid generalizing from aberrant observations, he would do best to select for observation
   1. a group at the center of the region inhabited by monkeys.
   2. a group at the periphery of the region inhabited by monkeys.
   3. a group containing a small number of individuals.
   4. a group containing a large number of individuals.
   5. many groups of monkeys.

17. Population growth pressure is a probable cause of which of the following?
   1. Genetic drift
   2. Production of sterile hybrids
   3. Ecological isolation
   4. Migration of lemmings
   5. Abiogenesis

18. A sexually immature male chicken is given daily injections of a hormone. At the end of two weeks, the investigator finds that the bird exhibits premature sexual behavior and crowing, and that its comb and gonads are unduly enlarged. He concludes that the hormone must have been extracted from adult
   1. testes
   2. ovaries
   3. thyroids
   4. pituitaries
   5. adrenals

Please continue to next page.
19. Carnivorous species are found in which of the following phyla of animals?
1. All six phyla
2. 1, 2, and 5, but not 3, 4, and 6.
3. 1, 5, and 6, but not 2, 3, and 4.
4. 2, 4, 5, and 6, but not 1 and 3.
5. 2, 4, and 6, but not 1, 3, and 5.

20. The Hardy-Weinberg law enables us to
1. predict genetic ratio from individual matings.
2. map chromosomes.
3. calculate gene frequencies in a population.
4. predict population growth.
5. measure the rate of evolutionary change.

21. Genetic drift is most apt to occur in
1. tropical climates
2. marine habitats
3. high elevations
4. small populations
5. bacteria

22. Which of the following is characteristic of a mouse homozygous for albinism?
1. It produces a white pigment in cells of its hair follicles.
2. It has a deficient capillary distribution.
3. It cannot manufacture melanin.
4. It does not absorb iron from its diet.
5. It lacks vitamin E.

23. Why were pea plants more suitable than cattle for Mendel's experiments?
1. There were no breeding records on cattle.
2. Pea plants can be self-fertilized.
3. Cattle are not easy to raise.
4. All pea plants have 2 X chromosomes.
5. Cattle have many genetic traits.

Please continue to next page.
24. It is suggested that Queen Victoria of England possessed a gene for hemophilia. This would indicate that
   1. her father also possessed this gene.
   2. hemophilia would occur in more of her male descendants than of her female descendants.
   3. all of her daughters must have carried the gene for hemophilia.
   4. all of her sons must have had a gene for hemophilia.
   5. Victoria herself was hemophilic.

25. If some mutations are harmful, why are they not eliminated from a gene pool?
   1. They are dominant and show up more frequently.
   2. They are recessive and carried by heterozygous individuals.
   3. They may have future survival value, hence they are retained.
   4. The Hardy-Weinberg Law enables them to survive.
   5. The population size is usually so small that genetic drift occurs.

26. There is a breed of cats in which genes for black or white hair color do not show dominance or recessiveness. If a cat carrying only black hair color genes is bred to a cat carrying only white-hair genes all of the offspring have grey hair. If two of these grey cats reproduce, the theoretical progeny ratio would be
   1. all grey
   2. either all black or all white
   3. 1/2 black, 1/2 white
   4. 1/2 grey, 1/4 white, 1/4 black
   5. 1/3 each of black, white, and grey individuals

27. A radioactive nucleus from one ameba is transferred to a non-radioactive ameba which has its nucleus removed. If, later on, the second ameba is found to have radioactive ribosomes in its cytoplasm, this would be evidence in support of the
   1. chromosomal theory of inheritance
   2. existence of the DNA code
   3. functioning of messenger RNA
   4. single gene-single enzyme hypothesis
   5. Watson-Crick model of the structure of DNA

Please continue to next page.
28. Slight differences in identical twins supports the hypothesis that
   1. dominance may be incomplete
   2. genetic traits are influenced by many genes
   3. single genes may produce multiple effects
   4. the environment affects the expression of genetic characteristics
   5. they developed from separate fertilized eggs

29. Which of the following insects undergo complete metamorphosis?
   1. Grasshoppers
   2. Mayflies
   3. Fruitflies
   4. Termites
   5. Bugs

30. If the pituitary stimulates the development of the follicles within
    the ovaries which in turn stimulate the growth of the uterine
    lining, then how can we best explain the periodical return of the
    uterine lining to the resting stage?
   1. The pituitary alternately secretes a stimulating and inhibiting
      hormone.
   2. The follicle produces a hormone which stimulates the uterine
      lining and inhibits pituitary hormone.
   3. The uterus produces a hormone which inhibits the follicle
      development which inhibits the pituitary.
   4. The hypothalamus controls the development of the uterine
      lining which feeds back to the pituitary.
   5. The ovary periodically changes its function because of an
      internal "clock."

31. What do the growth of a single cell, an organism, and a population
    have in common?
   1. They are influenced by the environment.
   2. They require energy and materials.
   3. They result in an S-shaped curve if size is plotted versus time.
   4. They involve chemical reactions catalyzed by enzymes.
   5. All of the above.

32. A fern differs from a moss in having
   1. an independent gametophyte
   2. an independent sporophyte
   3. swimming sperms
   4. archegonia
   5. haploid spores
"Year after year, men cruising timber or hunting deer in the Blue Mountains of Eastern Oregon had come back with the same story. Near the little hamlet of Kamela, they had often heard a faraway tinkling, a ghostly bell ringing. No one was ever able to track down the strange sound. It would fade away in the sighs of the wind through the big pines. Skeptics accused the men of hearing things."

"Last week, slashing a right-of-way for a power line from Bonneville Dam, lumberjacks brought down a ponderosa pine. Tied by a shriveled leather thong high in the treetop was the answer to the mystery of Kamela: a bronze cattle bell, inscribed with the date 1878. . . . The people of Kamela guessed that a pioneer had tied it to a sapling that grew into a towering pine." (Time Magazine) Which of the following is the best appraisal of the concluding sentence in this report?

1. Logical--because a tree elongates from the ground up.
2. Logical--because this particular tree could have attained great height since 1878.
3. Illogical--because no one knows with certainty when the bell was tied to the sapling.
4. Illogical--because elongation occurs only in the region of meristematic cells.
5. There is no basis for appraising the concluding sentence of this report.

Which will probably happen if fertilized eggs of toads and frogs are placed in the same container, assuming external conditions are suitable to both?

1. The environment will determine which RNA will direct the development and all frogs or all toads will result.
2. If given conditions are more favorable to a frog, the toad embryo will show the characteristics of a frog.
3. The frog embryo will assume toad features.
4. Fertilized frog eggs will become frogs; fertilized toad eggs will become toads.
5. No embryo will develop.

The class Sporozoa of the phylum Protozoa can be most easily characterized by

1. flagella
2. chlorophyll
3. parasitism
4. cilia
5. ameboid movement
36. Blue-green algae may be distinguished from green algae by
1. lack of the filament-forming habit.
2. the presence of centrioles during mitosis.
3. the absence of sexual reproduction.
4. the absence of discrete nuclei.
5. the absence of chlorophyll.

37. The characteristics defining a genus are more general than
those defining
1. a family
2. a species
3. an order
4. a phylum
5. a class

38. Nicotiana sylvestris flowers only during long days and Nicotiana tabacum flowers only during short days. If raised in the laboratory under different photoperiods, they can be induced to flower at the same time and can be cross-fertilized to produce self-fertile offspring. What is the best reason for considering N. sylvestris and N. tabacum separate species?
1. They cannot interbreed in nature.
2. They are reproductively distinct.
3. They are physiologically distinct.
4. They are morphologically distinct.
5. They will probably not occur together in nature.

Item 39 is based on the following abbreviated classification chart:

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Protista</th>
<th>Protista</th>
<th>Animal</th>
<th>Animal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum</td>
<td>Ciliophora</td>
<td>Chlorophyta</td>
<td>Arthropoda</td>
<td>Arthropoda</td>
</tr>
<tr>
<td>Class</td>
<td>Ciliate</td>
<td>Chlorophyceae</td>
<td>Crustacea</td>
<td>Crustacea</td>
</tr>
<tr>
<td>Order</td>
<td>Holotrichida</td>
<td>Volvocales</td>
<td>Isopoda</td>
<td>Diplostraca</td>
</tr>
<tr>
<td>Family</td>
<td>Parameciidae</td>
<td>Chlamydomonadidae</td>
<td>Porcellionida</td>
<td>Daphniidae</td>
</tr>
<tr>
<td>Genus</td>
<td>Paramecium</td>
<td>Chlamydomonas</td>
<td>Porcellio</td>
<td>Daphnia</td>
</tr>
<tr>
<td></td>
<td>caudatum</td>
<td>eugametos</td>
<td>scaber</td>
<td>pulex</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phylum</td>
<td>Tracheophyta</td>
</tr>
<tr>
<td>Class</td>
<td>Angiospermae</td>
</tr>
<tr>
<td>Order</td>
<td>Helobiae</td>
</tr>
<tr>
<td>Family</td>
<td>Alismaceae</td>
</tr>
<tr>
<td>Genus</td>
<td>Sagittaria</td>
</tr>
<tr>
<td>Species</td>
<td>sagittifolia</td>
</tr>
</tbody>
</table>
39. If our classification system represents evolutionary relationships, then which organisms probably would have the most similar antigens?
1. Chlamydomonas eugametos and Sagittaria sagittifolia
2. Porcellio scaber and Daphnia pulex
3. Paramecium caudatum and Chlamydomonas eugametos
4. Paramecium caudatum and Porcellio scaber
5. Sagittaria sagittifolia and Porcellio scaber

40. A biologist classifies chemical substances according to their contribution to the life of a cell. Which of the following categories would chlorophyll best fit?
1. Nutrition
2. Movement
3. Reproduction
4. Secretion
5. Energy transformation

41. You are asked to classify cell organelles on the basis of their principal functions. One category you erect is for organelles whose chief function concerns cell division. Which of the following is the most likely representative of this category?
1. Lysosome
2. Mitochondrion
3. Centriole
4. Ribosome
5. Golgi body

42. A living organism most like the postulated common ancestor of plants and animals is a/an
1. diatom
2. flagellate
3. ameba
4. blue-green alga
5. ciliate

43. On the phylogenetic "tree" of animal life, which of the following is assumed to be more primitive than a dinosaur but more advanced than a shark?
1. crayfish
2. starfish
3. amphioxus
4. salamander
5. none of the foregoing

44. Which is most important in determining the direction of evolution of an animal species?
1. High mutation rate for certain traits.
2. Independent assortment and recombination of certain traits.
3. Selection of certain traits by environmental conditions.
4. The gradual change of certain traits by environmental conditions.
5. "An inner desire to survive in the face of change."
45. Which of the following best states the evolution theory?
   1. Evolution is the maintenance of life under changing conditions.
   2. Evolution is the survival of the fittest.
   3. Evolution is the descent of humans from lower animals.
   4. Evolution is goal-directed change.
   5. Evolution is variation.

46. Which of the following is the best example of an evolutionary change in a species of organisms?
   1. Formation of a callus on the stem of a lilac bush.
   2. Change of color of a canary's feathers due to feeding the bird pepper.
   5. Development of thicker fur on a rabbit in winter.

47. The development of large size in land plants is especially correlated with
   1. increased efficiency in asexual reproduction.
   2. insect pollination.
   3. specialization of vascular tissues.
   4. appearance of an electron transport system.
   5. development of a cambium.

48. A population of deer was threatened with overpopulation until a number or cheetahs were imported; after a time, there were fewer deer, but the average running speed of the population of deer was increased. This is an illustration of
   1. induced mutation.
   2. hereditary transmission of the results of training.
   3. natural selection.
   4. population explosion.
   5. genetic drift.

49. Which of the following events probably contributed the most to the formation of the first living entity on this planet?
   1. Appearance in an ocean of the first soluble carbonates
   2. Occurrence in a warm, shallow bay of a medium with a pH of 7.0
   3. Synthesis of the first functional nucleic acid molecule
   4. Development of a limiting membrane
   5. Occurrence of the first mitotic cell division
50. Humans have achieved evolutionary success without the speed of deer, the teeth of wolves, or the skin thickness of rhinoceroses. Of the following, the evolutionary development which has probably contributed most to success of the human species in competition with other mammals is
1. the bi-ocular vision
2. upright posture
3. long gestation period
4. loss of body hair and tail
5. increased brain development

51. Fresh-water amebas are commonly protected from desiccation by
1. attaching to the gills of fishes
2. encystment
3. sexual reproduction
4. burrowing into the lake bottom
5. entering the alimentary canal of an invertebrate host

52. British moths living in soot-drenched areas tend to be darkly colored in contrast to their light-colored relatives in regions relatively free from soot. The increased prevalence of the dark color is referred to as
1. chromocenter
2. protective coloration
3. chromatroph
4. industrial melanism
5. warning coloration

53. Competition for food, light, space, etc. is probably most severe between two
1. closely related species occupying the same niche
2. closely related species occupying different niches
3. unrelated species occupying the same niche
4. unrelated species occupying different niches
5. species in different overlapping ecosystems

54. In a certain ecosystem, field mice are preyed upon by snakes and hawks. The entrance of wild dogs into the system adds another predator on the mice. Of the following, the most likely short-term result of this addition is
1. increase in snake population
2. tendency for hawks to prey on the dogs
3. extinction of the hawks
4. reduction in numbers of mice
5. migration of the hawks to another ecosystem
55. Compared to a Texas jack rabbit, the Arctic hare would be expected to have
1. longer legs
2. longer ears
3. shorter appendages
4. more sensitive whiskers
5. more frequent breeding seasons

56. Which of the following is a result of ecological isolation?
1. The variations among Darwin's finches on the Galapagos Islands.
2. The development of the amniote egg in reptiles.
3. The dominance of the sporophyte generation in ferns.
4. The formation of cellulose walls in blue-green algae.
5. The development of autotrophy in green plants.

57. The chief advantage of encystment to an ameba is
1. the ability to live for a time without ingesting food
2. the cessation of most metabolic activity so that available energy may be used for reproduction
3. protection from parasitic invasion
4. the opportunity to get rid of accumulated waste products
5. the ability to survive during unfavorable physical conditions

58. A crocodile has just eaten a lamb. A plover accommodatingly picks the crocodile's teeth. By this act, the plover, in ecological terms, is a
1. producer
2. primary consumer
3. secondary consumer
4. tertiary consumer
5. reducer

59. Which of the following is the best experimental procedure to determine the effectiveness of a vaccine in preventing influenza in parakeets?
1. Expose 100 parakeets to the disease and inoculate 50 with the vaccine.
2. Inoculate 100 parakeets with the vaccine and expose all 100 to the disease.
3. Inoculate 50 with the vaccine and expose all 100 to the disease.
4. Inoculate 50 with the vaccine and expose those to the disease.
5. Inoculate 50 with the vaccine and 50 with a sterile saline and then expose all 100 to the disease.
60. The helical structure of the DNA molecule was established by
   1. Watson and Crick
   2. Jacob and Monod
   3. Beadle and Tatum
   4. Briggs and King
   5. Hardy and Weinberg

61. Which of the following was most influential upon Darwin's formulation of the theory of natural selection?
   1. DeVries' concept of mutations
   2. Lamarck's ideas on inheritance of acquired characteristics
   3. Malthus' essay on population
   4. Mendel's genetic studies on peas
   5. Wallace's paper on survival

62. The "cell theory" of Schleiden and Schwann states that
   1. all cells have nuclei
   2. cells use ATP as the immediate source of energy
   3. cells arise only from preexisting cells
   4. cells reproduce by mitosis or meiosis
   5. cells are the fundamental structural units of plants and animals

63. Molecular biologists generally maintain that
   1. the kinds of atoms an organism possesses differentiate it best from other kinds of organisms.
   2. there are in living organisms no higher levels of organization than the molecule.
   3. all significant biological phenomena are intramolecular.
   4. organisms are more alike in their chemical reactions than in their morphological characteristics.
   5. only molecules in the first two rows of the periodic table occur normally in living organisms.

64. It is hypothesized that owl species X is the major factor in controlling rabbit species Z. The most workable yet valid procedure for the investigator would be to study
   1. examples of all species of rabbits and owls
   2. samples from representative populations of owl X and rabbit Z
   3. all individuals of a representative population of owl X and rabbit Z
   4. representative individuals of rabbit Z
   5. samples of all major ecosystems
65. If our hypothesis in question 64 is correct, then
1. a decrease in the population of X owls should decrease the population of Z rabbits
2. a decrease in the population of Z rabbits should increase the population of X owls
3. an increase of Z rabbits' diseases should not change the population of X owls
4. an increase in food for Z rabbits should not change the population of X owls
5. an increase in X owls should decrease the population of Z rabbits
APPENDIX D

BROWN-HOLTZMAN SURVEY OF STUDY HABITS AND ATTITUDES

Directions

The purpose of this survey is to furnish an inventory of study habits and attitudes. If taken seriously, this inventory can help us obtain a better understanding of the study habits and attitudes of the students participating in our program. If you will honestly and thoughtfully mark all of the statements on the pages that follow, we will be able to gather significant data relating to the study which the department is conducting this term. The value of this survey will be in direct proportion to the care with which you mark each statement. Since your answers will be treated with the strictest confidence, feel free to answer all questions frankly.

You will mark your answers on a separate answer sheet. Make no marks on this booklet. There are 100 statements in this questionnaire. For each statement a five-point scale is provided for indicating whether you rarely, sometimes, frequently, generally, or almost always do or feel as the statement suggests.

You are to rate yourself on each statement by marking the space on your answer sheet that represents your answer choice. Thus, for example, you would mark space R on your answer sheet if you rarely follow the procedure described or if you feel that the statement is rarely true for you. In marking your answers, be sure that the number of the statement agrees with the number on the answer sheet.

To aid you in answering this questionnaire, the terms have been defined on a percentage basis as follows:

R - RARELY means from 0 to 15 percent of the time
S - SOMETIMES means from 16 to 35 percent of the time
F - FREQUENTLY means from 36 to 65 percent of the time
G - GENERALLY means from 66 to 85 percent of the time
A - ALMOST ALWAYS means from 86 to 100 percent of the time

IMPORTANT - You are asked to rate yourself, not in accordance with what you think you should do or feel, or as you think others might do or feel, but as you yourself are in the habit of doing or feeling.

There are no "right" or "wrong" answers to these statements, and there is no time limit for this questionnaire. Work as rapidly as you can without being careless, and do not spend too much time on any one statement. Please do NOT omit any of the statements.
R-RARELY  S-SOMETIMES  F-FREQUENTLY  
G-GENERALLY  A-ALMOST ALWAYS

1. When my assigned homework is extra long or unusually difficult, I either quit in disgust or study only the easier parts of the lesson.

2. In preparing reports, themes, term papers, etc., I make certain that I clearly understand what is wanted before I begin work.

3. I feel that teachers lack understanding of the needs and interests of students.

4. My dislike for certain teachers causes me to neglect my school work.

5. When I get behind in my school work for some unavoidable reason, I make up back assignments without prompting from the teacher.

6. Difficulty in expressing myself in writing slows me down on reports, themes, examinations, and other work.

7. My teachers succeed in making their subjects interesting and meaningful to me.

8. I feel that I would study harder if I were given more freedom to choose courses that I like.

9. Daydreaming about dates, future plans, etc., distracts my attention from my lessons while I am studying.

10. My teachers criticize my written reports as being hastily written or poorly organized.

11. I feel that teachers allow their personal like or dislike for a student to influence their grading unduly.

12. Even though I don't like a subject, I still work hard to make a good grade.

13. Even though an assignment is dull and boring, I stick to it until it is done.

14. I give special attention to neatness on themes, reports, and other work to be turned in.
15. I believe that the easiest way to get good grades is to agree with everything your teacher says.

16. I lose interest in my studies after the first few days of a new term.

17. I keep all the notes for each subject together, carefully arranging them in some logical order.

18. I memorize rules, definitions of technical terms, formulas, etc., without really understanding them.

19. I think that teachers like to exercise their authority too much.

20. I believe that teachers truly want their students to like them.

21. When I am having difficulty with my school work, I try to talk over the trouble with the teacher.

22. I hesitate to ask a teacher for further explanation of an assignment that it not clear to me.

23. I feel that teachers are too rigid and narrow-minded.

24. I feel that students are not given enough freedom in selecting their own topics for themes and reports.

25. I lay aside returned examinations, reports, and homework assignments without bothering to correct errors noted by the instructor.

26. I get nervous and confused when taking an examination and fail to answer questions to the best of my ability.

27. I think that teachers expect students to do too much studying outside of class.

28. Lack of interest in my school work makes it difficult for me to keep my attention focused on assigned reading.

29. I keep my place of study business-like and cleared of unnecessary or distracting items such as pictures, letters, mementos, etc.
30. I have trouble with the mechanics of English composition.

31. When explaining a lesson or answering questions, my teachers use words that I do not understand.

32. Unless I really like a course, I believe in doing only enough to get a passing grade.

33. Telephone calls, people coming in and out of my room, "bull-sessions" with my friends, etc., interfere with my studying.

34. In taking notes, I tend to take down material which later turns out to be unimportant.

35. My teachers fail to give sufficient explanation of the materials they are trying to teach.

36. I feel confused and undecided as to what my educational and vocational goals should be.

37. It takes a long time for me to get warmed up to the task of studying.

38. I do poorly on tests because I find it hard to think clearly and plan my work within a short period of time.

39. I feel the teachers are overbearing and conceited in their relations with students.

40. Some of my courses are so uninteresting that I have to "force" myself to do the assignments.

41. I am unable to concentrate well because of periods of restlessness, moodiness, or "having the blues."

42. I skip over the figures, graphs, and tables in a reading assignment.

43. I believe that teachers secretly enjoy giving their students a "hard time."

44. I believe that having a good time and getting one's full share of fun out of life is more important than studying.
45. I put off writing themes, reports, term papers, etc., until the last minute.

46. After reading several pages of an assignment, I am unable to recall what I have just read.

47. I think that teachers tend to talk too much.

48. I believe that teachers tend to avoid discussing present-day issues and events with their classes.

49. When I sit down to study I find myself too tired, bored, or sleepy to study efficiently.

50. I have difficulty in picking out the important points of a reading assignment—points that later appear on examinations.

51. I feel that teachers try to distribute their attention and assistance equally among all their students.

52. I feel that my grades are a fairly accurate reflection of my ability.

53. I waste too much time talking, reading magazines, listening to the radio, watching TV, going to the movies, etc., for the good of my studies.

54. When in doubt about the proper form of a written report, I refer to an approved model to provide a guide to follow.

55. The illustrations, examples, and explanations given by my teachers are too dry and technical.

56. I feel that it is not worth the time, money, and effort that one must spend to get a college education.

57. My studying is done in a random, unplanned manner—is impelled mostly by the demands of approaching classes.

58. When reading a long textbook assignment, I stop periodically and mentally review the main points that have been presented.

59. I feel that teachers tend to be sarcastic toward their poorer students and to ridicule their mistakes.
R-RARELY  S-SOMETIMES  F-FREQUENTLY
G-GENERALLY  A-ALMOST ALWAYS

60. Some of my classes are so boring that I spend the class period
drawing pictures, writing letters, or daydreaming instead of
listening to the teacher.

61. "Extracurricular activities"--dating, clubs, athletics, living-
group activities, etc. --cause me to get behind in my school
work.

62. I seem to accomplish very little in relation to the amount of
time I spend studying.

63. I feel that teachers make their courses too difficult for the
average student.

64. I feel that I am taking courses that are of little practical value
to me.

65. I utilize the vacant hours between classes for studying so as to
reduce the evening's work.

66. I can concentrate on a reading assignment for only a short while
before the words become a meaningless jumble.

67. I think that football coaches contribute more to school life than
do the teachers.

68. I believe that the sole purpose of education should be to equip
students to make a living.

69. Problems outside of school--financial difficulties, being in love,
conflict with parents, etc. --cause me to neglect my school work.

70. I copy diagrams, drawings, tables, and other illustrations that
the instructor puts on the blackboard.

71. I feel that teachers think too much about grades and lose sight
of the real objectives of education.

72. I strive to develop a sincere interest in every course I take.

73. I complete my homework assignments on time.
R-RARELY          S-SOMETIMES         F-FREQUENTLY
G-GENERALLY        A-ALMOST ALWAYS

74. I lose points on true-false or multiple-choice examinations because I change my original answer only to discover later that I was right the first time.

75. I think that students who ask questions and offer comments in class are only trying to impress the teacher.

76. The prestige of having a college education provides my main motive for going to college.

77. I like to have a radio, record player, or TV set turned on while I'm studying.

78. When preparing for an examination, I arrange facts to be learned in some logical order—order of importance, order of class presentation, order of textbook, of time, or of history, etc.

79. I believe that teachers intentionally schedule tests on the days following important athletic or social events.

80. I believe that a college's football reputation is just as important as its academic standing.

81. With me, studying is a hit-or-miss proposition depending on the mood I'm in.

82. I am careless of spelling and English composition when answering examination questions.

83. I believe that one way to get good grades is by using flattery on your teachers.

84. I think that it might be best for me to drop out of school and get a job.

85. I study three or more hours per day outside of class.

86. Although I work until the last possible minute, I am unable to finish examinations within the allotted time.

87. I feel that it is almost impossible for the average student to do all of his assigned homework.
R-RARELY  S-SOMETIMES  F-FREQUENTLY
G-GENERALLY  A-ALMOST ALWAYS

88. I feel that the things taught in school do not prepare one to meet adult problems.

89. I keep my assignments up to date by doing my work regularly each day.

90. If time is available, I take a few minutes to check over my answers before turning in my exam paper.

91. I feel that the ridiculous assignments made by teachers is the main reason for student cheating.

92. Prolonged reading or study gives me a headache.

93. I prefer to study my lessons alone rather than with others.

94. When tests are returned, I find that my grade has been lowered by careless mistakes.

95. I feel that students cannot be expected to like most teachers.

96. I feel like cutting classes whenever there is something I'd rather do or whenever I need to cram for a test.

97. At the beginning of a study period I organize my work so that I will utilize the time most effectively.

98. During examinations I forget names, dates, formulas, and other details that I really do know.

99. I believe that teachers enter their profession mainly because they enjoy teaching.

100. I believe that grades are based upon a student's ability to memorize facts rather than upon the ability to "think" things through.