

AN ABSTRACT OF THE THESIS OF

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Title A COMPARISON OF THE EFFECTIVENESS OF TEACHING  
GENERAL HYGIENE BY CLOSED-CIRCUIT TELEVISION AND  
BY LECTURE PROCEDURES

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The central purpose of this comparison was to determine the congruence or difference between two teaching techniques, the television method and the conventional lecture method as used in teaching General Hygiene on the freshman college level at Oregon State University. Sub-problems associated with this study were, (a) the development of a college health knowledge test, (b) establishment of the validity and reliability of this measuring instrument, (c) application and analysis of the college health knowledge test in reference to the stated comparison.

If a teaching technique deserves to be called effective, it must produce a significant change in the student. In this case the change should take the form of an increase in knowledge which would be indicated by scores on an examination covering the contents of a general

hygiene course. Therefore, it was considered of paramount necessity that a valid measuring instrument be designed. The college health knowledge test was developed from 390 multiple-choice items selected and constructed to meet accepted criteria. The scope and content of the area of General Hygiene was determined in this study in three means: (a) from the statements of nationally recognized organizations and authorities, (b) by analysis of current textbooks on the subject, (c) by analysis of published tests. Standardization was carried out using 2,000 students with particular attention being given to the recommendations of health educators, an analysis of authoritative statements, and the preparation and application of three balanced trial forms. Complete item and distractor analysis and difficulty level were determined.

A final form of 100 multiple-choice items in eleven topic areas was constructed. The mean coefficient of reliability for the test is .89. On test validity, there is a moderately strong correlation of .80 between scores made on the test and the final grades given by instructors at the close of the hygiene course. This test provides a valid, reliable, and comprehensive measure of achievement and diagnosis of personal health knowledge. It is designed chiefly for college freshmen students who have taken a full term course in personal hygiene.

With the construction of a valid health knowledge test it was possible to compare the effectiveness of teaching by television and by

conventional lecture procedures. A random sample of 1015 college freshmen students was divided into four experimental groups: (a) Closed-Circuit Television Group, (b) Open-Circuit Television Group, (c) Control Group, (d) Conventional Group. A pre-test and post-test was administered to these groups. Using the test scores obtained and adjusting them with scores obtained for the College Entrance Examination Board Scholastic Aptitude Test to control statistically the variable of academic potential, or intelligence, an analysis of co-variance was computed and the adjusted means were tested with the 'F' test or 't' test whichever was more appropriate.

The following conclusions were drawn from the data presented in this study.

1. Evidence was obtained indicating a significant difference in the amount of health knowledge possessed by students as entering freshmen at Oregon State University. The amount of health knowledge was significant at the five percent level.
2. Evidence was obtained indicating a significant difference in the increase of health knowledge as it relates to the eleven topic areas in General Hygiene at the one percent level.
3. Evidence was obtained indicating a significant difference in the effectiveness of the four different teaching methods at the one percent level.
4. Much evidence was obtained indicating the ability of each of the different teaching techniques as they related to challenging the different academic potentials of the students.

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AND BY LECTURE PROCEDURES

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DONALD DEE SHAW

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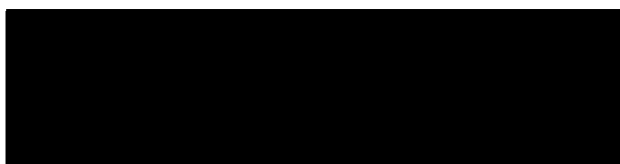
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# A COMPARISON OF THE EFFECTIVENESS OF TEACHING GENERAL HYGIENE BY CLOSED-CIRCUIT TELEVISION AND BY LECTURE PROCEDURES

## CHAPTER I

### INTRODUCTION

The pursuit and attainment of healthier living requires far broader knowledge than the old-fashioned, conventional rules of hygiene. It requires an understanding and appreciation of the body functions and the promotion of physical and mental well-being. Health is a quality of physical, emotional, social well-being reflected in an attitude toward life which results in more personally and socially-satisfying behavior. Good health is something to be enjoyed rather than a goal in itself to be striven for and worried about. Health promotion is a recognized component of present day functional education which is designed to prepare each student to deal with life's academic, cultural, and practical needs. This central theme runs through all phases of the school health program and is commonly called Health Education. Health education has been defined by Anderson (5, p. 36) as:

...the growth within a child of his ability to understand health knowledge and to utilize and apply meaning to it. Health education implies the growth of a child's ability to discriminate, appraise, and evaluate health knowledge and experience. The best health instruction in the world can result in education only when there is a candle of interest in the student which can be ignited. Motivation sparks education.

and again by Grout (31, p. 4) as; "...the translation of what is known about health into desirable individual and community behavior patterns by means of the educational process."

The need for health education has long been recognized at all levels of learning and at all levels of educational administration. Many colleges and universities, recognizing that a student cannot develop his intellectual potential unless he maintains a healthy physical condition, have required health courses to meet this need. Educators however, are perennially confronted with the problem of selecting an instructional approach most favorable to the achievement of certain health objectives. Varied methods and devices are currently used for health instruction in colleges and universities. One teaching facility which has been of interest to educators, and which has become highly controversial, is the utilization of television in the teaching-learning process.

### Statement of the Problem

The purpose of the present study is to investigate the effectiveness of teaching General Hygiene to large groups of college freshmen through the medium of television. More particularly, the problem in this investigation is to determine whether there are any significant differences in health knowledge displayed by students in a college

health education course employing two different approaches to health instruction -- television and traditional classroom teaching.

Several sub-problems within the study are: (1) selection of a measurement technique; (2) development of a measuring instrument; (3) application of this instrument to freshmen college students; and (4) analysis and evaluation of the results.

### Delimitation of the Problem

This study has been delimited as follows:

1. The problem has been restricted to Oregon State University students registered for Physical Education 160, General Hygiene, winter quarter, 1965.
2. This study compares only two approaches to health instruction -- use of television and traditional classroom teaching.
3. The study does not appraise possible changes in health attitudes or practices developed as a result of the two approaches to health instruction that were compared.
4. Eleven areas of subject matter normally included in general hygiene are identified and discussed on page 35.

### Need for the Study

It is becoming increasingly evident that the possession of certain basic knowledges in the area of health is essential if each individual is to take prompt advantage of the advances of medical science, protect himself against the hazards of medical quackery, and achieve for himself, his family, and his community an optimal level of health. Fundamental to the acquisition of such knowledge is a sound program of health instruction.

In this increasingly complex twentieth century, knowledge is growing at an unprecedented rate. One person cannot learn all there is to know and one school cannot teach all there is to learn, even with new methods and media of instruction designed for faster and better assimilation. Thus, it has become necessary to establish priorities in education. Educators are searching seriously for ways not only to greater academic accomplishment but also for means through which to develop individuals, who will assume an increasingly more responsible role in society and find satisfaction in living life to its fullest. The important question is: How can these experiences best be provided?

Veenker and Ismail (73, p. 129) indicated that the discussions describing attempts to resolve conflicting viewpoints as to the desired method, present observations made in essentially uncontrolled

situations or in the investigation of a single approach or from generalizations drawn from related studies. They feel such work is recognized as a valuable contribution, but a comparative analysis of the results of certain recommended approaches applied under controlled conditions would yield evidence as to their relative effectiveness. The American Association for Health, Physical Education and Recreation, Health Education Planning Conference of October, 1959 made eight specific research recommendations for the future of the field of health. One of these was this specific area of evaluation of method or program in the health sciences.

A summary report of the School Health Education Study (67, p. 3) recognizes the need for research in this area:

Health education is multidisciplinary in nature. Its content is largely derived from medicine, public health, and the physical, biological, and social sciences. Its scope is broad, covering such diverse areas as the nature of disease, the complexity of nutrition, effects of radiation, behavioral aspects of accident prevention, an understanding of health and medical care programs, significance of international health problems, selections of health products and services, environmental hazards in air and water, community health services, foundations of mental health, and preparation for marriage and parenthood. What is taught in the schools must be so related to the daily lives of the students that they can act intelligently in matters of health. With these wider concepts as a goal a more knowledgeable adult population should be the result, more aware of and competent to deal with current health problems and those of future generations. Therefore the methodology of health education is of paramount importance.

Another factor related to the need of this study is the present and projected college enrollment. The quantitative problem of college enrollment in the next decade is well known. The figures in Table I for the fall enrollment in higher education in this country in 1964 and 1965 show something of the problem of providing enough college teachers.

Table I. Opening (Fall) Enrollment in Higher Education, United States 1964 and 1965 (58, p. 17).

Credit Enrollment	Fall 1964	Fall 1965	Change	
			Number	Percent
Both sexes	2,529,000	2,814,000	285,000	11.2
Men	1,559,000	1,725,000	+166,000	+10.6
Women	970,000	1,089,000	+119,000	+11.4

In Table I, the numerical extent of the problem of teaching college students is evident. If, as has been predicted, there will be six million students in public and private institutions by 1970 or before, it becomes evident that the problem promises to become even more acute. The National Education Association (55, p. 12) indicated that the college enrollment in 1961 was 3.7 million and estimated that by 1970 the enrollment will be twice as great. The problem of providing faculties for this tremendous increase may prove to be overwhelming.



Mosier (54, p. 252) has stated that statistics reveal that for every current teacher, an additional faculty member will be needed to staff the colleges before the close of the 1960's.

According to the National Education Association report (54, p. 40) the availability of highly trained college teachers is diminishing. The percentage of doctorates among new college teachers is dwindling and the percentage of those teachers with a masters degree or less is rapidly increasing.

Universities and colleges with limited faculties and facilities are faced with the problem of accommodating vast numbers of undergraduate students. This points up the need for an investigation into methods of teaching larger classes, through improved means of communication, where one might increase the ratio of the students per instructor. The issue before colleges is: How can this problem best be met today?

This problem is particularly related to health education.

### Definition of Terms

Many times disagreement arises between groups of persons because different meanings are placed upon the use of terms rather than because of differences in basic philosophies. For this reason, it is advisable to define some terms which will be commonly used throughout this study.

1. Television: the changing of light intensities into electronic impulses, which are then transmitted by radio waves, and through electronic means, changed back into the original light pattern as a live telecast; it can be video taped, along a record of sound and sight on tape; or it can be kinescoped, producing a live program on a motion picture film (74, p. 166).
2. Closed-Circuit Television: refers to the process of television transmission whereby only those receivers connected to the television system are able to receive the transmitted program.
3. Open Circuit Television: refers to the process of television transmission whereby all receivers within the length of the signal are able to receive the transmitted program.
4. Instructional Television: refers to the utilization of the medium of closed-circuit or open-circuit television for the purpose of transmitting classroom instruction.
5. Lecture Approach: essentially the teacher-centered presentation of subject matter through the traditional textbook lecture technique, the more or less continuous oral presentation of a prescribed body of health information, closely related to the sequence of informational content as read by

students in a basic textbook.

6. Health: a state of complete physical, mental, emotional, and social well-being and not merely the absence of disease and infirmity (77, p. 16).
7. Health Education: the process of providing or utilizing experiences for favorably influencing understandings, attitudes and practices relating to individual, family and community health (34, p. 121).
8. Required Health Education: as a requisite for graduation, every student at Oregon State University is required to take a class in General Hygiene. Physical Education 160, General Hygiene is this designated course and includes instruction in the nature of the student, his environment, heredity, personal health, nutrition, exercise-rest-and-fatigue, safety, substances harmful to health, normal mental and emotional health, preparation for family living, prevention of disease and disorders, and consumer health.

Brief History of the Inter-Institutional Teaching by  
Television in the Oregon State System of  
Higher Education

Information for this brief history was taken from a report by Starlin and Lallas (69, p. 1-3) made in March, 1960. For a number of years, the Oregon State System of Higher Education has been interested in the potential of television for educational purposes. A

comprehensive plan for utilization of reserved non-commercial educational channels in the state was worked out by a State System Committee in 1952. In the fall of 1955, the Chancellor of the State System of Higher Education, through an inter-institutional television committee, set out to explore the possibility of using closed-circuit television for teaching on an inter-institutional basis. After sufficient interest was indicated by administrative heads of the state institutions of higher learning, an experimental plan was developed in 1956 to utilize television for inter-institutional teaching.

The original plan for inter-institutional classroom television in the Oregon State System of Higher Education proposed use of a closed-circuit television network. It suggested televised courses for Oregon State University, University of Oregon and Oregon College of Education. Other institutions were later added.

In May of 1956, the Chancellor submitted the above proposal to The Fund for the Advancement of Education requesting funds to help support the proposed experiment. This resulted in a grant of \$200,000 for experimentation in inter-institutional teaching by television. This money was matched by State System funds to permit acquisition and installation of television equipment for the project.

Initial plans for a closed-circuit operation were abandoned after costs for leasing of such facilities proved to be too costly. It was

determined that it would be more practicable to construct a low-powered television station and use it as a means of transmitting courses on an inter-institutional basis. Since channel 7 in Corvallis was reserved for non-commercial educational television use, and since Corvallis was about midway between participating institutions, it was decided to make application to the Federal Communications Commission to operate on channel 7. With permission granted in May, construction of the transmitter and studios was completed by the start of the academic year in October 1957.

The transmitter site is on Vineyard Hill, five miles north of Corvallis, Oregon. The transmitter is an RCA-TT-5A which operates with five kilowatts of power.

Production studios are available on both the Oregon State University and University of Oregon campuses. It was under these conditions that in 1959, Dr. C. L. Anderson (4, n. p.) developed 19 programs on 16 millimeter films followed by the production of 19 television video tapes on the subject of General Hygiene. These 19 films and video tapes were correlated with the textbook, Health Principles and Practice by C. L. Anderson and C. V. Langton. As a unit, this program was offered in the fall of 1959 as Television P. E. 160, General Hygiene. Since that time, several of the presentations have been revised. More than 10,000 students have benefitted, as of this writing, through participation in the above course. Participating

schools have been Oregon State University, University of Oregon, Oregon College of Education, Eastern Oregon College, Southern Oregon College and Portland State College.

Viewing rooms on the Oregon State University campus are set up in regular classrooms. Television receiving sets are console models with 24-inch screens and speakers mounted in the front of the set. The sets are mounted on stands constructed from one inch angle iron with a plywood platform fitted in the steel frame at approximately five feet from the floor. Casters are mounted on the legs of the stands to permit movement of the sets when necessary.

The broadcast facilities of channel 7 (call letters, KOAC-TV) are used for classroom television teaching in the morning hours. Closed-circuit General Hygiene is viewed at 9:00 a.m. on each Tuesday and Thursday of the regular term and open-circuit General Hygiene is viewed at 11:00 a.m. the same days.

### Summary

Institutions of higher learning are in a position to provide leadership needed to help individuals develop an understanding of and interest in the principles and practices of healthful living. Specifically, this leadership is, or can be, provided in the personal health courses offered at the institutions of higher learning. In these courses, students learn scientific principles and practices for the improvement of their

own health and after graduation, in many instances, the health of their families, communities, and even the health of the nation. If the United States is to remain strong and vital and a leader among nations, this kind of leadership is essential.

As a result of this need and the problems associated with teaching the ever burgeoning numbers attending institutions of higher learning, some pertinent questions must be raised relative to health instruction. How effective are the present methods of college health instruction? Are students developing an understanding of the principles and practices of health? How can health education best be taught at the college level? If these questions are to be answered, it is imperative that different approaches to health instruction at the college level be studied and compared. This was aptly summed up by Charles Hoban (36, p. 5) in a paper presented at the United States Office of Education Conference on Research in New Media:

...it is necessary to recognize that educational research and educational change are structurally related. It is inconceivable that educational research should have any major function other than to provide data upon which decisions on educational change, or no change, are made and implemented.

This, in essence, is the stand taken in the present study.

## CHAPTER II

### REVIEW OF RELEVANT LITERATURE

This chapter is a review of the literature related to this study. The first section is devoted to studies related to health education with television as an instructive medium. The second section relates the present study to the theory that has already been established. The third is a survey of research related to the measurement of health knowledge.

Few studies have been discovered which have been related to instruction of health education on the college level through the medium of television.

Cauffman (16, p. 260) reported a separate five-day per week health science class for eighth grade pupils which was taught by television in 17 junior high schools. During the first year of the experiment, 150 lessons were presented either live or via kinescope film. A study guide was prepared for use by teachers receiving television. Plans called for direct teaching of a 20-minute telecast by a studio teacher and for additional pre- and post-telecast teaching by teachers in classrooms receiving the broadcast. Evaluations of the lessons were made by means of pupil essays and teacher check lists. Since this was not a controlled study, no statistical findings for the pupil



evaluations are reported for comparisons. However, it was indicated that television was a valuable teaching aid that contributed to effective health science teaching and learning.

Hull (37, p. 1-120) reported an educational television project that consisted of four separate and different experiments. The broad purpose of these experiments was to compare the effectiveness of teaching with the aid of open-circuit telecasts and teaching with conventional methods. The basic plan of using traditional control and experimental groups was followed. Two of these experiments were conducted in the field of health education, one at the junior high school level in the Columbus, Ohio, schools and the other at Ohio State University.

In the experimental health science course for eighth graders, 381 students randomly selected from six junior high schools participated. The performance of control and experimental groups was compared on tests of subject matter content. Attitudes, personality and scholastic aptitude also were studied in relation to student performance. No significant difference was found in informational gains between the television and non-television groups or between the large and small groups that received television instruction. The responses obtained in the various tests on relationships of attitudes, personality and scholastic aptitude were so varied that there was no valid basis of comparison.

Students who were enrolled in the required one-hour course, Health Education 400, participated in the Ohio State University experiment. The achievement of students taught by television and by conventional methods was compared. Also, the performance of students taught in coeducational sections was compared with that of those in sex-segregated classes. Intelligence, sex, personality and attitude factors were studied in relation to performance. Attitudes of both students and instructors toward educational television were evaluated. In addition, the effects on the instructional staff of the reorganization of the health course and of teaching with the aid of television were assessed.

The mean total gain score of the students enrolled in television sections was significantly better than that of students in the conventionally taught sections. Students in large classes also did better than those in small classes. No significant differences were found between high and low achievers or among students differing in the factors of intelligence, personality or attitudes. Likewise, no significant results were obtained from students' reactions to the experience of television instruction and achievement. Teachers thought television instruction could be effective under certain conditions and for certain purposes. However, instructors showed a less favorable attitude toward television when it was used to replace time allotted for discussion (38, p. 1-92).

Another television experiment in health teaching was reported by Osborn (57, p. 8-9). This college study was unique in that the health teachers were their own producers. Two health teachers and four two-unit health education classes were involved. Each television teacher had one receiving class and one control class each semester. It was concluded from this study that the advantages in television teaching far outweighed the disadvantages since teachers had been helped to become better teachers and since pupils had also benefitted from the new and exciting experience.

Beasley's (8, p. 1-120) study gave further support to teaching of health by television. He stated that student reactions to a basic college health class taught through closed-circuit television revealed that a strong majority of students felt that television lessons were interestingly presented and that they were effective in contributing to learning. Beasley used the questionnaire method of investigation. Statements in the study were designed to measure the relative effectiveness of televised instruction in health education. The study utilized a five-point scale to allow variation in degree of agreement or disagreement with the questionnaire statements. After completing the course, 91 percent felt their understanding of health concepts was entirely adequate or generally adequate.

Whitlock (75, p. 1-152) in 1963 did a study to determine the attitude of college students toward a televised health education course at

San Jose State College, San Jose, California. This investigator attempted specifically to answer six attitude factors related to health education and instructional television. The study provides evidence that attitudes toward required health education, televised and conventional, were generally favorable. The data seemed to indicate that the motivated student is able to function effectively in a somewhat remote environment with the added personal responsibility that comes with being taught by television.

Most of the studies found which dealt with teaching health by television were of an attitudinal nature. No study has been found that reported the effectiveness of teaching General Hygiene to obtain health knowledge by closed-circuit television. It seems appropriate, therefore, that an investigation of teaching General Hygiene by closed-circuit television be conducted.

#### Studies Related to Achievement Using Television as a Medium

There have been a number of studies of student achievement and attitudes toward televised education completed in the United States in the last seven years. Most of these studies have dealt with the college level students. The armed services also have completed a number of investigations.

In a report to the American Council on Education, Kumata

(45, p. 84) stated that at least 60 studies have been aimed at answering the general question as to whether the mode of communication makes a difference in student achievement. With very few exceptions, he states, the majority show non-significant differences. Later studies by Kumata (44, p. 2) and others confirm the earlier reports. A survey carried out by investigators from Purdue University (53, p. 6) shows 569 school systems and 117 colleges and universities used television for direct instruction in regular courses. The total number of students reached by television included more than one-half million children and more than 100,000 college students during the 1958-59 school year. It was reported that despite certain technical handicaps, "in the bulk of cases there has been no significant difference between how much students learned by television and how much they learned by conventional instruction. "

Macomber and Siegel (52, p. 19) report that the most consistent feature about studies of television and conventional test scores is the dearth of statistically significant differences obtained. In courses in chemistry and psychology (14, p. 44), ten out of eleven examinations resulted in no significant differences in learning. The second report of the Miami study (51, p. 13-16) stated that in general there is little difference between the two media although scores tend to favor the conventional instruction. Studies such as those that took place at New York University (59, p. 22-26), the Chicago City Junior College

(27, p. 40), and the University of Oregon (69, p. 67) for the most part reached these same general conclusions -- no significant differences.

Several investigators favored the introduction of television courses at their particular schools. Their reports stressed what they felt were the advantages of television education. For example, Smith (68, p. 2-13) and Fletcher (28, p. 31) recommended this medium of education quite highly in stressing that television education was at least as effective as conventional education and at times was more effective in achievement. Although television students often outscored students in conventional classes, rarely did Smith and Fletcher find statistically significant differences.

Erickson and Chausow (27, p. 17) reported no significant differences in the majority of their comparisons of television versus conventional instruction. However, non-campus television students achieved significantly better in some instances when compared to campus television students. It appears that these non-campus students, taking the courses via open-circuit television at home, were older and more mature. These higher age levels had a possible relation to achievement.

Several studies point out that television education shows some advantages where low ability students are concerned. Macomber and Siegel (51, p. 3) note this fact in relation to their studies. In a study of basic training for army personnel, Kanner, Runyon and Desiderato

(41, p. 1-65) concluded that television education has definite advantages for low aptitude students. In 5 of their 17 tests, there was a significant difference in favor of television education. The other 12 tests resulted in no significant differences. These 5 significant differences represented the strongest departure, one of the few, away from the lack of significant differences.

One of Kumata's (45, p. 97) studies contradicts the overwhelming majority of television studies. He found that the mode of presentation significantly affects learning. He discovered that television students did significantly poorer than conventional students.

Studies within the armed forces, such as Allen's (2, p. 62), indicate that as far as men in the military service are concerned, television education is just as effective as conventional classes in basic-training or for the teaching of special courses.

In summary, to quote Smith's report (68, p. 13), "training would be the same either way -- learning is up to the student."

### Measurement of Health Knowledge

Of fundamental importance to research in health instruction is the availability of suitable devices for appraising the status of the health knowledge, attitudes and practices of the population under study. Even though an investigation is well designed, the degree of confidence to be placed in its findings is relative to the validity of the instruments

used and the treatment methods applied to test results. It appears that failure to recognize this simple truth has constituted a serious obstacle to more extensive study of health instruction.

The published health knowledge tests are not only very limited in number available, especially on the college level, but many are not satisfactory tests. That is, they may exhibit such deficiencies as: reliability low or not determined, validity not established, norms not available, test administration inconvenient or expensive, test attempts to cover too many grades, degree of difficulty too high or too low, discrimination value of individual items not demonstrated, multiple forms not equated, validity of individual test items questionable, scope and content inadequate, emphasis misplaced, test statements poorly worded and so forth. This situation points to the need for focusing attention on well-organized test research in health education.

Few studies in health education may be classified as "pure" test research. Even most of those devoted to test construction are also concerned with other purposes. As a result, the present survey makes no attempt to abstract or to list the results of all such studies. Rather, a review of available instruments relating to health instruction will be pointed up.

Although standardized objective tests have been used when available, a variety of oral and written techniques have also been used as health tests to evaluate health knowledge, attitudes and practices.



Included are such devices as picture tests by Bobbit and Sellery (10, p. 10), check lists (11, p. 113-18), pupil and parent questionnaires by Dalmat (20, p. 287) and personal data inventories by Rich (62, p. 631-37). Some comprehensive evaluation projects such as Johns (40, p. 128) combined several appraisal techniques in the long-range study of health instruction programs.

Recognition of the need for valid measurement instruments is reflected in the increased number of studies directed toward test construction during the past decade. As a result, several types of instruments have been developed at various grade levels. Colebank (17, n.p.) constructed a 100-item health behavior inventory for junior high school pupils. His inventory used a three-track procedure that required students to match parallel items that are concerned with a basic health principle but are stated in distinct forms designed to measure practice, attitude and knowledge. LeMaistre (48, n.p.) developed a health behavior inventory of 50 multiple-choice items for senior high school student; the inventory was later expanded to include 75 items. Mayshark (50, p. 52-59) demonstrated the feasibility of developing a valid, standardized instrument to measure health and safety attitudes. The ability to measure health knowledge at a single grade level was also adequately demonstrated by Veenker (72, p. 338-48).

Between 1940 and 1960, at least 42 different tests of health knowledge, attitudes and behavior for elementary, secondary and college levels were developed. Of the writer's list of 42, some 13 tests are constructed for the elementary school level, 12 for the junior high school, 5 overlap the junior high school and elementary level, 8 are for the senior high school only, and 6 overlap the senior high and elementary and junior high; 16 were constructed for the college level with only 4 of these designed to evaluate health knowledge. A compilation of these published tests with a brief description of each is provided in Appendix I. These tests are identified in the appendix as tests which are commercially or privately published and tests that resulted from theses or dissertations that required the development of evaluation instruments.

A review of the test forms in the four different tests which are designated by their authors as intended for college or high school and college levels indicated a number of major weaknesses. Test #1 is the only one of the four test forms designated for college alone. There are 13 areas covered by the 100 items. The emphasis ranges from a high of 16 items on nutrition to a low of a single item on current health. The latter would seem inadequate. Several of the items have more than one correct answer, like item 28: "Today, man can expect to live ---x. to 65 years, n. to 70 years (keyed as correct). Anyone who lives to 70 years must have lived to 65 years. Some items in this

test have no completely correct response. In spite of the criticisms made, the content coverage is, on the whole, good.

Test #2 is available in two forms. Both forms overemphasize first aid, averaging 18 percent allocation to this subject, and neglect fatigue and rest, averaging only 3 percent. Other areas are very weakly represented. The area of human reproduction and heredity is omitted entirely. The test is designed for an excessively broad age range, "grade 7 to 12 and college." It is difficult to accept the proposition that a test which is suitable for a seventh grader is adequate also for college level. Reliability is satisfactory, but validity is not specified. This test is to be commended for its good selection of well worded items and its attention to application of knowledge. It does show some weakness in that 40 percent of the items are of true-false form, requiring little discrimination, and the remaining 60 percent are multiple-choice items offering only four alternatives, again not requiring the degree of discrimination which may be expected of the college or university student.

Both tests #3 and #4 exhibit the weakness of the previous test in being designated for both high school and college. This, along with the added problem in test #4 of altering the number of choices among the multiple-choice items, some items provide for only three alternatives, hardly adequate for the college level. The majority of items provide four choices; some provide five and six choices.

Distribution of items among the various divisions is unbalanced in several areas; thus 10 items out of 100 are devoted to the care of eyes, ears and skin, but only 1 item each to excretion, exercise and oral hygiene.

### Summary

From the literature on the subject, there does not appear to have been a study comparing closed-circuit television teaching and conventional classes in health on the college level. However, television is considered a valuable aid which contributes to effective teaching and learning in health education. In most studies reported the major advantages in teaching health education by television seemed to outweigh the disadvantages. The available research leads one to believe that certain approaches to teaching in health education are more effective than others. To meet the acknowledged responsibility of equal education for all, it is apparent that society needs to consider methods and procedures designed to teach large groups where appropriate. This is especially true on the college and university level where enrollment has so greatly exceeded education's ability to prepare, on a qualitative and quantitative basis, sufficient teaching personnel.

Although it appears that important gains have been made in the measurement of the health knowledge of school children much remains to be done. The review here completed suggests a continuing

need for extensive test research in all areas of health education.

Test results reported do provide substantial evidence to support the conclusion that appropriate testing procedures will yield significant information basic to effective health education aims and objectives. In addition, health behavior can be changed favorably through health instruction.

An analysis of the literature discloses that a great deal of work still remains to be done in the development of satisfactory instruments for assessing health knowledge. The literature also suggests that more research needs to be accomplished, particularly through comparative studies that will supply evidence to health educators which will assist them in implementing functional health instruction programs.

## CHAPTER III

## CONSTRUCTION OF THE PERSONAL HYGIENE KNOWLEDGE TEST

Determination of Scope and Content

This study is concerned with a comparison of the effectiveness of teaching General Hygiene by closed-circuit television and by lecture procedures to freshmen at Oregon State University. To be able to accomplish this objective, one of the necessary tools used would be a suitable measuring instrument of knowledge in the field of personal hygiene. After a thorough review of the available literature, it was felt by the author that none of the presently available tests in personal hygiene was applicable or suitable for this study. Knowledge in the field of health has broadened astronomically in the last ten years. Many concepts have been altered, or in some cases completely changed. Therefore, it seems there is a need for the construction of an adequate test in personal hygiene, of appropriate content and difficulty, designed specifically for the college student. One of the major purposes of this study, as was stated on page 3, was to construct and apply a suitable knowledge test in the personal hygiene area for the use on college level.

An immediate requirement in the construction of a test must be the delimitation of its content. The concern of this study is limited to

personal hygiene, as distinct from community hygiene, family hygiene, industrial hygiene, first aid, or safety education. Personal hygiene is the course in the health field usually offered by colleges. Where a hygiene course is recommended or required it is usually personal hygiene. At Oregon State University, this class in personal hygiene is offered and required of all students and is called P. E. 160, General Hygiene. This class and this specific area is the major area of interest of this investigation.

The scope and content of the area of personal hygiene have been determined in the study as follows: (a) from the statements of nationally recognized organizations and authorities; (b) by analysis of current textbooks on the subject; (c) by analysis of published tests.

### Statements of Organizations and Authorities

Representative of the statements of educational groups is that of the American Council on Education (3, p. 20-21), in its elaboration of the health objectives which it proposed as a part of the general education of the student. The Council's list of knowledge, understandings and abilities which it held that the student should acquire, dealt with, in summary, the following topics of hygiene.

1. Normal body functions.
2. Major health hazards.
3. Sources and evaluation of health information.
4. Planning sound time schedules for food, work, recreation, rest and sleep.
5. Maintenance of good nutrition.
6. Maintenance of good emotional adjustment.
7. Healthful exercise and recreation.
8. Avoidance of disease.
9. Intelligent utilization of medical and dental services.
10. Community health problems and protection.

Every authoritative statement of educational goals since Horace Mann has listed health as a principal goal. In 1961, the Educational Policies Commission (23, p. 5) stated:

The central purpose of education is to develop rational powers of the individual or his capacities to think and reason. Basic to this development is physical health since disease, defects, or disability may interfere with learning. Mental health is also of profound importance: with it the pupil may have the desire and respect for learning that promotes optimum mental performance, without it the likelihood of such development is drastically reduced if not rendered impossible. Health depends upon a reasoned awareness of the value of physical and mental fitness and the means by which these may be maintained.

Lantagne (47, p. 383-87) found that junior college students demonstrated over 25 percent greater interest in health problems than did high school students. It was felt that maturity might be the primary factor involved. The topics found to be of greatest interest to both men and women were: sex instruction, preparation for marriage, and mental health. This level of interest in family health led to a later



study of 2,000 junior college students in regard to their interest in marriage and parenthood. Lantagne concluded that deans of instruction should recognize that marriage education, not as a family institution in the sociological approach, but dealing with physical and emotional aspects of marriage, should be an integral part of the general education of all college students.

Rugen and Nyswander (63, p. 213-16) have more recently proposed an extensive list of objectives of individual health education.

In summary, their list covers the following topics:

1. Individual and group responsibility for health.
2. Interdependence of physical, mental, and emotional health.
3. Organization of time for balanced daily living.
4. Fatigue and the need for, and conditions of, adequate rest and sleep.
5. Suitable play and exercise.
6. Getting along with others.
7. Importance and maintenance of good posture and body mechanics.
8. Provisions of proper food and nutrition.
9. Cleanliness.
10. Need for, and essentials of, periodic health examination.
11. Medical attention.
12. Individual procedures in personal and group health problems.
13. Immunization as protection against disease.
14. Causes and prevention of communicable diseases.
15. Hazards of self-diagnosis and self-medication.
16. First aid and prevention of accidents.
17. Effects on health of wholesome and unwholesome practices of daily living.
18. Adjustment to health handicaps.
19. Structure, function and care of special organs, including eyes, ears, nose, throat, mouth and teeth.
20. The role of heredity in health; structure and function of the sex organs, and the nature of wholesome relationships with the opposite sex.

21. Effects of alcohol and tobacco, and the need for temperance in all things.

The Cooperative Committee on School Health Education (18, p. 1-81) in 1955 conducted an extensive study of health needs in 91 towns and cities from coast to coast. The data were summarized from the responses of 34 authorities and of teachers and administrators in the participating areas. The health needs, described as problems, were reported in the following order of frequency: healthful living, nutrition, emotional health, disease prevention and control, rest and recreation, cleanliness, dental health, and vision and hearing. Although the health needs revealed by this study were geared toward the total school health program, many of them could be applied in planning for health instruction.

The Public Health Service (71, p. 1-40) in one of the National Health Survey reports provided information to show that the health needs of students were evident in respect to acute conditions including respiratory, infectious, and parasitic diseases; to digestive disorders; to injuries in general and those occurring at home, in motor vehicles, and at work; and to impairments including those of a visual, auditory, or orthopedic nature.

Hedden (35, p. 1-227) approached the problem of determining health needs of students by gathering information from students, parents, medical doctors, nurses, and teachers in the Junior College District of Kern County, California. He classified student health needs

under the topics of personal health; nutrition; dental health; rest, sleep, and relaxation; communicable and chronic disease; stimulants and depressants; mental health; safety education; and consumer health.

One of the primary hazards to the life and well-being of children and youth is accidents. Ample evidence of needs relative to accidental injury and death are to be found in Accident Facts, published annually by the National Safety Council, and Safety Education, published monthly by the same organization. Evidence that supports the inclusion of instruction about accident hazards in specific aspects of the home, school, and community environment can be derived from the studies of Hase (32, p. 13-16) and Yost (78, p. 5-7) who bring to light ample evidence of needs relating to accidental injury and death.

Selected studies give evidence of a number of special areas of health education. Lamb and Ford (46, p. 15-26) and Eppright and Roderbuck (26, p. 464) provided evidence relating to dental health. Slater (66, p. 78) in 1952 indicated the needs as related to the use of alcohol.

A review of the statements of recognized organizations and authorities regarding health information the student should acquire indicated that, although there are minor differences, certain topics are found in most statements. These topics make up a common core of objectives or subject matter for instruction in personal hygiene and include heredity; personal health; nutrition; exercise, rest and

fatigue; safety; substances harmful to health; normal mental, emotional and social health; preparation for family living; prevention of disease and disorder; consumer health.

### Analysis of Textbooks

A survey of college textbooks on personal hygiene reveals that the outline of topics just offered may well serve as the common core for these textbooks, with the addition of an introductory phase. Unlike the general statements of organizations and authorities, the subject matter presented in textbooks is in such detail and variety that, although the proposed outline of topics is very appropriate, difficulties of classification arise unless the outline is amplified to make clear what may be included under each topic. Classification of the textbook content becomes necessary not only to find out the scope and general topics considered, but also to determine the emphasis given to each of those topics as reflected in the amount of space or pages allocated to each area of personal hygiene.

A sample of six of the most popular current college textbooks on personal hygiene was analyzed in detail to determine scope, content, and emphasis. The outline proposed above, with the addition of a section on introductory material found necessary because such is presented in every textbook, was amplified to the degree necessary, and was used for the tabulation of space devoted to each topic. The

outline of topics follows, with a brief description of the content under each topic.

Classification of content of college personal hygiene:

1. Introductory: Social and biological background, definitions, nature of health, personal and social significance of health, objectives of hygiene, science as the basis of hygiene, history of health, health education needs of the student, indices of health.
2. Heredity: Physiological and psychological potential; biological inheritance; endowment of constitutional factors; diathesis; longevity genetics; eugenics; non-hereditary disorders at birth.
3. Personal Health: Care of skin, teeth and hair; understanding of the eye and vision and the ear and hearing; personal appearance; cleanliness; effective and enjoyable personal living; bathing; care of nose and throat; need for periodic examination.
4. Nutrition: Digestion, absorption, metabolism; nutritional needs; foods and their composition; selection and preparation of foods; body weight control, daily dietary needs; influence of physical and emotional state; nutrition as a community problem.
5. Exercise, Rest and Fatigue: Benefits of physical fitness; sound physical fitness program; understanding of fatigue; the body and rest; relationship of posture; relaxation; general considerations.
6. Safety: Protection against physical and chemical hazards; including accidents, light, heat, cold, poisons; climate, shelter, clothing; the human factor in accidents; good safety practices; protection of life and property; sense of responsibility; accident prevention in the home, school, highways and other public places.
7. Substances Harmful to Health: Understanding the effects of stimulants and depressants; harmful effects of tobacco, alcohol and narcotics; objective evaluation of advertisements pertaining to the use of stimulants and depressants; bacterial poisons; toxin transfer; chemical poisons; food poisoning.

8. Normal Mental, Emotional and Social Health: Understanding of the characteristics of good mental health; appraisal of one's own mental health; reactions to stress; practices that are conducive to good health; relationship between tension and mental and physical illness; mental disorders; treatment and preventive aspects of mental illness; social implications of health; personality; human conduct; development of self; philosophy of life; health of the nervous and endocrine systems.
9. Preparation for Family Living: Sex education; structure and function of male and female reproductive systems; dating; selecting a mate; engagement; preparation for marriage; appraisal of sexual drives and desires; menstrual cycle; pregnancy and childbirth; marriage; general considerations of sex and reproduction.
10. Prevention of Disease and Disorders: Prevention and treatment of communicable and non-communicable diseases; resistance and immunity; infection; modes of transmission; causes, symptoms, treatment, and preventive aspects of diseases; chronic diseases; causative agents, reservoirs, and organisms; the disease cycle; degenerative diseases; blocking routes of transmission.
11. Consumer Health: State and local health services; national and international health services; voluntary health agencies; role of various health advisers; evaluation of health information and advice; role of specialists; nature of good medical and dental care; recognition of nostrums and quackery; selection of good medical and dental care; insurance programs and other health services; geriatrics; conservation of human resources.

The eleven topics above were found to be common to the six textbooks analyzed, though in considerably different proportions. In addition to this common core, a few texts devoted small amounts of space to certain additional topics including first aid, community health, industrial health, and various other topics. It was found possible, however, to classify over 91 percent of all materials under the eleven topics named above.

The list of six textbooks analyzed is provided in the bibliography of this study. Together, they totaled 2943 pages, ranging from 340 pages to 691 pages each, and averaging 491 pages in length. Table II, on the following page, presents the detailed analysis of the contents in each of these textbooks, and the emphasis as represented by the percentage of total space devoted to each of the topics. The mean and the range for each topic are given. The means are significant as a factor in helping to determine the number of items to be devoted to each topic in the test to be constructed as a part of this study.

Study of Table II indicates that there is general agreement among authors on the areas to be included in college textbooks on personal hygiene. All of the eleven topics were included in the textbooks considered. Very little material beyond the eleven topics is included in these volumes. Although hygiene textbooks are in general agreement on the topics to be included, there are considerable differences among books as to the emphasis placed on a given topic. Thus the range in percentage of total pages devoted by different writers to the subject of heredity varies from a high of 6.7 percent to a low of only 1.1 percent. The mean emphasis, however, 3.0 percent, would be judged reasonable by most health educators. Similarly, although there is considerable range in the emphasis given to several of the topics, the means are in general, not unreasonable.

Table II. Content and Emphasis in the Six Personal Hygiene Text-books for College Use.

Topic	Texts	Percentage of total pages						Range	Mean	
		#1	#2	#3	#4	#5	#6			
1. Introduction		12.5	6.0	11.1	2.2	7.2	2.7	12.5-	2.2	6.9
2. Heredity		6.7	2.1	2.3	3.0	1.1	2.5	6.7-	1.1	3.0
3. Personal Health		8.5	5.4	10.8	11.1	6.2	1.1	11.1-	1.1	7.2
4. Nutrition		7.4	10.0	14.8	16.0	8.4	15.2	15.2-	7.4	12.0
5. Exercise, Rest and Fatigue		4.2	6.0	7.7	7.3	4.1	12.2	12.2-	4.1	6.9
6. Safety		6.9	6.5	3.1	3.7	5.4	2.2	6.9-	2.2	4.6
7. Substances Harmful to Health		7.4	4.1	13.4	9.2	5.6	9.9	13.4-	4.1	8.2
8. Normal Mental, Emotional and Social Health		4.4	7.7	8.0	13.6	13.2	7.1	13.6-	4.4	9.0
9. Preparation for Family Living		9.6	13.5	11.4	10.2	14.8	10.2	14.8-	9.6	11.6
10. Prevention of Disease and Disorder		10.0	11.2	10.8	14.6	18.2	13.5	18.2-	10.0	13.1
11. Consumer Health		6.7	5.9	6.3	5.2	8.6	2.7	8.6-	2.7	5.9



### Analysis of Tests

The four different published personal hygiene knowledge tests designed by their authors as intended for use in high school or college or for college alone, were analyzed as to content and emphasis. These tests are those whose weaknesses were described on pages 24 to 26, and are listed in Appendix I. The outline of eleven topics comprising the core of personal hygiene, used in the analysis of textbooks, served again as the guide for tabulation of emphasis in the tests as determined by the proportion of items devoted to each topic area.

It was found that 90 percent of the items included in the four tests can be classified under the eleven topic core outline. The remaining 10 percent belong to the supplementary areas of public health, family health and industrial hygiene, as in the case of the textbooks, and in addition there is representation in the area of school health. Two items in one test are extraneous to the field of hygiene and will be ignored. Table III presents the detailed analysis of the content of each of the four test forms, with emphasis indicated in terms of the percentage of items in each test devoted to each of the topics. The range and the mean for each topic are shown. These means will serve subsequently as one factor in determining the weight given to each of the eleven areas to be included in the test under construction as a part of this study.

Table III. Content and Emphasis in the Four Published College Health Knowledge Tests.

Topic	Percentage of test items				Individual Item Range	Mean
	Test #1	#2	#3	#4		
1. Introduction	6	5	3	6	3-6	5.0
2. Heredity	3	4	1	4	2-4	3.3
3. Personal Health	5	10	7	6	6-10	7.0
4. Nutrition	17	10	17	15	8-17	14.8
5. Exercise, Rest and Fatigue	12	9	9	10	9-12	10.0
6. Safety	6	2	3	3	1-6	3.5
7. Substances Harmful to Health	5	8	7	4	4-5	6.0
8. Normal Mental, Emotional and Social Health	15	8	11	13	4-13	11.7
9. Preparation for Family Living	2	7	11	11	2-11	7.7
10. Prevention of Disease and Disorder	13	14	26	14	14-26	16.7
11. Consumer Health	6	8	4	7	5-8	6.5

Study of Table III on page 40 shows that eleven topics are common to all test forms. Comparison of the percentages allotted to each topic by the several authors demonstrates, as in the case of textbooks, considerable differences in emphasis. Within the eleven topic core are found ranges of 26 percent to 13 percent in topic 10, prevention of disease and disorder; 15 percent to 8 percent in topic 8, normal mental, emotional and social health. Test three, that devoting 26 percent of its items to topic 10, is obviously far out of balance. Over emphasis may be as serious a weakness as is omission. If test three is omitted in the computation of the mean for this topic there would be a reduction from 16.7 percent to 13.6 percent, more nearly in line with the conclusions of other authors.

Comparison of the topic means of the tests with those of the textbooks shows a fair consistency for most areas. Thus the topics of nutrition, prevention of disease and disorder, normal mental, emotional and social health, personal health, preparation for family living, though not holding the same rank in each list, are in both cases included among the top five of each list. Among the points of difference between the tests and the textbooks the only area showing any marked difference was the area of preparation for family living with a mean of 11.6 percent in the textbooks and a mean of 7.7 percent in the tests. Even here, however, in the graduated ranking the area of preparation for family living in the textbook was third and in the tests was fifth.

Added to the means for the textbooks and the means for the tests was the means for the amount of time allocated to each topic in the course outline for P.E. 160, General Hygiene, Winter term, 1965. As the test to be constructed was to measure the knowledge increase in this particular group of students, it was felt that adequate weight of the scope and content of the class work should also be included. A copy of the course outline will be found in Appendix I of this study. Table IV presents the totals of all the means in each of the eleven areas used to determine the emphasis of the scope and content of the test to be constructed.

The distribution of items among the eleven topic areas was made in approximate correspondence with the average emphasis given to each topic by the textbooks, the tests, and the course content, allowing equal weight to each of these three determining factors. Slight modifications from these means was necessary to adjust for certain omissions in texts and tests described in the earlier sections of this chapter. Taken into consideration in making these adjustments were the statements from authoritative organizations and health educators cited previously. The mean emphasis allotted to personal hygiene topics by textbooks, tests and course, to be called the cumulative mean, along with the total items selected in each of the topic areas, is presented in Table V. The test items were allocated on the basis of a 100 item test.

Table IV. The Means of the Textbooks, Tests, Course, and the Cumulative Content and Emphasis Total Mean in the Eleven Topic Areas.

Topics	Textbook	Tests	Course	Total Cumulative Mean
1. Introduction	6.9	5.5	5.5	5.9
2. Heredity	3.0	3.3	11.1	5.8
3. Personal Health	7.0	7.0	5.9	6.6
4. Nutrition	12.0	14.8	5.5	10.8
5. Exercise, Rest and Fatigue	6.9	10.0	11.1	9.3
6. Safety	4.6	3.5	5.5	4.5
7. Substances Harmful to Health	8.2	6.0	11.1	8.4
8. Normal Mental, Emotional and Social Health	9.0	11.7	11.1	10.6
9. Preparation for Family Living	11.6	7.7	16.6	12.0
10. Prevention of Disease and Disorder	13.1	16.7	11.1	13.6
11. Consumer Health	5.9	6.5	5.5	5.9

Table V. Cumulative Item Emphasis and Assigned Topic Emphasis.

Topics	Cumulative Mean	Items Alloted to Each Topic
1. Introduction	5.9	6
2. Heredity	5.8	5
3. Personal Health	6.6	6
4. Nutrition	10.8	15
5. Exercise, Rest and Fatigue	9.3	10
6. Safety	4.5	6
7. Substances Harmful to Health	8.4	7
8. Normal Mental, Emotional and Social Health	10.6	13
9. Preparation for Family Living	12.0	14
10. Prevention of Disease and Disorder	13.6	13
11. Consumer Health	5.9	5
Totals	93.4	100.

#### Determination of Form for Test Items

The selection of the form for the items of a test should arise from the objective of the test and the nature of the subject matter. A purpose of this study is to construct a test which can eventually be standardized. Therefore, the test must be objective in nature. This

excludes the oral and essay type examination from consideration. Various objective forms are available such as multiple-choice, true-false, completion, and matching. A test prepared by a teacher for his own use might well include more than a single form of item for each form has certain advantages, in addition to the fact that students may find more interest in a variety of forms. The multiple-choice form is adapted to testing the higher mental processes and reduces guessing; the true-false questions are simpler to construct and facilitate a larger sampling of subject matter in a short period of time; the completion type item reduces guessing and is easily prepared; the matching form can be made to elicit complex thinking and is efficient in terms of space and testing time per item.

Each of these objective forms has its disadvantages. The multiple-choice item is more difficult to construct and requires more time and space than does the true-false type, which, however, is more open to ambiguity and guessing, and less adaptable for testing understanding and reasoning. The completion type item requires more writing time and the scoring may not be completely objective. The matching type is relatively limited in its application and requires much caution in the avoidance of irrelevant clues and implausible alternatives.

Writers in the field of educational measurement are in general agreement that the multiple-choice type is the most valuable and most generally applicable of the various test forms. Baron (7, p. 209)

indicates

... the multiple-choice item possesses several advantages. The number of alternate responses reduces the chances of guessing more than is the case with the true-false or matching type of question; the listing of plausible answers stimulates thinking; the limitation of possible answers eliminates ambiguity in scoring; and the technique of scoring is not complicated.

Hawkes (33, p. 138) states that "it can be made particularly effective in requiring inferential reasoning, reasoned understanding, or sound judgement and discrimination on the part of the pupil; it is definitely superior to other types for these purposes." There seems to be considerable evidence to show that carefully constructed multiple-choice tests can adequately measure the understanding of complex principles, the ability to draw conclusions, and the ability to make inference from one set of facts to another.

The form of the test items once determined, a study of variations of the multiple-choice type was made and a set of specifications adopted to guide the construction of the test items (24, p. 1-43). This guide was used as the source of criteria for the acceptance or rejection of each item as the test items were being assembled.

### Preparation of the Preliminary Tests

A schedule of test development was set up which called for the development of 390 multiple-choice type items relating to the eleven topic areas in General Hygiene. Each item was carefully constructed



according to the table of specifications previously mentioned. Each topic area was also considered in the light of Bloom's (9, p. 1-207) taxonomy, which illustrated ways of testing for important kinds of objectives. After the 390 multiple-choice items in the field of General Hygiene had been constructed, they were distributed among the eleven topic areas in accordance with the average emphasis given to each topic by the textbooks, tests, course, and health educators, allowing equal weight to each of these four determining factors. The percentage of weight for each topic area is indicated in Table V. Multiple-choice items employing the use of five distractors were adopted.

In the development of a valid test the procedure followed was to (a) mimeograph test items and submit them to the subject matter experts for the criticisms of test; (b) revise test items on the basis of criticisms received from the experts; (c) prepare three balanced trial forms, and apply each to over a thousand freshman college students at the close of their hygiene course taking into consideration any ambiguities or other difficulties brought to light by students taking the test; (d) analyze the trial results with complete item and distractor analysis, to determine the power of discrimination and the difficulty of each item; (e) construct the final test with 100 items carefully selected from the best of those proved by the trials listed above; (f) apply this test to more than 1000 freshman college students at the close of their hygiene course to establish correlations for validity and reliability.

After consultation with Oregon State University professors in the field of Health Education, a jury representing geographical areas and health departments throughout the nation was selected to review and criticize the preliminary forms. A letter (see Appendix I) was drafted and sent to all jury members asking them to serve in this capacity. A list of those granting their permission to serve will be found in Appendix I of this study. The jury was composed of 16 members from eight different states and nine different colleges and universities.

Each of the multiple-choice items had been formulated and placed on a 3x5 card. These items after purification and placement in the eleven topic areas were mimeographed and sent to the jury with the following instructions.

This is in regard to the list of multiple-choice questions which you kindly consented to judge in connection with the construction of a college health knowledge test. These items have been constructed on the following basis:

A detailed analysis has been made of authoritative statements, published texts, six standard textbooks, and recommendations from a representative group of health educators. General and specific objectives were then formulated in the eleven topic areas selected as a result of the above evaluation. The 390 test items were then constructed to meet these objectives. The following is a list of suggested criteria to use in making your evaluation. Directions for scoring and an example of scoring is also illustrated.

## CRITERIA FOR EVALUATING ITEMS

1. Does the item present a single definite problem in the stem of the question with consistent answer choices?
2. Are the foils and true answer sufficiently discriminating?
3. Is it a valid item, clear and understandable?
4. Will it differentiate between those who are knowledgeable and those who have misconceptions and misinformation?
5. Do the answers follow a random pattern?
6. Is the wording as concise as possible without failing to explain each important point clearly?
7. Are all distractors plausible?

### INSTRUCTIONS:

Judge each item in accordance with a three-point scale and check (✓) your choice. If you feel the item is:

superior -- check #1.  
average -- check #2.  
inferior -- check #3.

### EXAMPLE:

1	2	3
---	---	---

A meaningless action we feel compelled to carry out is called:

- (A) an obsession
- \* (B) a compulsion
- (C) a psychosis
- (D) a phobia
- (E) a conflict

\*(the answers to all questions were starred with an asterisk)

It is interesting to note that every member of the jury, recognizing the importance of the study, promptly returned the rating sheets and most of the jury made valuable suggestions in reference to various individual multiple-choice items. Each individual multiple-choice item rating score that had been provided by the jury was then tabulated on an accounting sheet. Each of the 390 multiple-choice items had been set up for a rating on a three-point scale as follows: superior, average, inferior. Weights were assigned to each of these three categories respectively as follows: 1, 2, 3.

It should be noted that the lower weights have been assigned to the categories considered most desirable, whereas the undesirable category has been assigned a weighting of 3. Given the weights indicated, it became possible to compute the mean rating, hereafter called the composite mean, achieved by each multiple-choice item. To illustrate the computation of these individual items, the values given by each member of the jury for Item 29 (Table VI, p. 51) were 1, 1, 1, 1, 2, 2, 3, 1, 2, 2, 3, 1, 1, 1, 2, 1. The sum of these ratings were 25, this number divided by the number of ratees, 16, gave a composite mean for Item 29 of 1.56.

It should be recalled that the ratings have a possible range from 1.00 to 3.00. The lower the rating the better the item in the judgement of the jury. These ratings will be referred to later in this study as one of the criteria to be used in choosing multiple-choice items for the

Table VI. Means of the Multiple-Choice Items According to the Ratings by the Jury.

Item	Composite Mean	Item	Composite Mean	Item	Composite Mean
1	2.00	41	1.90	81	1.63
2	1.72	42	1.72	82	2.54
3	1.81	43	1.63	83	2.45
4	2.00	44	1.72	84	1.90
5	1.81	45	2.00	85	2.09
6	2.09	46	2.27	86	1.90
7	2.27	47	1.90	87	1.45
8	2.09	48	2.00	88	1.90
9	2.36	49	1.81	89	2.00
10	2.09	50	1.09	90	1.54
11	1.81	51	1.72	91	1.63
12	1.72	52	1.54	92	1.45
13	1.90	53	1.63	93	2.00
14	1.63	54	1.72	94	1.63
15	1.45	55	1.63	95	1.90
16	1.72	56	1.63	96	1.81
17	2.00	57	1.71	97	1.72
18	2.09	58	2.09	98	1.72
19	2.36	59	1.63	99	1.90
20	1.90	60	2.00	100	1.54
21	1.63	61	1.90	101	1.72
22	2.18	62	1.81	102	2.18
23	1.36	63	1.81	103	1.36
24	1.90	64	1.81	104	1.18
25	1.81	65	1.71	105	1.90
26	1.45	66	2.00	106	1.81
27	1.36	67	1.81	107	1.54
28	1.72	68	2.00	108	1.63
29	1.56	69	2.00	109	1.90
30	1.90	70	1.54	110	2.09
31	1.72	71	1.63	111	1.63
32	1.63	72	1.63	112	1.63
33	1.27	73	1.90	113	1.54
34	1.18	74	1.81	114	1.81
35	1.54	75	1.54	115	1.81
36	1.36	76	2.09	116	2.45
37	1.54	77	2.36	117	1.27
38	1.63	78	2.18	118	1.63
39	1.72	79	2.09	119	2.09
40	1.72	80	1.72	120	1.63

Table VI. (Continued).

Item	Composite Mean	Item	Composite Mean	Item	Composite Mean
121	2.18	166	2.00	211	1.45
122	1.72	167	1.54	212	1.90
123	1.54	168	1.81	213	1.90
124	1.63	169	1.81	214	1.81
125	1.54	170	1.72	215	2.36
126	2.09	171	1.90	216	2.18
127	1.54	172	2.27	217	1.63
128	2.45	173	1.90	218	1.81
129	1.81	174	1.72	219	1.90
130	1.81	175	1.90	220	1.81
131	2.36	176	2.18	221	2.00
132	2.00	177	2.45	222	1.90
133	1.90	178	2.63	223	1.63
134	1.72	179	2.18	224	1.54
135	1.72	180	1.81	225	1.63
136	2.00	181	1.90	226	1.63
137	1.81	182	2.27	227	1.81
138	2.18	183	2.09	228	1.72
139	2.09	184	1.63	229	1.72
140	1.63	185	1.63	230	1.54
141	1.63	186	2.09	231	1.54
142	1.54	187	2.00	232	1.54
143	1.72	188	2.00	233	1.63
144	2.18	189	1.72	234	1.36
145	1.54	190	2.00	235	1.72
146	2.00	191	1.63	236	2.09
147	1.81	192	1.72	237	1.72
148	2.27	193	2.00	238	2.09
149	1.72	194	2.09	239	1.72
150	2.00	195	2.18	240	2.00
151	2.09	196	2.27	241	1.63
152	2.27	197	1.72	242	1.63
153	1.81	198	2.00	243	1.63
154	1.81	199	2.00	244	1.72
155	2.36	200	1.81	245	1.72
156	2.00	201	1.90	246	1.81
157	1.54	202	1.81	247	2.18
158	1.54	203	1.71	248	1.63
159	1.90	204	2.00	249	1.90
160	2.09	205	1.90	250	2.00
161	1.90	206	1.63	251	1.72
162	2.88	207	1.72	252	2.36
163	2.18	208	1.63	253	2.27
164	1.81	209	1.63	254	1.63
165	2.00	210	1.81	255	1.72

Table VI. (Continued).

Item	Composite Mean	Item	Composite Mean	Item	Composite Mean
256	2.36	301	1.45	346	1.81
257	1.72	302	1.63	347	1.90
258	1.63	303	2.45	348	1.45
259	1.45	304	1.72	349	2.09
260	1.81	305	1.81	350	1.90
261	1.81	306	1.72	351	1.54
262	2.45	307	1.90	352	1.72
263	1.54	308	1.54	353	1.72
264	1.72	309	1.36	354	1.90
265	2.00	310	1.72	355	2.09
266	2.00	311	1.90	356	1.63
267	1.54	312	2.00	357	2.09
268	1.81	313	1.72	358	2.09
269	2.27	314	1.81	359	1.63
270	1.90	315	1.63	360	1.81
271	2.00	316	1.90	361	1.90
272	2.18	317	1.81	362	2.45
273	2.00	318	1.54	363	2.09
274	1.81	319	1.72	364	1.45
275	1.90	320	1.63	365	1.63
276	1.63	321	1.90	366	2.00
277	1.90	322	1.72	367	1.63
278	2.09	323	2.00	368	1.45
279	1.54	324	2.00	369	2.00
280	1.54	325	1.90	370	2.45
281	1.72	326	1.72	371	2.00
282	1.90	327	1.63	372	2.00
283	1.54	328	2.00	373	1.72
284	1.54	329	2.00	374	2.45
285	2.00	330	1.90	375	2.00
286	2.00	331	1.90	376	1.45
287	1.72	332	1.63	377	1.45
288	2.18	333	1.81	378	2.45
289	1.72	334	2.45	379	1.63
290	1.36	335	2.72	380	1.63
291	1.54	336	1.63	381	1.45
292	1.45	337	1.81	382	1.63
293	1.81	338	2.00	383	2.45
294	1.81	339	2.27	384	2.00
295	2.27	340	1.72	385	2.00
296	1.90	341	2.36	386	1.45
297	1.45	342	2.09	387	1.72
298	1.45	343	2.00	388	2.00
299	1.63	344	1.90	389	2.00
300	1.81	345	1.63	390	2.45

final 100 item test to be constructed as a part of this study. Table VI is a listing of each multiple-choice item by number consecutively and the composite mean arrived at as a result of the jury's rating.

In tabulating the judge's rating the following policies adapted from Ellis (25, p. 103) were used as general guidelines for this study:

1. If the wording of an item is changed either by rewording or qualification, but its original idea is not altered, the item is tabulated as if its original wording were unchanged.
2. If the corrections or qualifications made by the judge changed the essential meaning of the item, the rating assigned to it by the judge was not tabulated.
3. If a part of the questionnaire was marked and the remainder left blank, those ratings in the portion which had been judged were tabulated.

#### Revision of Test Items and Placement into Three Balanced Trial Forms

As a result of the suggestions that were offered by members of the jury as they rated each individual multiple-choice item, it was felt necessary to revise some of the items. For a test to have relevance to education, before writing a single question, the goals of instruction that are most important to be measured must be taken into consideration. The preparation of written objectives (see page 35) is the usual procedure. Without such forethought, a test might measure very precisely some very unimportant things.

If tests are to be educationally useful, the test question must



demand more from the student than rote recall. The preparation of written test specifications gives an author the opportunity to identify knowledge and skills that the test questions ought to measure.

The actual development of the test questions is a crucial, arduous process. It is crucial because lofty objectives are meaningless if the questions do not require the student to demonstrate attainment of those objectives. It is arduous because of the several important steps that must be completed in the writing of the questions.

A well-conceived and constructed multiple-choice question should require a student to select, weigh, and apply what he knows to answer the question correctly. First, the author of a question must identify the skill or knowledge he wishes to measure. He must satisfy himself that, among the many questions that might be asked, a particular question is worth asking. Next he must devise a way of asking the question to insure that the correct answer is not identified in some superficial manner. Also, the author must word the question and the answer choices so that those who know what is being asked can answer correctly and those who are less knowing will, in effect, be defeated by their own ignorance.

The art of writing a multiple-choice question requires a knowledge of the subject and a knowledge of how the subject is taught at the educational level for which the question is intended. The writer of the question should be familiar not only with what students ought to have

learned, but also with what they they ought not to have learned. That is, he should be able to construct each question in such a way that students who have misinformation or misconceptions will be differentiated from those who are knowledgeable. Then each answer choice in a multiple-choice question will contribute to differentiating between competent and less-than-competent students. Taking all of this into account and considering the advice offered by the specialists who were acting as a jury, the 390 test items were reviewed and in some cases rewritten.

After passing the test of expert judgement, questions must then pass the test of use. If a test is to provide reliable measurement, possible sources of error are best identified and eliminated in advance. Therefore, whenever feasible, questions are tried out experimentally before inclusion in a final test.

Considerable valuable information, such as determining difficulty of a question, is derived from "pretesting": the higher the percentage correct the easier the question. Similarly, the attractiveness of each answer choice can be determined by the number of students who select it. It has been declared by Hawkes (33, p. 40) that, "the worth or effectiveness of a test item depends not only upon its desirability for inclusion in the curriculum and upon its difficulty, but also upon its power to discriminate between pupils of high and low levels of general achievement in the field involved." Thus a suitable

test item needs to possess not only curricular validity and appropriate difficulty, but also a validity for measurement purposes as determined by a satisfactory power of discrimination.

The discrimination power of an item signifies, according to Hawkes (33, p. 41), "the degree to which success or failure on that item by itself indicates possession of the ability which is being measured." An item has perfect discriminating power if every student who answers the item correctly ranks higher on the total achievement test than any student who fails on that item. An item is said to have zero discriminating power when there is no systematic difference between the test achievement of the students who respond correctly to that item and those who do not. An item may be said to have negative discriminating power if the students who answer it correctly rank lower on the total test than do those who miss the item.

The power of a question to differentiate among students of different academic abilities is a complex matter. To determine this, it is necessary to have for each student a measure of the ability that is being tested by the question. This measure serves as a criterion. Actually, the relation between students' success on a question and success on the entire test of which the question is a part, is an

appropriate measure of the capacity of the question to discriminate between the more able and less able students.

Since much of the power of a multiple-choice question depends on the nature of the answer choices, obtaining measures solely on the questions over-all performance is not sufficient. If the strengths and weaknesses of a question are to be diagnosed, knowledge of the performance of each of its strategic parts must be obtained. Therefore, for each question an analysis should be made of the ability of the group of students selecting each answer choice. In general, the more able students should select the correct response to a question, and, in general, those who are less able should more frequently find wrong answers attractive.

Jerome Bruner (12, p. 32) in the Process of Education would support the procedures herein discussed with this statement:

What is often overlooked, is that examinations can also be allies in the battle to improve curriculums and teaching. Whether an examination is of the objective type involving multiple-choice or of the essay type, it can be devised so as to emphasize an understanding of the broad principles of a subject. Indeed, even when one examines detailed knowledge, it can be done in such a way as to require understanding by the student of the connectedness between specific facts.

Statistically re-examining each item of a test for the purpose of discovering its strength and flaws is known as item analysis. Item analysis customarily concentrates on two vital features of each test

item; its level of difficulty and its discriminating power. By the former is meant the percentage of pupils who answer correctly each test item; by the latter is meant the ability of the test to differentiate between pupils who have achieved well and those who have achieved poorly. Item analysis is most useful when the test items are a part of a power test. It has been stated by Green (30, p. 80):

... The basic function of all measurement is to place individuals along a scale of ability or achievement in approximate accordance with their real differences in ability and achievement. Such a function implies discriminative power on the part of the test. Since tests are made up of separate items, it is clear that each item of a test must have this quality in a maximum degree if the total test is to possess it.

Item analysis data are useful in improving an instrument, in providing a basis for defining levels of performance or competence on a test, and in improving curriculum and instruction. Furst (29, p. 314) has this to say, "Item analysis contributes to the improvement of a test by providing data on effectiveness of individual items. These data help to identify items that should be revised or eliminated entirely from the test." Generally, such an item will be defective in one or more of the following respects: it is too easy or too difficult for the group; it is ambiguous in some ways; it contains a stereotype or cliché in the best answer, so that better students tend to avoid choosing it; it contains irrelevant clues to the best answer; it contains

elements of content that do not function. It seems then that each of the 390 multiple-choice items constructed must pass the test of use.

To perform item analysis and to determine difficulty level, it was necessary to test each of the items on a representative group. Because of the total number of questions, it was necessary to prepare three balanced trial forms with an equal number of questions allocated to each of the eleven topic areas. The number of preliminary forms necessary is determined by the number of items which should be set up for trial. This number is generally recommended as being 50 percent greater than that desired in the final form. It has been determined through experience that 100 items of multiple-choice type constitute a suitable length examination for the usual college period of 50 minutes. The construction of a test of this length then, should begin with at least 150 items to allow for the elimination of items found upon trial to be weak in some respect.

The writer wished to test as many items as feasible within this limitation. As a consequence, it was decided to set up three balanced forms of equal length with the multiple-choice items drawn from the pool of 390 items that had been constructed and purified for this purpose. Each of the multiple-choice items that had been allocated to each of the eleven topic areas were classified and ranked according to the jury's ratings. As an example, the topic area Heredity had been assigned five percent of the total test emphasis. Questions 41 to 61

in Table VI contain the ratings for the topic area Heredity. These items were ranked according to the ratings provided by the jury from most superior to most inferior. Then using a table of random numbers and the random selection process identified by Li (49, p. 150), each item consecutively was assigned to form A, then an item to form B, then an item to form C, and so on, until all the items in this topic area had been assigned. This same process was followed with all eleven topic areas until three forms of equal length and approximate difficulty were assembled. Together the three forms contained 390 items, a margin of 290 percent over the expected length of the final form.

#### Tryout of Items and Statistical Analysis

The next step in test construction is to administer the whole item pool to groups of subjects. In this case where the item pool was large, it was necessary to give form A of the balanced form to one group, form B to another group, and form C to another group. The groups selected however were from the same population and homogeneous in every way. After contacting Dr. C. L. Anderson, Chairman of the Department of Hygiene and Environmental Sanitation at Oregon State University, it was found possible to administer the three balanced trial forms as a final examination to all sections of General Hygiene, P. E. 160, fall quarter 1964.

It was essential that relatively large numbers of individuals try each item. Nunnally (56, p. 144) indicated, "If there are fewer than 100 persons, only a limited amount of information can be obtained from the tryout. In order for the results of the tryout to be acceptably stable, as many as 300 subjects should be obtained, and the use of 1000 subjects is not unusual." It might also be pointed out that by using the balanced trial forms as a final examination in a regular credit course it gives each respondent a built in intrinsic motivation to do as well as possible creating an exceptionally valid situation for the tryout of the items.

During the fall quarter of 1964 there was a total of 834 students available and registered for credit in General Hygiene at Oregon State University. This was an extremely adequate sample as was pointed out by Nunnally (56, p. 144), that the sample size plays an important role in statistical methods. Li (49, p. 211) also makes this point in his discussion on the subject. It seems to be obvious that in a situation such as this the larger the sample size, the more accurate the result.

Two types of errors are involved in testing any statistical hypothesis. The increase in accuracy of a test always means the reduction of the probability of committing one or both types of error. The probability of committing a type I error, rejecting a true hypothesis, is called the level of significance which may be fixed as large or small



as one wishes regardless of the sample size. The advantage of having a large sample is to reduce the probability of committing a type II error, accepting a false hypothesis, after the significance level is fixed. Thus a large sample is more likely to cause rejection of a false hypothesis than a small sample. This is the advantage of having a large sample in a test of statistical hypothesis. With this in mind the total number, 834 students, the three balanced forms were administered to them as a final examination in General Hygiene. Here again, the balanced trial form A, B or C, was assigned to each particular section by a random process.

In order to perform to the best of his ability, the pupil writing the test must be completely oriented with respect to the test. Precisely stated, he must know the directions well and must be thoroughly familiar with the mechanics of it. To accomplish this the administrator of the test either reads the directions to the students or the student reads the directions himself before he responds to any item on the test. All instructions were standardized and an effort was made to test all subjects under uniform conditions. The following instructions were given:

DO NOT WRITE ON THIS TEST: Please read all instructions carefully before beginning.

FOLLOW THE INSTRUCTIONS IN THE ORDER IN WHICH THEY ARE GIVEN.

1. On the answer sheet, write your name, grade or class (i.e. freshman, sophomore, etc.), your instructor's name, number of the viewing room if you are in a TV section, and the number of your exam questions as shown in the upper right corner of this page.
2. MARK ONLY ON THE ANSWER SHEET. Be sure your marks are heavy and black. Erase completely any answer you wish to change. There will be no correction for guessing, if you do not know the answer you are encouraged to guess.
3. This test is composed of MULTIPLE-CHOICE items. You have a selection of one best answer from five choices. Choose the response that is most correct and then mark the response you chose in the appropriate space on your answer sheet for each question.
4. This is not a speeded test. If you work at an average rate you should have sufficient time to complete it. We encourage you to complete all of the questions.
5. Upon completion of the test, you must: return the original test, the answer sheet with all spaces filled in properly, and the marking pencil to your instructor.
6. You may now begin.

As this was not a speeded test, sufficient time for all students to finish the exam was given. The use of an answer sheet was required to make machine tabulation a possibility. All test forms were machine scored and tabulated on an International Test Scoring Machine and an International Business Machine Fortran #1410.

The method used in determining the discrimination values of the individual test item is a modification of that used by Casanova and Cureton (15, p. 289). This procedure breaks down into the following

main steps:

1. Determine the basis of comparison.
2. Choose a representative sample of papers.
3. Divide into comparison groups.
4. Obtain an item count for each group.
5. Convert the frequency data into the desired index.

Determining the basis of comparison: For this analysis the papers were grouped according to the total test score. This is an internal criterion. When the total test scores are used in this way, we assume that those who get the high scores are the "best" students and that those who get low scores are the "poor" students.

Choosing a representative sample of papers: Because the test was given to all students in P. E. 160, General Hygiene, it was necessary first to sort out only those students who were freshmen. This was done because the test to be constructed as a part of this study will be designed only for freshman college students in the field of General Hygiene.

Dividing into comparison groups: Working only with the sample of answer sheets drawn from the total group, it was then necessary to separate the answer sheets themselves into subgroups. This was done by using the procedure validated by Kelley (42, p. 17), where the procedure is to rank the answer sheets in order of total score and then to

select the upper and lower 27 percent which yields the optimum proportions with which to work.

Obtain an item count for each group: The purpose of this step is to get a count of the number of individuals in each comparison group who chose each alternative in each item. This would include the incorrect alternative as well as those keyed as correct or best. This process was accomplished in this study by machine tabulation.

Convert the frequency data into the desired index: This operation was completed by the Statistical Department at Oregon State University based on the following formula (15, p. 289):

$$CR = \frac{P_1 - P_2}{\frac{P_1 Q_1}{N_1} + \frac{P_2 Q_2}{N_2}} = \frac{\frac{F_1}{N_2} - \frac{F_2}{N_2}}{\frac{F_1(1 - \frac{F_1}{N_1})}{N_1^2} + \frac{F_2(1 - \frac{F_2}{N_2})}{N_2^2}}$$

where CR = Critical Ratio.

$P_1$  = Proportion succeeding in the upper group.

$P_2$  = Proportion succeeding in the lower group.

$Q_1$  = Proportion failing in the upper group.

$Q_2$  = Proportion failing in the lower group.

$F_1$  = Number succeeding in the upper group.

$F_2$  = Number succeeding in the lower group.

$N_1$  = Number of cases in the upper group.

$N_2$  = Number of cases in the lower group.

This particular approach not only gives a critical ratio for the test constructor to work with that is mathematical in nature, but it also allows for a visual inspection by the use of integers every item and every foil of every item. It might be well to mention that this modified approach has been programmed and adopted for future use of purification of test items by the Statistical Laboratory at Oregon State University. The following is an example of the kind of data that resulted from the item analysis procedure.

Item	Group	No.	Foil Frequency					T. Fail	Succd.	Cr.
			1	2	3	4	5			
180	High	40	0	0	2	0	1	3	37	6.061
	Low	40	14	0	6	6	1	27	13	

The item analyzed which eventually became item number 62 on the final test was:

62. Amino acids are found in:

- |                  |                   |
|------------------|-------------------|
| 1. carbohydrates | 4. minerals       |
| * 2. proteins    | 5. fats           |
| 3. vitamins      | *(correct answer) |

Item number 180 on the trial balanced form "C" which eventually became item number 62 on the final test form is illustrated above. The high 27 percent group had 40 students and the low 27 percent had 40 students. There were four foils or distractors and one correct answer in this multiple choice item as there were in all the items. In

this case 14 of the low group chose foil number one. None of the high group chose foil number one. Foil number two was chosen by 37 of the high group and 13 of the low group; this was the correct answer. Foil number three was chosen by 2 of the high group and 6 of the low group. Foil number four was chosen by none of the high group and by 6 of the low group. Foil number five was chosen by 1 of the high group and by 1 of the low group.

In analyzing the foil, or distractor choices, it can be readily recognized that all foils were attractive to the low group. This is an indication of a good item. Foil number one was most attractive to the low group with foil number two, the correct answer, being the next most popular choice by the low group. Foils number three and four were of equal distractor value attracting 6 each of the low group. Foil number five was least attractive to both groups with 1 each in both high and low. It is significant to point out that this item met many of the qualifications of a good multiple-choice item. All foils were attracted by the low group indicating good foil or distractor arrangement. The total number failed in the high group was 3 whereas 37 of them succeeded. The total number who failed in the low group was 27 whereas 13 of them succeeded. This item according to our formula yielded a critical ratio of 6.061.

It is interesting to note that this same item number 112 as rated by the jury yielded a composite rating of 1.63, one of the better ratings

indicating a superior item. The inherent value of this approach to item analysis is the visual as well as mathematical approach. The difficulty level can readily be determined by inspecting the number failing or succeeding in the high group as to those failing or succeeding in the low group. All of the 390 multiple-choice items were analyzed using this method. Table VII contains all of the critical ratios for the 390 multiple-choice items.

#### Selection of Final 100 Multiple-Choice Items for General Hygiene Test

After each of the 390 multiple-choice items for General Hygiene had been constructed, judged, purified, and analyzed, it was possible to make a selection of 100 items allocated to the eleven topic areas for a final form of a test in General Hygiene. The percentage of emphasis for each topic area was determined and is found in Table VIII on page 73.

Degree of difficulty. A test that is to discriminate effectively between students at the various levels of achievement in any group must contain items of all degrees of difficulty for that group. Some items should be so difficult as to be missed by all students of low and moderate achievement; such items will be useless for discriminating between students at these lower levels of achievement. These difficult items are necessary, however, to discriminate between those students of good and high achievement. Similarly, some items should be so

Table VII. Critical Ratios of the 390 Multiple-Choice Items.

Item	Critical Ratio	Item	Critical Ratio	Item	Critical Ratio
1	1.955	44	1.048	87	.000
2	3.638	45	2.102	88	1.661
3	.191	46	2.345	89	.252
4	3.019	47	2.553	90	1.187
5	.576	48	4.188	91	6.008
6	3.019	49	.901	92	.993
7	4.270	50	2.076	93	4.862
8	1.483	51	3.261	94	1.587
9	1.987	52	2.742	95	4.158
10	3.280	53	2.973	96	2.799
11	1.563	54	.000	97	.878
12	1.392	55	1.822	98	1.065
13	3.821	56	2.087	99	1.401
14	3.261	57	2.253	100	1.337
15	1.939	58	3.908	101	.000
16	2.146	59	1.401	102	.793
17	5.269	60	2.516	103	4.698
18	1.736	61	1.642	104	3.477
19	3.211	62	6.532	105	1.268
20	2.395	63	1.548	106	2.595
21	1.542	64	.990	107	3.052
22	6.277	65	.967	108	2.442
23	6.242	66	2.026	109	2.146
24	.197	67	4.600	110	1.939
25	5.392	68	5.271	111	1.001
26	3.580	69	3.733	112	6.866
27	1.820	70	4.336	113	3.821
28	4.267	71	.836	114	.458
29	3.269	72	.000	115	4.806
30	1.530	73	2.503	116	4.564
31	3.872	74	1.763	117	2.447
32	2.253	75	5.804	118	2.649
33	3.688	76	2.713	119	1.227
34	2.442	77	.804	120	4.336
35	.827	78	3.935	121	2.122
36	4.060	79	2.597	122	1.958
37	2.580	80	4.915	123	1.594
38	1.701	81	4.346	124	1.804
39	1.009	82	4.600	125	4.095
40	.878	83	.381	126	3.592
41	4.585	84	3.836	127	3.302
42	1.980	85	.000	128	.678
43	2.658	86	1.604	129	.273



Table VII. (Continued).

Item	Critical Ratio	Item	Critical Ratio	Item	Critical Ratio
130	5.437	174	2.942	218	.560
131	.224	175	5.393	219	2.000
132	.478	176	1.402	220	1.888
133	2.848	177	2.864	221	3.863
134	2.609	178	2.066	222	3.164
135	1.594	179	1.729	223	3.164
136	1.363	180	6.061	224	3.651
137	.747	181	.672	225	2.428
138	3.091	182	2.942	226	.852
139	2.295	183	1.888	227	2.337
140	3.843	184	.589	228	4.933
141	4.095	185	1.187	229	6.829
142	2.852	186	1.537	230	6.434
143	.227	187	2.864	231	2.837
144	1.069	188	3.164	232	3.302
145	2.535	189	3.956	233	5.198
146	3.956	190	1.187	234	.979
147	3.192	191	4.128	235	3.630
148	.273	192	.928	236	.674
149	.478	193	1.363	237	2.295
150	.457	194	5.393	238	1.825
151	2.566	195	.000	239	4.624
152	2.321	196	4.640	240	1.450
153	1.424	197	3.467	241	.457
154	3.212	198	1.264	242	3.032
155	2.535	199	.683	243	.000
156	2.055	200	2.390	244	.593
157	2.349	201	.501	245	3.875
158	.227	202	2.099	246	1.641
159	.000	203	3.442	247	2.014
160	1.283	204	2.566	248	3.371
161	1.729	205	5.198	249	2.880
162	3.164	206	1.144	250	.916
163	3.651	207	.488	251	4.155
164	3.023	208	1.402	252	1.427
165	3.695	209	2.000	253	.443
166	2.309	210	3.053	254	.443
167	4.572	211	1.719	255	3.381
168	2.237	212	1.382	256	4.485
169	.448	213	2.963	257	3.143
170	.517	214	2.439	258	6.049
171	2.609	215	2.057	259	5.230
172	2.806	216	.747	260	2.218
173	3.192	217	1.590	261	1.008

Table VII. (Continued).

Item	Critical Ratio	Item	Critical Ratio	Item	Critical Ratio
262	2.513	305	3.038	348	1.116
263	3.872	306	4.845	349	2.513
264	2.302	307	4.360	350	5.998
265	.000	308	.889	351	.640
266	3.676	309	.231	352	5.216
267	2.241	310	3.879	353	4.776
268	4.666	311	4.037	354	3.371
269	.752	312	.955	355	6.766
270	2.470	313	1.695	356	2.201
271	4.553	314	1.330	357	1.701
272	.916	315	1.734	358	5.537
273	.389	316	.457	359	3.879
274	2.348	317	1.727	360	4.776
275	4.878	318	1.695	361	1.381
276	3.588	319	1.381	362	1.851
277	2.241	320	1.168	363	.585
278	3.963	321	.365	364	3.381
279	5.520	322	3.295	365	3.436
280	.366	323	3.523	366	1.777
281	1.175	324	2.186	367	2.538
282	4.560	325	5.425	368	.000
283	.379	326	3.331	369	.250
284	3.464	327	2.025	370	1.777
285	3.038	328	1.664	371	5.704
286	3.816	329	3.638	372	1.394
287	5.846	330	1.208	373	1.008
288	2.862	331	2.302	374	2.241
289	1.832	332	2.723	375	4.207
290	.604	333	3.322	376	1.979
291	4.070	334	5.669	377	.000
292	.000	335	3.264	378	1.858
293	3.950	336	.000	379	4.154
294	3.872	337	4.997	380	5.222
295	4.020	338	5.401	381	2.070
296	3.867	339	1.357	382	4.196
297	.366	340	1.116	383	2.093
298	2.460	341	3.797	384	4.037
299	6.227	342	3.610	385	3.464
300	2.630	343	5.299	386	1.021
301	1.208	344	2.346	387	.213
302	4.282	345	3.230	388	1.477
303	.000	346	1.701	389	.457
304	6.852	347	5.585	390	2.540

easy that only the most inferior students will miss them. These are of no value for ranking the good students, but are necessary for discriminating between the poor students.

The difficulty of a test, according to Hawkes (33, p. 33), should be adjusted "so that the highest score made will be near but not at the highest possible score, and the lowest score made will be near but not at zero. The full range of possible scores should be actually utilized if the test is to have the maximum discriminatory value. "

Test authorities, although recognizing that test items should be distributed along the entire difficulty scale, are not agreed upon what the best form of distribution of item difficulty is. That is, some recommend an equal proportion of items at each difficulty level; others favor using relatively few very easy or very difficult items, with most items toward the middle level of difficulty. There is general agreement, however, according to Hawkes (33, p. 32) that, "there should be a range in difficulty from about 5 to 20 percent, up to 80 to 95 percent, and that the average difficulty of all items should be about 50 percent. "

Nunnally (56, p. 146) indicates:

... a good general procedure is to choose approximately an equal number of items at each difficulty level in the possible score range. That is, if a 40-item test is being constructed with five alternatives for each item, the procedure would be to choose five items with difficulties between 20 and 30 percent, five items with difficulties between 30 and 40 percent, and so on to five items with difficulties between 90 and 100 percent.

Ahman and Glock (1, p. 195) suggest the use of one or two test items to which 100 percent had responded correctly would be to place them at the beginning of the test, thereby letting them serve as a gentle introduction to the remainder of the test.

Using the item analysis data and referring to the composite mean rating of each item in all of the eleven topic areas, items were selected for the final 100 item test. The critical ratio for each of the 100 selected items, in consecutive order for all the eleven areas of General Hygiene, are presented in Table VIII.

The procedure proposed by Hawkes (33, p. 32) and described on page 35 was chosen as a design for determining difficulty level, with the addition of the suggestion by Ahman and Glock (1, p. 195) where a few items of relatively low difficulty were placed at the beginning of the test. Items were distributed along the entire difficulty scale, with representation in every decile, including five items at each extreme. The overall mean difficulty level was at the 44 percent level. By excluding the five ordered items, three of low difficulty level placed at the beginning of the test and two of exceedingly high difficulty level placed within the body of the test, the mean difficulty level falls exactly at the 50 percent difficulty level which complies precisely with the standard suggested by the authorities quoted on previous pages. The range of difficulty level ranged from .000 to 6.866 dispersed throughout the eleven topic areas.

Table VIII. Critical Ratio Data for the 100 Items Selected for the Final General Hygiene Test.

Topic Area (numbers are assigned according to placement in the final test)	Critical Ratio
Introduction, the Student and his Health	
3	.000
6	.000
13	1.227
99	1.701
25	2.349
74	5.393
Heredity	
51	1.719
98	2.295
28	3.638
76	3.649
100	5.392
Personal Health	
6	.609
30	1.695
82	1.888
92	2.390
41	2.740
86	4.267
25	.458
81	.878
54	1.144
89	1.537
44	1.729
87	2.447
94	2.186
65	3.023
23	2.649
36	3.843
29	4.600
26	4.585
70	5.520
77	6.008
62	6.061

Table VIII. (Continued).

Topic Area	Critical Ratio
Exercise, Rest and Fatigue	
61	.585
11	.901
67	1.825
75	2.241
35	2.538
24	3.381
48	3.019
31	3.381
63	4.666
73	4.862
Safety	
68	.916
57	1.979
93	2.076
52	3.091
14	3.588
56	4.207
Substances Harmful to Health	
12	1.116
97	1.394
72	1.804
64	2.609
22	3.523
69	4.095
40	4.845
Normal Mental, Emotional and Social Health	
10	1.777
19	1.822
34	1.858
59	2.000
46	2.036
84	2.253
27	3.816
42	3.732
15	3.863
55	4.564

Table VIII. (Continued)

Topic Area	Critical Ratio
Normal Mental, Emotional and Social Health (cont.)	
60	4.154
38	5.222
37	6.766
Preparation for Family Living	
5	.000
17	.836
39	1.021
90	1.208
9	2.014
7	2.057
21	2.070
50	2.309
43	2.742
96	2.864
32	3.442
66	3.464
53	3.651
79	4.346
Prevention of Disease and Disorders	
4	.224
78	.916
18	.478
16	1.427
8	2.442
91	2.503
71	2.609
20	3.143
83	3.212
58	3.230
95	3.302
80	3.610
88	3.875
Consumer Health	
45	.000
49	1.009
47	3.331
85	3.688
33	3.879

The placement of items in the test was completed by using the Li (49, p. 569) table of random numbers for the selection of all items but the ordered items intentionally placed at the beginning of the test, thereby letting these ordered items serve as a gentle introduction to the remainder of the test. A copy of the completed test will be found in Appendix I. Table IX shows the position of items for each area, as found in the final test, and the percentage each area is of the total.

Table IX indicates the number of items falling into each of the eleven topic areas in the final General Hygiene test and the percentage of emphasis in each area. As this test will be used to evaluate television and lecture teaching procedures at Oregon State University, it was felt desirable to do a verification study on the text that is currently in use at this institution. The text currently being used in the course P.E. 160, General Hygiene, at Oregon State University is Health Principles and Practice by C. L. Anderson and C. V. Langton, 4th edition (6, p. 1-460). It was felt a documentation of each item used in the test would aid in establishing content validity when identified with content in the text currently being used. This effort also led to the verification of the key (See Appendix I) constructed for use with the final test. Table X identifies page numbers associated with each of the items in the test.



Table IX. Position of Items for Each Area, as Found in Final Test, and the Percentage Each Area Is of the Total.

Area	Items	Percent of total
Introduction - the Student and his Health	1, 3, 13, 25, 74, 99	6.0
Heredity	28, 51, 76, 98, 100	5.0
Personal Health	6, 30, 41, 82, 86, 92	6.0
Nutrition	2, 23, 26, 29, 36, 44, 54, 62, 65, 70, 77, 81, 87, 89, 94	15.0
Exercise, Rest and Fatigue	11, 24, 31, 35, 48, 61, 63, 67, 73, 75	10.0
Safety	14, 52, 56, 57, 68, 93	6.0
Substances Harmful to Health	12, 22, 40, 64, 69, 72, 97	7.0
Normal Mental, Emotional and Social Health	10, 15, 19, 27, 34, 37, 38, 42, 46, 55, 59, 60, 84	13.0
Preparation for Family Living	5, 7, 9, 17, 21, 32, 39, 43, 50, 53, 66, 79, 90, 96	14.0
Prevention of Disease and Disorders	4, 8, 16, 18, 20, 58, 71, 78, 80, 83, 88, 91, 95	13.0
Consumer Health	33, 45, 47, 49, 85	5.0

Table X. Content Validity Documentation Using C. L. Anderson and C. V. Langton Text - Health Principles and Practices, 4th Edition by Page Number.

Item	Page Numbers	Item	Page Numbers	Item	Page Numbers
1	42, 101	34	259	67	177
2	167	35	181, 184, 185	68	196
3	1, 29, 67	36	362	69	227, 228
4	106, 131, 360	37	144, 145	70	157, 159
5	316, 317	38	269	71	122
6	302, 303	39	304	72	231, 232, 233
7	316, 317	40	223, 224	73	47
8	42, 360	41	126	74	24
9	315, 318	42	265	75	147, 148, 149
10	269, 272	43	283, 302	76	81, 82
11	101, 174	44	162	77	156, 157
12	234, 237	45	337, 338	78	353
13	143, 101, 174	46	284	79	296, 299
14	209, 211	47	359, 360	80	364
15	71, 95	48	181	81	145
16	43, 363	49	19, 20	82	199, 120
17	304	50	293	83	42, 360, 362
18	53, 92, 324, 363	51	75	84	272
19	260, 273	52	196, 197	85	131
20	351	53	317	86	105, 106
21	301, 321	54	375	87	156
22	234, 235	55	263	88	106
23	141	56	195	89	153, 154
24	143	57	192, 196, 210	90	303, 305
25	38	58	51, 328, 365	91	224
26	155, 156, 157	59	264	92	136
27	260, 261	60	269, 270, 271	93	195
28	75, 85	61	174, 176	94	92
29	252	62	153, 154	95	329, 330, 331
30	260, 269	63	174, 175	96	292
31	173	64	241	97	248
32	301	65	149, 150	98	89
33	80	66	307, 308, 309	99	42, 360
				100	75

### Determination of Validity and Reliability

The concept of validity refers to the extent to which a test measures what it is supposed to measure with respect to the group for which it is intended. As Wood (76, p. 17) states, "the basic question of validity in a test is always the extent to which the test serves its purposes." The validity of the health knowledge test in this study has been provided for in three ways: (a) by the manner in which the test was initially set up, (b) by the development of test items of demonstrated worth, and (c) by comparison with an outside criterion.

#### Curricular Validity

This type of validity refers to the extent to which the content of the test is representative of the content of the course or subject. Curricular validity of the test was guaranteed by the procedure in which its scope, content and emphasis were determined, which included (a) a study of the statements of nationally recognized organizations and authorities; (b) detailed analysis of current textbooks in the subject area; (c) analysis of published tests; and (d) applying the pooled judgement of a group of college health educators and specialists related to educational measurement. Such validity was further enhanced by application of the test to over 834 college freshmen students

with criticisms by instructors and students. An attempt was made, in the construction and selection of test items, to meet the modern educational objective of social utility, by providing items of functional value, related to recognized needs, and which draw upon the higher mental processes of judgement and discrimination, rather than upon mere possession of information.

### Item Validity

The initial trial forms of the test were composed of items which, for the most part, in some form had survived trial and revision. The validity of the items selected, for use in a modern test, was further improved by requiring that each item (a) pass the scrutiny of a "jury" of health educators and subject matter specialists, (b) survive trial and revision, (c) demonstrate suitable difficulty and discrimination value. Item validity is assured with a mean discrimination value of 31 percent and the over-all mean discrimination value in this test was at the 44 percent level, and with the five ordered items removed fell at the 50 percent level.

### Statistical Validity of Whole Test

Test scores made by 100 students, a ten percent sample of those taking the final test, were correlated with final grades received from their instructors for the entire course. All of the students were listed

alphabetically and every tenth student selected for the sample. A correlation of .80 was found to exist between test scores and final grades in the course. The results obtained from the analyzed sample show there is a strong positive correlation between scores on the final test and teachers' grades in General Hygiene. Insofar as teacher grades are themselves valid measurements of achievement, the statistical validity of the health knowledge test is demonstrated. The data for the statistical calculations of the correlation coefficient are included in Table XVI in Appendix I.

The formula used for computation of the validity correlation coefficient was the Pearson Product-Moment correlation taken from Li's text (49, p. 301):

$$r = \frac{\Sigma (X - \bar{x}) (Y - \bar{y})}{\sqrt{\Sigma (X - \bar{x})^2 \Sigma (Y - \bar{y})^2}}$$

$$r = \frac{16843}{20982} = .80$$

where  $X$  = raw test score

$Y$  = raw final score for grade

$\bar{x}$  = deviation of test score from mean

$\bar{y}$  = deviation of final score from mean

### Reliability of the Test

The split-halves method was used to determine the reliability of the half test, then the Spearman-Brown Prophecy formula (29, p. 319) was applied to determine the reliability of the whole test. For each student in the sample group, his total score on the odd-numbered items, and his score of the even-numbered items were determined. These odd and even scores were assembled for the group, and a correlation run. The resultant coefficient was then corrected by the prophecy formula to give the coefficient of correlation for the full length test. This coefficient indicates the reliability of the test.

The calculation of reliability was applied to the same 100 group sample of students used in computing the statistical validity of the test and whose scores are listed in Appendix I. The coefficient of correlation for reliability for the whole test was .89. This is significantly higher than the reports of the reliability of most other published health knowledge tests. This reliability coefficient is satisfactory not only for the measurement of general group achievement, but according to Remmers and Gage (61, p. 207), it is probable that "tests with reliabilities as low as .85 are of distinct value for individual diagnosis."

### Summary

This chapter has been devoted to the development of a college health knowledge test. After a thorough review of the literature, it was felt that none of the presently available tests in personal hygiene was applicable nor suitable for the measurement necessary in this study. Therefore, it was deemed necessary to construct an adequate test in General Hygiene for the college freshmen level.

An early step in the construction of a test was the delimitation of its content. The scope and content of the area of personal hygiene was determined in three ways: (a) from the statements of nationally recognized organizations and authorities; (b) by analysis of current textbooks on the subject; (c) by analysis of published tests. Eleven topic areas were found to be common to the above sources. General and specific objectives were then formulated in each of the eleven topic areas. A percent of emphasis was determined in each of the eleven topic areas as they related to the evaluation conducted to determine content and scope.

The selection of the form for the items of a test should arise from the objectives of the test. As this test, hopefully, will eventually be standardized, it was decided to use a type of item that was objective in nature. The multiple-choice type item was chosen as the type

best meeting this criteria. Three hundred ninety multiple-choice items were then constructed to test all of the specific objectives in the eleven topic areas. These items were then mimeographed and submitted for the criticisms of 16 test and subject matter experts throughout the United States. After receiving the criticism of the experts items were reviewed and in some cases rewritten keeping in mind the table of specifications.

If a test is to provide reliable measurement, possible sources of error are best identified in advance of its administration. Taking this into consideration the 390 multiple-choice items were by random procedures divided into three balanced forms. These three balanced trial forms were then administered to 834 freshman students at Oregon State University in the class P. E. 160, General Hygiene. Item analysis and difficulty level was determined for each item and each foil in preparation to accumulate data for the selection of 100 items for a final health knowledge test. Using the item analysis data and referring to the ratings provided by the jury, items were selected for the final 100 item test.

Validity of the test was then appraised. Validity for this test was established in three ways: (a) by the manner in which the test was initially set up; (b) by the development of test items of demonstrated worth; and (c) by comparison with an outside criterion, in this case students grades.



Reliability of the test was demonstrated by the use of the split-halves method. Then, the Spearman-Brown Prophecy formula was applied to determine the reliability of the whole test. The calculation of both the reliability and validity coefficients of correlation was from a sample of 100 students drawn at random from the parent population.

The final 100 multiple-choice item college health knowledge test developed as a result of the above effort will be found in Appendix I.

## CHAPTER IV

### PROCEDURES AND FINDINGS OF THE STUDY

A restatement of the purpose of this study seems appropriate before presenting the procedures followed and the findings. The study was conducted to compare the effectiveness of teaching General Hygiene by television and by conventional lecture procedures. A specially designed health knowledge test for college freshmen was constructed. A test of this type was needed to give a valid and objective assessment of health knowledge. Such an instrument makes it possible to determine any increase in the level of health knowledge acquired by Oregon State University freshmen enrolled in General Hygiene. This made it possible to formulate several purposes.

1. To determine the effects of different approaches in teaching health, or the lack of such teaching, in the high schools of Oregon and surrounding states. This is reflected in scores on the health knowledge test obtained by freshmen at Oregon State University when entering the course in General Hygiene.
2. To identify areas of strengths and weaknesses in the eleven topic areas of General Hygiene as a basis for curriculum planning.
3. To compare the effectiveness of teaching methods, particularly as it is reflected in television and conventional lecture procedures. This comparison would be based on the knowledge increase as measured by the health knowledge test.

The null hypotheses to be tested as a result of the above statements are:

1. There is no significant difference in the health knowledge possessed by students as entering freshmen at Oregon State University as determined by the health knowledge test.
2. There is no significant difference in the increase in health knowledge as it relates to the eleven topic areas in General Hygiene as determined by the health knowledge test.
3. There is no significant difference in the effectiveness of the different teaching methods based on knowledge increase as measured by the health knowledge test.

#### Description of Experimental Conditions

As a requirement for graduation, all students enrolled as undergraduates at Oregon State University are required to complete the course in General Hygiene. Three courses are offered by the Department of Hygiene and Environmental Sanitation. One course carries one credit hour; one course, three credit hours; and one course P. E. 160, General Hygiene, two credit hours. P. E. 160, General Hygiene, is the course chosen for evaluation in this study. The classes are coeducational and P. E. 160, General Hygiene, is offered as a regular lecture course or by closed and open-circuit television.

The television General Hygiene course was developed and taught by Dr. C. L. Anderson. During winter quarter 1965, the quarter when all testing for this phase of the study was carried on, Dr. Anderson

also taught four conventional lecture sections here-after called the Control Group. The other 15 sections were taught by six other professors using the conventional lecture method. All classes used the same textbook, Health Principles and Practice, 4th edition, by C. L. Anderson and C. V. Langton. All classes covered the eleven topic areas to be evaluated in this study. The units taught in all classes were: Introduction, the Student and His Health; Heredity; Personal Health; Nutrition; Exercise, Rest and Fatigue; Safety for Health; Substances Harmful to Health; Normal Mental, Emotional and Social Health; Preparation for Family Living; Prevention of Disease and Disorders; Consumer Health.

The following groups, a total of 1015 Oregon State University students, were then formed for the purpose of this study.

1. The Closed-Circuit Television Group. This group attended classes instructed through the medium of closed-circuit television at 9 A. M. to 10 A. M. every Tuesday and Thursday for the entire term. There were 205 students in this group.
2. The Open-Circuit Television Group. This group attended classes instructed through the medium of open-circuit television at 11 A. M. to 12 A. M. every Tuesday and Thursday for the entire term. It was possible for students from this group to view the programs at this hour on sets other than those located in the classroom. There were 117 students in this group.
3. The Control Group. This group received face-to-face instruction via the lecture method from Dr. C. L. Anderson twice a week for the entire term. There were 144 students in this group.

4. The Conventional Group. This group received face-to-face instruction via the lecture method from instructors on the regular staff of the Department of Hygiene and Environmental Sanitation at Oregon State University. These classes also met twice a week for the entire term. There were 549 students in this group.

Individuals were placed in experimental groups by random selection. As students appeared to enroll in P.E. 160, General Hygiene, they were randomly placed within class sections by order of appearance and the number of stations available in various sections. Students who registered in one of the television sections were handed instructions informing him or her that the first class meeting would be at 7:00 p.m., January 5, 1965. Students were asked to report to Withycombe Hall, Room 101; Dearborn Hall, Room 301; or to Physics-Chemistry Building Room 151. This would be in advance of the first scheduled class period. All students enrolled in the television classes were then given the pre-test at this time. All other students in conventional lecture classes were given the health knowledge test as a pre-test their first class meeting.

It is interesting to note at this point that the principle of pre-testing has been fostered by many in educational circles. Shaw (65, p. 59) in the field of Health Education had this to say:

The greatest shortcoming in the testing of knowledge of health is a failure to determine what a student or class knows about a topic at the beginning of a study. Not only is it impossible to determine real progress without

pre-testing but inevitably costly repetition follows such an oversight. Too often we teach, then have to check back to see what we taught in order to test.

Rash (60, p. 10) goes so far as to say that the evaluation of learning will also involve the evaluation of teaching. He adds:

... efforts to improve learning will involve at once the evaluation of teaching, as well as the evaluation of learning. The extent to which the expected outcomes do appear as outcomes will bear a very close relationship to the effectiveness of the teaching. To this extent, then, an evaluation of outcome becomes, in reality, an evaluation of teaching.

This procedure then, the administration of the health knowledge test as a pre-test, constituted our first measurement task.

### Analysis Procedure

The statistical analysis procedure followed in this study were recommended and approved by the Department of Statistics at Oregon State University. Analyses made in this chapter are based on, (a) pre-test and post-test scores obtained by administering the health knowledge test to all Oregon State University freshmen registered for P. E. 160, General Hygiene, winter quarter 1965, and (b) scores obtained from the Administrative Record Division at Oregon State University on the College Entrance Examination Board Scholastic Aptitude Test for each of the individual students included as part of the sample in this study.

It was immediately recognized that one of the variables which should be considered for control purposes was the scholastic ability or aptitude generally referred to as individual intelligence. A decision was made to use the statistical control of analysis of co-variance. The analysis of co-variance technique is especially well suited to research in education. This technique is an extension of analysis of variance and has one very useful additional feature. It enables one to compensate for initial differences in the groups being studied. In this particular study, although groups were organized by random procedure, it was necessary to compensate statistically for the variable of intelligence. Co-variance analysis permits the experimenter to adjust the mean scores obtained on the final measure to compensate for differences between groups. In this study the mean increase in knowledge scores for each group will be adjusted for initial group intelligence by use of the College Entrance Examination Board Scholastic Aptitude Test scores before making final comparison of achievement between groups being taught by the different teaching methods.

The College Entrance Examination Board Scholastic Aptitude Test (13, p. 285) hereafter called the S. A. T. test, was chosen after consultation with Dr. William R. Crooks, Chairman of the Department of Psychology at Oregon State University. This test available only in the College Entrance Examination Board Admission Testing Program, has two scores, verbal and mathematical. The verbal score

was chosen for this study.

The S. A. T. test has survived 36 years of use with a remarkable record. More than 800,000 students took this test last year. The predictive value of the S. A. T. test has been built upon validity studies made throughout the years since 1926. Studies using average grades for the four college years, grades in specific academic subjects, academic failure, and graduation versus non-graduation have also been made (19, p. 316). The evidence from all these studies has confirmed the judgement that a well made test of verbal ability provides relevant information about a student's academic promise. This is why the S. A. T. test has proved helpful to colleges in making sound admission decisions. Standard scores are available with 32 pages of norms.

The S. A. T. test has a proven reliability of .90. John T. Dailey (19, p. 317) in his review in Buros' Fifth Mental Measurement Year-book had this to say, "This test is essentially a conventional, general abstract 'intelligence' test at the bright adult level. It does a very effective job of estimating scholarship potential." In the present study we were concerned about the potential difference of individual intelligence level among groups. This instrument appeared to be best suited to this purpose because it identified differences among students of all ranges between superior and lesser ability.



By going to the administration files at Oregon State University, S. A. T. scores were obtained for all freshmen involved in this study and these scores were used in the analysis of co-variance.

The analysis of co-variance was calculated by IBM machine tabulation, by the Oregon State University Statistic Laboratory using the procedure described by Li (49, p. 415) where the formula is:

$$\bar{y}_x = \bar{y} - \bar{b} (\bar{x} - \bar{\bar{x}})$$

where  $\bar{y}_x$  = adjusted mean

$\bar{y}$  = the sample mean

$\bar{b}$  = the average regression coefficient

$\bar{x}$  = the average of the test scores for a given group

$\bar{\bar{x}}$  = the average weighted mean for all groups

Then an 'F' test (49, p. 184) or a 't' test (49, p. 270) was used to determine if the resulting adjusted means are statistically significant at the one or five percent level of confidence.

After giving the health knowledge test as a pre-test to the 1015 Oregon State University freshmen concerned with the study, it was then possible to consider the first purpose and the related hypothesis. This hypothesis stated: There is no significant difference in the amount of health knowledge possessed by students as entering freshmen at Oregon State University as determined by the health knowledge

test.

One stem of information called for on the testing form was the home address of students. This was used to identify the high school from which the student was graduated. Any high school or city with eight or more students attending Oregon State University and who became a part of the sample in this study were identified with that city. Cities having less than eight students in the sample were grouped together and will be identified accordingly. That is, cities having seven students will be grouped together and those with six will be grouped together and so on. All out-of-state students will be listed together.

Table XI shows the statistical data relative to the effect of different approaches to teaching health, or the lack of teaching it, in high schools as reflected in scores obtained by freshmen at Oregon State University on the health knowledge test.

The 'F' test was computed on the adjustment means in Table XI with 30 and infinity degrees of freedom. The critical level fell at 1.47 and 'F' was found at 1.552, indicating that it fell beyond the critical level and therefore was found to be statistically significant at the five percent level of confidence. Therefore, we reject the null hypothesis that there is no significant difference in the amount of health knowledge possessed by students as entering freshmen at Oregon State University as determined by the evaluation with the health knowledge tests.

It might be well at this point to further evaluate Table XI on

Table XI. Statistical Data on Students from Various Areas.

Residence	Number of Students	Adjusted Mean Scores on Health Knowledge Test Given as Pre-test
1. Central Point	8	59.5734
2. Grants Pass	14	53.9382
3. Coos Bay	9	53.7787
4. Salem	76	53.2403
5. Newburg	9	52.9797
6. Medford	12	52.2739
7. Astoria	8	51.7393
8. McMinnville	15	51.5377
9. Corvallis	63	51.2509
10. Klamath Falls	20	50.9391
11. Eugene	34	50.8171
12. Newport	8	50.8094
13. Lebanon	19	50.7428
14. Springfield	9	50.7198
15. Gresham	8	50.5121
16. Roseburg	17	50.5046
17. Cities in Oregon with four students in sample	36	50.2613
18. Out of state students	108	50.0554
19. Cities in Oregon with three students in sample	57	49.8485
20. Albany	26	49.5353
21. Lake Oswego	16	49.4977
22. Cities in Oregon with five students in sample	40	49.4852
23. Cities in Oregon with one student in sample	64	49.4494
24. Cities in Oregon with seven students in sample	28	49.3780
25. Cities in Oregon with two students in the sample	50	49.2560
26. Cities in Oregon with six students in sample	36	48.7614
27. Tigard	8	48.5625
28. Portland	176	48.3651
29. Beaverton	22	48.3515
30. Tillamook	8	47.8049
31. Hillsboro	11	47.4996
(average adjusted mean --- 49.9980)		

page 97. First of all, the average adjusted mean of 49.9980 speaks well for the statistical validity of the college health knowledge test that has been constructed as a part of this study. This is an indication that on the 1015 college students used in this study the health knowledge test of 100 items placed the students according to scores received nearly with a mean of 50.0000 or, in this case, what would be considered the mid-point on the normal curve.

The most obvious information that is observable on Table XI is that students from Central Point, Grants Pass, Coos Bay and Salem have pre-test scores that indicate students from these cities excel in knowledge of health as determined by the health knowledge test. Students from Tigard, Portland, Beaverton, Tillamook, and Hillsboro have pre-test scores that indicate these cities rank lowest of all according to the scores obtained on the college health knowledge test. It might be pointed out that out-of-state students fell nearly perfectly into the middle of the distribution with a mean score of 50.0554. It is quite significant that students from such a large metropolis as Portland should rank as low as is indicated by the table.

The second purpose of the study, as indicated on page 88, was: To identify areas of strengths and weaknesses in the eleven topic areas of General Hygiene as a basis for curriculum planning. The null hypothesis related to this purpose was: There is no significant difference in the increase in health knowledge as it relates to the

eleven topic areas in General Hygiene as determined by the health knowledge test.

In evaluating purpose number two and its accompanying hypothesis, it was necessary to obtain the increase in knowledge in each of the eleven topic areas selected. The health knowledge test given as a pre-test at the beginning of the winter quarter, 1965, was administered again as a post-test at the end of this quarter to the sample previously identified. As it was necessary to key and correct each test eleven times to obtain scores in each of the eleven topic areas, it was unfeasible due to cost, to include the entire sample. Due to this limiting factor, the entire sample was ordered alphabetically and every fifth name selected as a sample from the parent population. This sample was used to test the hypothesis that there is no significant difference in the increase in health knowledge as it relates to the eleven topic areas in General Hygiene as determined by the health knowledge test. Table XII portrays the data on the eleven topic areas tested in General Hygiene as it relates to the study. A 't' test was computed on the difference between pre-test and post-test means in this sample and the 't' ratio was found to be statistically significant at the one percent level as shown in Table XII. Therefore, we reject the hypothesis that there is no significant difference in the increase in health knowledge as it relates to the eleven topic areas in General Hygiene as determined by the health knowledge test. It is justifiably concluded

Table XII. Statistical Data on the Eleven Topic Areas in General Hygiene.

Topic Areas	Total Number Possible	Pre-test Means	Post-test Means	Mean Difference	Percent of Increase in Each Area
Introduction, the Student and his Health	6	2.14	3.14	1.00	16.6
Heredity	5	1.29	3.61	2.32	46.4
Personal Health	6	4.10	5.88	1.78	29.6
Nutrition	15	7.12	10.32	3.20	21.3
Exercise, Fatigue and Rest	10	5.82	8.72	2.90	29.0
Safety	6	3.25	5.30	2.05	34.1
Substances Harmful to Health	7	3.02	4.44	1.42	20.3
Normal Mental, Emotional and Social Health	13	7.09	10.06	2.97	22.8
Preparation for Family Living	14	9.60	12.26	2.66	19.0
Prevention of Disease and Dis- orders	13	5.30	9.55	4.25	32.7
Consumer Health	5	2.21	3.55	1.34	26.7
Total	100			25.89	
't' test ratio				21.05 *	

\* significant at the one percent level.

that a statistical difference does exist in the increase in knowledge in the eleven topic areas of General Hygiene as determined by the health knowledge test in this study.

One of the most revealing figures in Table XII is the overall increase in knowledge. The mean increase in health knowledge identified by this particular sample was 25.89 points. The mean increase in health knowledge in the entire sample of 1015 students was 26.60 points. This in itself lends some validity to the sample selected from the parent population as being valid. It also is a tribute to the program in General Hygiene at Oregon State University. To compare this with the study done by Dearborn (21, p. 90) in California where 34 junior colleges that included 5,287 students was given a standardized college health knowledge as a pre-test and post-test, the mean increase in health knowledge was 12.2 points. This is less than one-half the increase shown by the students at Oregon State University in health knowledge during one quarter.

The fact that very few secondary schools include the area of heredity in their course of study probably accounts for the low pre-test score in this area and allowed for the fine increase of 46.6 percent in knowledge during the quarter. The test results of this particular area points up the need for pre-testing in the field of General Hygiene to point up strengths and weaknesses of the students prior to beginning a course.

In the area of Preparation for Family Living it is quite evident that some good basic preparation has been done by the schools or that a special interest of the students is a motivating factor. This particular area yielded a pre-test score of 9.60 and a post-test score of 12.26 out of a possible 14. This gave a mean increase in knowledge of 19.0 percent and an overall mastery of the knowledge tested of 87.5 percent in this topic area.

Most of the other topic areas fell close to the mean topic increase with the exception of Introduction, the Student and His Health. This may have been accounted for by differing degrees of emphasis by the various instructors in introducing a field of General Hygiene. In this area the students tested yielded a pre-test mean score of 2.14 points and a post-test score of 3.14 points for a mean increase of 1.00 points during the quarter. This seems to be a rather modest increase and may merit further investigation.

Purpose number three was: To compare the effectiveness of teaching methods, particularly as this relates to television and conventional lecture procedures; the comparison to be based on the knowledge increase as measured by the health knowledge test. The associated null hypothesis formulated to test this purpose was: There is no significant difference in the effectiveness of the different teaching methods based on knowledge increase as measured by the health knowledge test. By using the scores obtained from the S. A. T.



test and the scores obtained from the pre-test and post-test on the health knowledge test an analysis was made of the four groups; (a) the Control Group, (b) the Closed-Circuit Television Group, (c) the Open-Circuit Group, and (d) the Conventional Group. Using the S. A. T. scores as the independent variable and the difference between the pre-test scores and the post-test scores as the dependent variable an analysis of co-variance was computed for the four groups. Table XIII shows the adjusted mean as a result of the analysis of co-variance and the 'F' test that was performed to test the hypothesis.

Table XIII. Statistical Summary of the Adjusted Interaction Means Between the Different Teaching Groups.

Adjusted Interaction Means		DF	MS	F
Control Group	28.6063	3	68.4279	4.369 *
Closed-Circuit T. V.	27.1572	1010		
Open-Circuit T. V.	26.2531			
Conventional Group	25.9395			

\* Significant at the one percent level of confidence.

Table XIII shows that we reject the hypothesis: There is no significant difference in the effectiveness of the different teaching methods based on the knowledge increase as measured by the

health knowledge test. In this case using 3 and 1010 degrees of freedom, an 'F' of 4.369 was significant at the one percent level. There is a difference between the effectiveness of the different teaching methods used in this study. Having determined there was a difference between the groups it was then decided to show by the 't' test of least significance difference, a comparison between the Control Group and each of the other three groups organized. Table XIV shows this comparison.

Table XIV. Statistical Data Testing the Means of the Control Group with the Means of the Other Teaching Groups.

Teaching Groups and Means	Difference Between Means	't'
Control vs Open-Circuit T. V. 28.6063 - 26.2531	2.3532	2.28 * <sup>+</sup>
Control vs Closed-Circuit T. V. 28.6063 - 27.1572	1.4491	16.11 *
Control vs Conventional 28.6063 - 25.9395	2.6668	34.43 *

\* Significant at the five percent level.

+ Not Significant at the one percent level.

For each of these groups comparing the Control Group with each of the other three, the obtained 't' with 69 degrees of freedom was significant at the five percent level. Using the 't' test we again reject

the null hypothesis, there is no significant difference in the effectiveness of the different teaching methods based on knowledge increase as measured by the college health knowledge test. It has also been shown that there is a significant difference between the Control Group and each of the other teaching groups. Although the analysis shows a significant difference at the five percent level it is interesting to note that the comparison between the Control Group and the Open-Circuit Television Group is not significant at the one percent level of confidence. This indicates a closeness or likeness in these two approaches. We would accept the null hypothesis that there is no significant difference in the effectiveness of the different teaching methods of the Control Group and the Open-Circuit Television Group. It might be well also to point out that in the Control Group compared to the Closed-Circuit Television Group at the one percent level of confidence the 't' ratio was rapidly approaching non-significance.

The next comparison of the effectiveness of the different teaching methods was between the Conventional Group and Open-Circuit Television Group and between the Conventional Group and the Closed-Circuit Television Group. Table XV portrays the statistical data on this comparison.

For each of these groups comparing the Conventional Group with the two television groups the obtained 't' with 69 degrees of freedom was not significant at the one or the five percent level of

Table XV. Statistical Data Testing the Means of the Conventional Group with the Means of Open-Circuit and Closed-Circuit Television Groups.

Teaching Groups and Means	Difference Between Means	't'
Conventional vs Open-Circuit 25.9395 - 26.2531	.3136	1.1767 *+
Conventional vs Closed-Circuit 25.9395 - 27.1572	1.2177	1.7984 *+

\* Not significant at the one percent level of confidence.

+ Not significant at the five percent level of confidence.

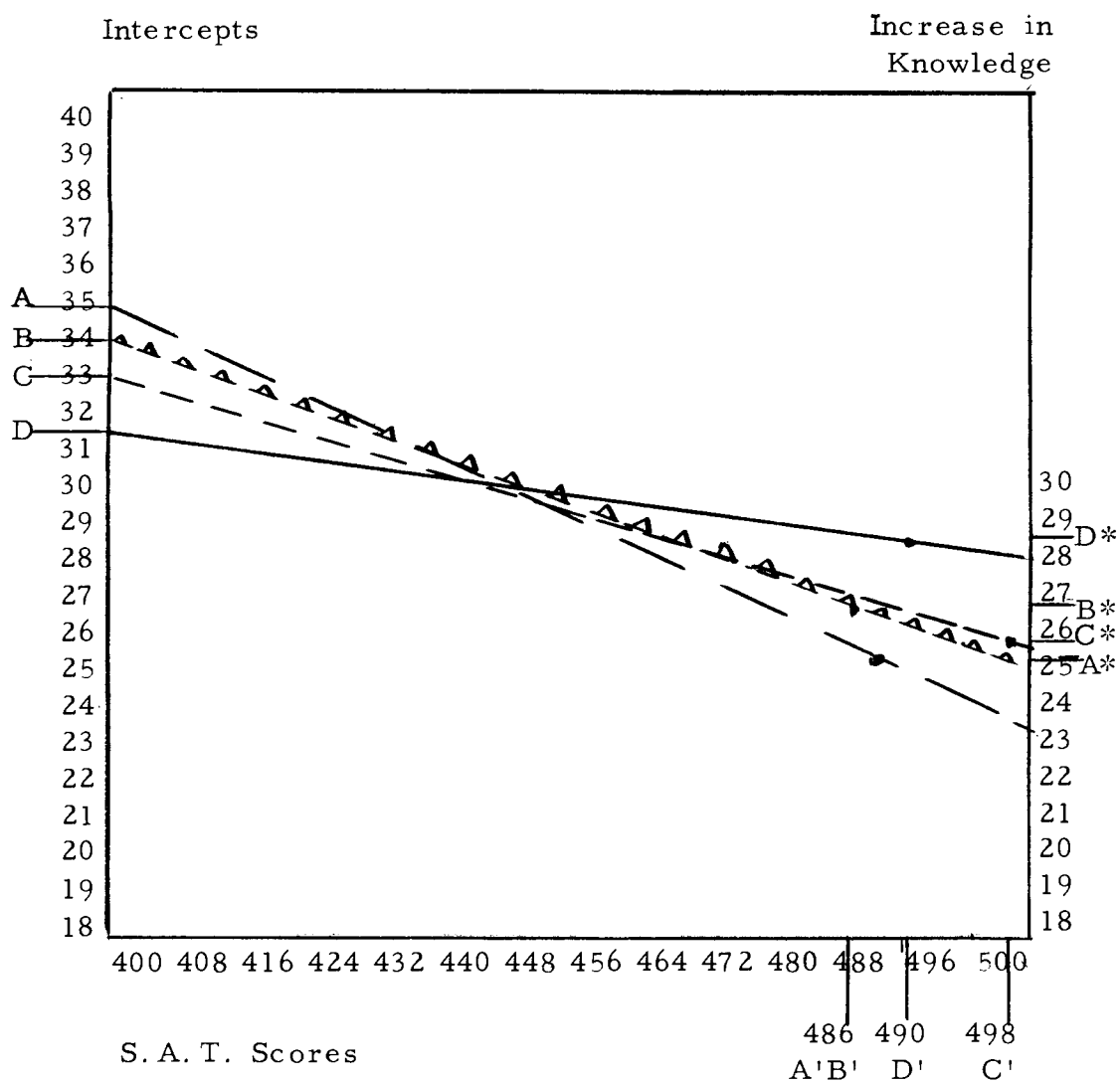
confidence. Using the 't' test, we would accept the null hypothesis that there is no significant difference in the effectiveness of the Conventional Group as compared to the Open-Circuit Television group; or the Conventional Group as compared to the Closed-Circuit Television Group. This indicates, that based on the scores obtained from the health knowledge test adjusted by the scores obtained from the S.A.T. test for academic potential, that neither of these groups was statistically superior. In health knowledge increase, one did just about as well as the other.

### Regression Analysis

To further bring out the comparison between the teaching groups,

Figure I was designed. Figure I is a graphic representation of the line of regression of the four different teaching groups. The line of regression basically shows what was done for each group as measured by the increase in health knowledge as it relates to the students' intelligence according to the obtained S. A. T. scores. In this analysis if we consider first the Control Group it will be noted that the line of regression is not so abrupt as the line of regression is for the other groups. This shows an indication that the teaching method used in the Control Group had more meaning for all the students. The students with a low intelligence level as measured by the S. A. T. test did better and made a greater knowledge increase than the students with a high intelligence level, however, it will be noted that the Control Group's line of regression is much flatter and the more intelligent students did much better in this group than in the other three teaching groups. The Control Group had a mean knowledge increase of 28.6063; a mean S. A. T. score of 490.00; an intercept of 31.8626. This determined the slope of the line of regression. The Conventional Group had the most severe slope on its line of regression of all the different teaching groups. As can be seen in Figure I very little was done for the student with high academic potential in the Conventional Group. Most of the teaching in the conventional group according to the line of regression was aimed at the average student or the below average student. The Conventional Group had a mean knowledge increase

FIGURE I. The Negative Lines of Regression of the Four Teaching Groups Showing the Interaction of Health Knowledge Increase on the Academic Potential.



- A. The Conventional Group ——— .
- B. The Closed-Circuit Television Group
- C. The Open-Circuit Television Group - - - - - .
- D. The Control Group ——— .

A. B. C. D. = Intercept

A\*B\*C\*D\* = Mean increase in knowledge

A'B'C'D' = S.A.T. test score (academic potential)

of 25.9395; a mean S. A. T. score of 486.00; an intercept of 34.5472, this determined the slope of the line of regression.

The Closed and Open-Circuit Television Groups were quite similar in what they did for the student. As can be seen in Figure I these two approaches again seem to be designed to complement the average student. The Closed-Circuit Television Group had a mean knowledge increase of 27.1572; a mean S. A. T. score of 485.00; an intercept of 34.3868. The Open-Circuit Television Group had a mean knowledge increase of 26.1025; a mean S. A. T. score of 498.00; an intercept of 33.0017, this determined the slope of the line of regression. This analysis seems to indicate a decided need for a special class in General Hygiene for those students with high academic potential.

### Summary

After the construction of a valid college health knowledge test, it was then possible to compare the effectiveness of teaching by television and by conventional procedures. With this in mind, several purposes to be investigated were formulated.

1. To determine the effects of different approaches to teaching health, or the lack of teaching it, in the high schools of Oregon and surrounding states, as it reflects in scores obtained by freshmen at Oregon State University on the college health knowledge test.
2. To identify areas of strengths and weaknesses in the eleven topic areas of General Hygiene as a basis for curriculum planning.

3. To compare the effectiveness of teaching methods, particularly as this relates to television and conventional lecture procedures, based on the knowledge increase as measured by the college health knowledge test.

Null hypotheses were then formulated to test each of these stated purposes.

1. There is no significant difference in the amount of health knowledge possessed by students as entering freshmen at Oregon State University as determined by the college health knowledge test.
2. There is no significant difference in the increase in health knowledge as it relates to the eleven topic areas in General Hygiene as determined by the college health knowledge test.
3. There is no significant difference in the effectiveness of the different teaching methods based on the knowledge increase as measured by the college health knowledge test.

All freshmen students at Oregon State University registered for P. E. 160, General Hygiene, winter quarter, 1965, were given a pre-test and a post-test using the college health knowledge test constructed and designed for this study. These 1015 students were divided into four experimental groups by the random procedure of the registration process. These groups were: (a) the Closed-Circuit Television Group, (b) the Open-Circuit Television Group, (c) the Control Group, (d) the Conventional Group.

The statistical analysis done in this chapter was based on the scores obtained from administering the college health knowledge test as a pre-test, as a pre-test and a post-test, using the difference to



to determine any increase in health knowledge and the S. A. T. scores which reflected academic potential. Recognizing that one of the variables which needed to be controlled was the scholastic ability or academic potential, generally referred to as individual intelligence, as it relates to the composition of each of the groups, the analysis of co-variance technique was applied to compensate statistically for this variable. In this study the mean increase in knowledge scores for each group was adjusted for initial group intelligence by using the analysis of co-variance.

After administering the health knowledge test as a pre-test the scores were adjusted by compensating for intelligence using the S. A. T. scores for each student in the various groups. The resulting scores were identified according to towns, cities and areas. Using this data it was now possible to test the number one hypothesis.

The 'F' test was computed on the adjusted means and found to be significant at the five percent level of confidence. Therefore the null hypothesis number one was rejected and it was concluded that there is a significant difference in the amount of health knowledge possessed by entering freshmen at Oregon State University as determined by the health knowledge test.

After obtaining the scores in each of the eleven topic areas of General Hygiene on the pre-test and post-test of the health knowledge test it was then possible to test hypothesis number two. The scores from

the pre-test were subtracted from the scores on the post-test in each of the eleven topic areas and this yielded a mean increase in knowledge in each of the eleven topic areas of General Hygiene. A 't' test was computed on these means and was found to be statistically significant at the one percent level of confidence. Therefore, the hypothesis that there is no significant difference in the increase in health knowledge as it relates to the eleven topic areas in General Hygiene as determined by the health knowledge test was rejected. A mean knowledge increase of 26.60 points was shown in this analysis.

The third hypothesis to be tested was: There is no significant difference in the effectiveness of the different teaching methods based on the knowledge increase as measured by the health knowledge test. Using the S. A. T. scores as the independent variable and the difference between the pre-test scores and the post-test scores as the dependent variable an analysis of co-variance was computed for the four teaching groups. An 'F' test was computed on the means obtained by the above procedure and was found to be significant at the one percent level of confidence. This allowed rejection of the third hypothesis.

It was then felt desirable to determine if a significant difference existed between each of the teaching groups compared to the Control Group. Comparing each group individually with the Control Group by using the 't' test for least significant differences, each in turn was found to be significantly different at the five percent level of confidence.

It was also pointed out that the comparison between the Control Group and the Open-Circuit Television Group was not significant at the one percent level of confidence. This indicated a closeness or likeness in these two approaches to teaching.

A comparison was then made between the Conventional Group and the two television groups. By using the 't' test for least significant difference each in turn was found to not be significant at the one or the five percent level of confidence. This would indicate a closeness or likeness in these two approaches to teaching.

To further bring out the comparison between the four teaching groups a graphic presentation was made of the four lines of regression. A negative slope was obtained on all four groups. However, the Control Group did show better ability to be able to provide sufficiently for all levels of academic potential. The two television techniques were very similar and the Conventional Group did the least of all for the student with high academic potential. It must be remembered however, that the over-all increase in health knowledge of 26.60 points per student reflects an excellent program in General Hygiene at Oregon State University, much better than any other studies of this nature investigated in this study.

## CHAPTER V

## SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

For many decades health has been held as one of the foremost objectives of education. This objective, although accepted in principle, is far from accomplishment in fact. The health of our nation and of its individual citizens suffers from a deficiency of adequate health instruction, sound health attitudes and proper health practices.

The ultimate aim of school health instruction is to lead students into favorable health practices. To this end, it is necessary to provide the health knowledge which forms the base for the development of favorable attitudes and practices which may lead to the achievement of a higher health status.

The acceptance of health instruction as a necessary function of the school brings with it an obligation to appraise the effectiveness of that instruction. Measurement of health knowledge is one phase of such evaluation, and can serve many important purposes for the student and the administrator, as well as for the teacher.

Institutions of higher learning are in a position to provide leadership needed to help individuals develop an understanding of and an interest in the principles and practices of healthful living. Specifically,

this leadership is, or can be, provided in the personal health courses offered at the institutions of higher learning. If the United States is to remain strong and vital and a leader among the nations this education is essential.

A larger freshmen class presents itself each year at most institutions of higher learning. Universities and colleges with limited facilities and faculties are faced with the problem of accommodating vast numbers of undergraduate students. Educators are searching for ways to teach students in large classes and still provide greater academic accomplishment. This points up the need for an investigation into methods of teaching larger classes, through improved means of communication, where one might increase the ratio of the students per instructor.

The purpose of this study was to investigate the effectiveness of teaching General Hygiene to large groups of college freshmen through the medium of television. More particularly, it was to compare the effectiveness of teaching General Hygiene by two approaches, television and traditional classroom procedure.

Of fundamental importance to a comparison of the effectiveness of teaching General Hygiene is the availability of suitable devices for appraising the status of health knowledge. An analysis of the literature disclosed that published college health knowledge tests were not only limited in the number available, but many were not satisfactory

tests. As a consequence it was necessary to construct an adequate test in General Hygiene for the college freshmen level.

The procedure of test construction included the following major steps:

1. Determination of scope, content, and emphasis by analysis of statements of recognized authorities, standard textbooks, standardized tests and course content.
2. Development and selection of a body of 390 multiple-choice items to cover the accepted content.
3. Referral of these items to a jury of 16 test and subject matter experts for criticism, acceptance and rating.
4. Allocation of items on the basis of the jury's rating into three balanced trial forms and then application of these three forms to 834 freshmen students at Oregon State University.
5. Complete item analysis and difficulty level was determined on every item and every foil as a result of the above application.
6. Selection was made of the best 100 items for the final form of the college health knowledge test.

The final form of the test produced results confirming its effectiveness. Fundamentally objective, its validity and reliability were inherent from the manner in which it was developed. Every item included was subjected to the scrutiny of a group of experts, and was required to demonstrate suitable difficulty and discrimination values. Statistical analysis showed the test to be highly satisfactory both as to its reliability, with a coefficient of .89, and as to statistical validity of the whole test, with a coefficient of .80 when

correlated with instructors' grades in the hygiene courses. The final 100 multiple-choice item college health knowledge test developed as a result of the above effort will be found in Appendix I of this study.

After the construction of a valid college health knowledge test it was then possible to compare the effectiveness of teaching by television and by conventional procedures. With this in mind several purposes to be investigated were formulated.

1. To determine the effects of different approaches to teaching health, or the lack of teaching, in the high schools of Oregon and surrounding states, as it reflects in scores obtained by freshmen at Oregon State University on the college health knowledge test.
2. To identify areas of strengths and weaknesses in the eleven topic areas of General Hygiene as a basis for curriculum planning.
3. To compare the effectiveness of teaching methods, particularly as related to television and conventional lecture procedures, based on knowledge increase as measured by the college health knowledge test.

The null hypotheses formulated to test these stated purposes were:

1. There is no significant difference in the amount of health knowledge possessed by students entering as freshmen at Oregon State University as determined by the college health knowledge test.
2. There is no significant difference in the increase in health knowledge as it relates to the eleven topic areas in General Hygiene as determined by the college health knowledge test.

3. There is no significant difference in the effectiveness of the different teaching methods based on the knowledge increase as measured by the college health knowledge test.

To be able to test the stated hypothesis, all freshmen students at Oregon State University registered for P.E. 160, General Hygiene, winter quarter, 1965, were given a pre-test and a post-test using the college health knowledge test constructed and designed for this study. These 1015 students were divided into four experimental groups by the random procedure of the registration process. The groups were: (a) the Closed-Circuit Television Group, (b) the Open-Circuit Television Group, (c) the Control Group, (d) the Conventional Group.

Using the test scores obtained and adjusting them with scores obtained from the College Entrance Examination Board Scholastic Aptitude Test by the statistical process of the analysis of co-variance the following results were reported.

Hypothesis number one. The 'F' test was computed on the adjusted means that resulted from the analysis of co-variance and was found to be significant at the five percent level of confidence. Therefore, the null hypothesis was rejected and it was concluded that there is a significant difference in the amount of health knowledge possessed by the students entering as freshmen at Oregon State University.



Hypothesis number two. After obtaining scores from the administration of the college health knowledge test as a pre-test and a post-test to Oregon State University freshmen the differences were found in each of the eleven topic areas of General Hygiene and means were then computed for each area. A 't' test was computed on these means and was found to be statistically significant at the one percent level of confidence. Therefore, the null hypothesis was rejected and it was concluded that there is a difference in the increase in health knowledge as it relates to the eleven topic areas in General Hygiene as determined by the college health knowledge test.

Hypothesis number three. Using the S.A.T. scores as the independent variable and the difference between the pre-test scores and the post-test scores as the dependent variable an analysis of covariance was computed for the four teaching groups. An 'F' test was computed on the means obtained by the above procedure and was found to be significant at the one percent level of confidence. This allowed for rejection of the third hypothesis and it was concluded there was a difference in the effectiveness of the different teaching methods based on the knowledge increase as measured by the college health knowledge test.

It was then felt desirable to determine if a significant difference existed between each of the teaching groups compared to the Control Group. Using a 't' test each group was found to be statistically different at the five percent level of confidence. However, the Control Group as compared to the Open-Circuit Television Group was not significantly different at the one percent level of confidence, indicating a closeness or likeness in these two approaches to teaching.

A comparison was then made between the Conventional Group and the Open-Circuit Television Group and between the Conventional Group and the Closed-Circuit Television Group. Using a 't' test in both comparisons they were found not to be statistically different at the one or five percent level of confidence, indicating a closeness or likeness in these two approaches to teaching.

To bring out further the comparison, the lines of regression for each of the four groups were graphically portrayed. A negative slope was obtained on all four groups. The Control Group was most effective in providing instruction for all levels of academic potential. The Conventional Group showed better ability to provide for students with low academic potential. The two television techniques were similar in their ability to provide for the academic level of the student.

An overall increase in health knowledge as determined by the college health knowledge test was 26.60 points per student and reflected an excellent institutional program in General Hygiene at Oregon

State University.

### Conclusions

The following conclusions are drawn from the data presented in this study.

1. The test developed for the measurement of personal health knowledge, on the freshmen college level, is considered superior to those previously available.
2. The college health knowledge test appears to be a valid instrument for measuring acquisition of knowledge and understanding at the freshmen college level in General Hygiene. It is easily administered and scored.
3. Appropriate testing procedures yield significant information basic to effective health education curriculum construction.
4. Health knowledge can be favorably changed through health instruction.
5. Evidence was obtained indicating a significant difference in the amount of health knowledge possessed by students as entering freshmen at Oregon State University. The amount of health knowledge was significant at the five percent level.
6. Evidence was obtained indicating a significant difference in the increase of health knowledge as it relates to the eleven topic areas in General Hygiene. The increase in health knowledge in the eleven topic areas was significant at the one percent level.
7. Evidence was obtained indicating a significant difference in the effectiveness of the different teaching methods. The difference in the effectiveness of the four teaching methods was found to be significant at the one percent level.

8. Evidence was obtained indicating a significant difference in the effectiveness of the teaching method in the Control Group compared to the Closed-Circuit Television Group at the five percent level. The Control Group compared to the Closed-Circuit Television Group was found to be rapidly approaching non-significance at the one percent level.
9. Evidence was obtained indicating no significant difference in the effectiveness of the teaching method between the Control Group and the Open-Circuit Group at the one percent level.
10. Evidence was obtained indicating a significant difference in the effectiveness of the teaching method between the Control Group and the Conventional Group at the five percent level.
11. Evidence was obtained indicating no significant difference between the Conventional Group and the Closed or Open-Circuit Television Group at the one or five percent level.
12. Evidence was obtained indicating students of high mental ability attained a greater knowledge increase in the Control Group. The Control Group also provided very well for students at all levels of academic potential.
13. Evidence was obtained indicating students of low mental ability found a greater knowledge increase in the Conventional Group.
14. Evidence was obtained indicating an exceptional increase in health knowledge through instruction in General Hygiene in all groups, an average of 26.60 points per student. This increase reflects an outstanding teaching contribution in the course P.E. 160, General Hygiene, by all instructors.

### Recommendations

On the basis of data obtained in this study, it is recommended:

1. A second equivalent form of the college health knowledge test should be developed to provide separate but equated instruments for situations requiring two test forms. It is the intention of the writer to proceed with this project.

2. There is a need for pre-testing in General Hygiene at the freshmen college level to discover the background of the class so that teaching emphasis may be directed to new areas of learning and to attempt to correct health misconceptions held by the student.
3. To give instructors an estimate of the effectiveness of their own instruction in General Hygiene, a program of pre-testing and post-testing might be carried on.
4. A further study might be implemented at the secondary school level throughout the state of Oregon using the college health knowledge test to assess the amount of health knowledge possessed by graduating seniors. This could be used as an external standard for reference in appraising local curriculum methods and teaching effectiveness.
5. Administrators on the higher education level should provide for the use of the medium of television as a means for teaching General Hygiene to college freshmen.
6. Further investigations should be made into the various patterns of instruction using the medium of television to teach General Hygiene.
7. An honors section should be established in the course P. E. 160, General Hygiene, to more fully challenge the student with high academic potential.

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## APPENDIX

EVALUATION INSTRUMENTS IN HEALTH EDUCATIONPart I. - Published Instruments

## Elementary School

1. Adams, Georgia S. and John A. Sexton. California tests in Social and Related Sciences: Part III, Related Sciences, Test 5, Health and Safety. Monterey, California, California Test Bureau, 1953. For grades 4-8, this 75 item test is composed of true-false and multiple-choice questions designed to measure knowledge in the health and safety areas. Norms and a manual of directions are available. This test is one of a battery of subject matter tests in the sciences for the upper elementary grades.
2. Bicycle Safety Quiz. Hartford, Connecticut, Aetna Life Insurance Company, n.d. Designed for the elementary level, this 20 item true-false quiz can be used independently or in conjunction with the showing of a film, "Safe on Two Wheels. "
3. Community Bicycle Safety Program: What? Why? How? New York Association of Casualty and Surety Companies, 1956. Designed to help communities in establishing community-wide bicycle safety programs. Included are a brief 25-item quiz on traffic rules and safe riding practices and three skill tests to evaluate riding ability.
4. Crow, Lester D and Loretta C. Ryan. Health and Safety Education test. Rockville Center, New York, Acorn Publishing Co. , 1960. For grades 3-6, this 90 item multiple-choice test was constructed to measure a student's knowledge, application of rules, understanding of cause and effect, and ability to select the best habits in health and safety areas. Norms and teacher's directions are available.
5. Dzenowagis, Joseph G. Self-Quiz of Safety Knowledge. Chicago, School and College Division, National Safety Council. 1956. This test consisting of 40 safety misconceptions, is designed to measure safety preparedness at the fifth and sixth grade levels.

6. Elementary Science and Health, Grades 4, 5, 6. Columbus, Ohio. State Department of Education. 1960. The Ohio Scholarship tests consist of matching, multiple-choice, and other objective type items to measure health knowledge.
- ✓ 7. Los Angeles Health Education Evaluation Instruments. Los Angeles City School District, California. n. d. A number of instruments for evaluating health knowledge, attitudes, and behavior at elementary and secondary levels are now available.
8. Speer, Robert K. and Samuel Smith. Health Test. Rockville Center, New York, Acorn Publishing Company. 1960. For grades 3-8, this has two forms and was designed to test the students judgment, understanding, and knowledge of health facts. Multiple-choice and problem-type questions are used. Norms and teachers directions are available.
9. National Safety Council Tests. Chicago. National Safety Council. n. d. These tests are included in a series of school safety lessons, issued monthly, September through May, for each of four grade levels: lower elementary, upper elementary, junior high, senior high.
10. Elementary Health. See No. 12.

#### Junior High School

11. Adams and Sexton. California Tests in Social Sciences. See No. 1.
- ✓ 12. Elementary Health: Every Pupil Scholarship Test. Emporia, Kansas, Bureau of Educational Measurement, Kansas State Teachers College, 1960. This 60-item multiple choice test, for grades 6-8, aims to measure the student's knowledge of rules and principles of healthful living and his health attitude. A new form is issued each April and January, and norms are available following each testing period.
13. Health Education and Hygiene, Grades 7, 8, 9. Columbus, Ohio, State Department of Education, 1960. The Ohio Scholarship test consists of matching, multiple-choice, and other objective type items to measure health knowledge. New test forms are available twice a year.

14. Kilander, Frederick H. Information test on biological aspects of human reproduction. New York, New York University, 1958. This 33 question multiple choice test is for junior high school through college levels. Norms are available.
15. \_\_\_\_\_. Nutrition information test. New York, New York University, 1959. This 33-question multiple-choice test is for junior high school through college levels. Norms are available.
16. \_\_\_\_\_. Stimulants and depressants information test. New York, New York University, 1958. This 33-question multiple-choice test is for junior high school through college levels. Norms are available.
17. \_\_\_\_\_. Tuberculosis information test. New York, New York University, 1957. This 20-question multiple-choice test is for junior high school through college levels. Norms are available.
18. Los Angeles Health Education Evaluation Instruments. See No. 8.
19. National Safety Council Tests. See No. 10.
20. Shaw, John H. and Maurice E. Troyer. Health education test: Knowledge and application. Rockville Centre, New York, Acorn Publishing Company, 1957. Available in forms A and B for grades 7-12 and college freshmen, this test consists of 100 multiple-choice and true-false items. Knowledge and application of knowledge are tested. Some physical education items are also included. Norms and a manual of directions are available.
21. Speer and Smith. Health Test. See No. 9.

#### Senior High School

22. Dearborn. College Health Knowledge Test. See No. 32.
23. Johns, Edward G. and Warren L. Juhnke. Health practice inventory. Stanford, California, Stanford University Press, 1952. Thirteen health areas are represented in the statements included in this 100-item inventory which appraises the health practices of senior high school students, college students, and adults. Norms are available.



24. Kilander, Frederick H. Kilander health knowledge test: evaluation and adjustment series. Yonkers-on-Hudson, New York, The World Book Company, 1952. This secondary school test measures the extent of the individual student's knowledge and understanding of health matters. Two forms are available, each consisting of 75 multiple-choice items. A manual of direction and norms are available.
25. \_\_\_\_\_. See Nos. 14, 15, 16, 17.
26. Los Angeles Health Education Evaluation Instruments. See No. 8.
27. McHugh, Gelolo. Sex knowledge inventory. Durham, North Carolina, Family Life Publications, Inc., 1950. Available in two forms X and Y. Form Y of this inventory measures understanding of the human reproduction system and vocabulary relating to sex. It is suggested that this form could be used at high school, college, and adult levels. Form X is designed specifically for use by marriage counselors in determining sex knowledge and preparation for marriage. Instructors manuals are available.
28. National safety council tests. See No. 10.
29. Shaw and Troyer. Health education test: knowledge and application. See No. 20.
30. Test your A. Q. (Alcohol Quotient). 535 North Dearborn Street, Chicago, Illinois, American Medical Association, 1956. This is a 20-question true-false test which provides a basis for a good discussion at the senior high and college levels.

#### College

31. Bridges, Frank A. Health knowledge test for college freshmen. Rockville Centre, New York, Acorn Publishing Company, 1956. This 100-item multiple-choice test measures knowledge in 13 health areas. Norms and a manual of directions are available.
32. Shaw, John H. and Maurice E. Troyer. Health education test: knowledge and application. See No. 20.

33. Dearborn, Terry H. College health knowledge test. Stanford, California, Stanford University Press, 1959. One hundred multiple-choice items testing knowledge in 11 health areas. Although designed for the college level, this test is said to be suitable for senior high schools offering a full semester course in personal hygiene.
34. Kilander, Frederick H. Kilander health knowledge test for college students. East Orange, New Jersey, The author, 1961. This instrument designed mainly for college students, consists of 100 multiple choice items representing nine areas of health knowledge. Norms are available.
35. Gaines, Josephine. Student self-appraisal inventory of interests and estimated knowledge in major health education areas. Seattle, Washington, The author, 1960. Although useful primarily in planning content in the college health education course, the knowledge portion of this inventory could be used in evaluating the change in extent of knowledge following teaching in specific health areas.
36. Johns and Juhnke. Health practice inventory. See No. 23.
37. Junior college health knowledge test. Los Angeles, Los Angeles City Schools, 1957. This 100-item multiple choice test covers 11 areas of health instruction. The test was prepared by a committee of junior college health education personnel in cooperation with the Los Angeles City Schools.
38. Leonard, Margaret L. and Clark W. Horton. An inventory of certain practices of health. Sacramento, California, The State Department of Education, 1949. This inventory was developed for use at the college level by the California Community Health Education Project. Its 88 statements can be used to study actual health behavior from the students standpoint both of the student's practices and of the extent to which certain illnesses or health problems become a part of the pattern of behavior. Instructors manual is available.
39. \_\_\_\_\_. An inventory of points of view related to health. Sacramento, California, The State Department of Education, 1949. This inventory developed for college students by the California Community Health Education Project, consists of 109 statements which provide an opportunity for determining student attitudes on individual and public health.

40. \_\_\_\_\_. Reactions to certain situations related to the health of elementary school children. Sacramento, California, The State Department of Education, 1949. This situation-response type inventory was designed to be used with pre-service or in-service teachers at the elementary level. Consisting of 102 items, it explores opinions concerning the role of the teacher in the school health program.
41. McHugh. Sex knowledge inventory. See No. 27.
42. Test your A.Q. (Alcohol Quotient). See No. 30.
43. Kilander, Frederick H. See Nos. 14, 15, 16, 17.

## Part II. --Theses and Dissertations

### Elementary School

44. Dzenowagis, Joseph G. A determination of prevalence of certain harmful health and safety misconceptions among fifth and sixth grade school children. Doctoral dissertation, Boston University, Boston, 1953. An instrument consisting of 203 misconceptions, was constructed to determine their prevalence in this group.
45. Galarneaux, Alexander F. A determination of the prevalence of certain harmful health and safety misconceptions among fifth and sixth grade school children in an urban-residential community. Master's thesis, Boston University, Boston, 1954.
46. Yellen, Sylvia. The development of a health practice inventory for children in grades three, four, and five. Master's thesis, University of California, Los Angeles, 1957. In indicating the frequency of their practices, students response to picture illustrations of various health practices in this inventory. Thirty-one behaviors are illustrated.
47. Klein, Walter C. A health knowledge and understanding test for fifth grade pupils. Doctoral dissertation, Indiana University, Bloomington, 1958. Sixty best answer type items.

## Junior High School

48. Colebank, Arthur D. Health behavior of selected junior high school pupils. Doctoral dissertation, University of California, Los Angeles, 1952. This three part, 108-item test evaluates health behaviors, attitudes, and knowledges.
49. Lundh, Ina Joanaa. The development of an instrument for appraising dental health knowledges, attitudes, and practices of junior high school students. Master's thesis, University of California, Los Angeles, 1957.
50. Mayshark, Cyrus. A health and safety attitude scale for the seventh grade. Doctoral dissertation, Indiana University, Bloomington, 1954. Two forms, consisting of 60-situation-response, multiple-choice items, were developed.
51. Myers, Frank H. A safety attitude scale for the seventh grade. Doctoral dissertation, Indiana University, Bloomington, 1955.
52. Veenker, Harold C. A health knowledge test for the seventh grade. Doctoral dissertation, Indiana University, Bloomington, 1957. Two test forms, consisting of multiple-choice items, were constructed.
53. Poole, Richard D. A health knowledge test for high school. See No. 58.

## Senior High School

54. Augustin, Wilbert Raymond. The construction and standardization of two alternate forms of a health knowledge test for senior high school students. Doctoral dissertation, Temple University, Philadelphia, 1959.
55. Dzenowagis, Joseph. See No. 44.
56. LeMaistre, Harold E. The development of a health behavior inventory to evaluate health education in the senior high school. Doctoral dissertation, University of California, Los Angeles, 1958. This 50-item inventory consists of a number of problem situations met by two senior high school students.

57. Pellett, Elizabeth A. Tuberculin test questionnaire.
58. Poole, Richard D. A health knowledge test for high school. Doctoral dissertation, Indiana University, Bloomington, 1959. Seventy-two best answer type items.

### College

59. Borozne, Jospeh A. Determination of the prevalence of certain harmful health and safety misconceptions among freshman prospective elementary teachers attending teachers colleges in New England. Doctoral dissertation, Boston University, Boston, 1957. An instrument, consisting of 130 misconceptions, was constructed to determine the prevalence of misconceptions.
60. Carr, Wilbur Lloyd. The development of an instrument to appraise the effectiveness of the college requirement in health education. Doctoral dissertation, University of North Carolina, Chapel Hill, 1957.
61. Reid, Carmen Patricia. Health problems test: A health knowledge test for college students. Doctoral dissertation, University of California, Los Angeles, 1956. This test consists of descriptions of a number of health problems, on which 100 true-false questions are based.
- ✓62. Richardson, Charles Everett. Three test instruments for measuring health attitudes of college students. Doctoral dissertation, University of California, Los Angeles, 1959. This set of 51 incomplete sentences, to be completed by students, could be used to determine beliefs, attitudes, and feelings.
63. Segal, Zev. A comparison of sex education attitudes of graduate students in elementary education and graduate students in secondary education. Doctoral dissertation, New York University, New York, 1961. An 80 item attitude scale was constructed, including the following areas: boy-girl relationships, human reproduction, family responsibility, dating, sound courtship practices, and venereal disease.
64. Serdual, George. Standardization of a first aid knowledge test for college students. Doctoral dissertation, Indiana University, Bloomington, 1957.

65. Yancey, Maude J. A study of some health misconceptions of prospective teachers in negro colleges of North Carolina. Doctoral dissertation, University of Michigan, Ann Arbor, 1952. A true-false type checklist, covering a variety of areas in the health field.

Corvallis, Oregon  
November 19, 1964

Dear \_\_\_\_\_.

As a doctoral candidate at Oregon State University in the field of Health Education, the problem selected for my dissertation concerns the development of a College Health Knowledge Test of General Hygiene at the college freshmen level. One of the procedures employed in this study requires the professional judgement of a small number of highly selected specialists throughout the country. Dr. C. L. Anderson, chairman of my committee, has suggested that I write to inquire whether you would participate as one of the jury for this study.

The jury will be asked to make judgements on a three-point scale of some 390 items, all multiple-choice objective type questions, to determine their validity in a test of this nature.

Would you be willing to serve as a judge? Your cooperation will be greatly appreciated. If you choose to serve would you sign in the space provided \_\_\_\_\_? I have enclosed a stamped self-addressed envelope for your convenience. Thank you.

Sincerely yours,

Donald D. Shaw

## LIST OF JURY SELECTED AND UNIVERSITIES REPRESENTED

Dr. C. L. Anderson ----- Oregon State University  
 Dr. Gordon Anderson ----- Oregon State University  
 Dr. Denis Baron ----- Oregon State University  
 Dr. Mary Beyner ----- Ohio State University  
 Dr. George Cousins ----- Indiana University  
 Dr. Wesley Cushman ----- Ohio State College  
 Dr. John Ellis ----- Oregon State University  
 Dr. Roy Foster ----- Oregon State University  
 Dr. Herman Gower ----- Oregon State University  
 Dr. Arthur Koski ----- Oregon State University  
 Dr. Cyrus Mayshark ----- Oregon State University  
 Dr. Richard K. Means ----- Auburn University  
 Dr. Charles Richardson ----- Southern Illinois Univ.  
 Dr. Robert Russell ----- Stanford University  
 Dr. Wesley Staton ----- Colorado State University  
 Dr. Ray Watters ----- Brigham Young University



Table XVI. Validity Correlation Coefficient Data.

Test *	Final *	Test	Final	Test	Final	Test	Final
Scores	Scores	Scores	Scores	Scores	Scores	Scores	Scores
89	363	63	281	82	341	75	326
88	364	63	268	75	336	84	346
88	358	67	287	75	328	75	331
79	342	85	353	75	322	72	297
81	352	71	284	66	284	83	346
79	338	85	359	84	333	68	286
72	298	79	348	55	246	85	347
79	306	69	284	64	290	83	340
73	312	73	307	65	289	74	314
77	339	64	300	81	331	71	282
80	343	63	287	83	332	78	342
71	288	82	349	85	340	61	286
75	332	68	286	81	345	87	361
85	347	90	368	84	352	77	338
81	346	69	285	84	356	71	322
82	340	76	336	79	338	68	290
89	359	82	335	73	312	77	339
83	343	87	359	58	249	66	283
68	280	81	349	73	289	79	329
73	289	63	289	80	340	85	344
70	304	75	334	85	356	77	328
81	346	75	328	82	349	75	321
79	341	82	346	81	350	66	291
87	327	77	332	91	366	68	299
75	326	77	326	74	314	75	320

\* Test Scores are post-test scores on Health Knowledge test

\* Final Scores are scores on which the students final grade was computed.

## CLASSROOM TELEVISION

General Hygiene  
Winter Term, 1965

## Assignments

Textbook: HEALTH PRINCIPLES AND PRACTICE, 4th Edition, C. L.  
Anderson and C. V. Langton

Thursday, January 7	Preface, Forward, Chapter 1 The Student and His Health
Tuesday, January 12	Chapter 2, Inherited Basis of Health
Thursday, January 14	Chapter 2, Inherited Basis of Health
Tuesday, January 19	Chapter 3, Problems of Personal Health
Thursday, January 21	Chapter 3, Problems of Personal Health
Tuesday, January 26	Chapter 4, Nutrition in Health
Thursday, January 28	Chapter 5, Exercise, Fatigue and Rest
Thursday, January 28, 7:15p.m.	<u>Examination</u> , Chapters 1, 2, 3 and 4 and corresponding TV lectures
Tuesday, February 2	Chapter 5, Exercise, Fatigue and Rest
Thursday, February 4	Chapter 6, Safety for Health Promotion
Tuesday, February 9	Chapter 7, Substances Harmful to Health
Thursday, February 11	Chapter 7, Substances Harmful to Health
Tuesday, February 16	Chapter 8, Normal Mental and Emo- tional Health
Thursday, February 18	Chapter 8, Normal Mental and Emo- tional Health
Tuesday, February 23	Chapter 9, Preparation for Family Living
Thursday, February 25	Chapter 9, Preparation for Family Living
Monday, March 1	Chapter 9, Preparation for Family Living

Tuesday, March 2, 7:15 p.m.	Chapter 10, Prevention of Disease and Disorders
Thursday, March 4	Chapter 10, Prevention of Disease and Disorders
Tuesday, March 9	Chapter 10, Prevention of Disease and Disorders
Thursday, March 11	Chapter 11, State and Local Health Services Chapter 12, International and National Health Services
Saturday, March 13, 10:00 - 12:00 a.m.	<u>Final Examination</u>

## COLLEGE HEALTH KNOWLEDGE TEST

DO NOT WRITE OR MARK ON THIS TEST. Please read all instructions carefully before beginning.

I. FOLLOW THE INSTRUCTIONS IN THE ORDER IN WHICH THEY ARE GIVEN.

1. On the answer sheet, write your name, sex, class(i.e. freshman, sophomore, etc.), your student number, high school or preparatory school attended and the name of your home town or city.
2. This test is composed of 100 MULTIPLE-CHOICE items. You have a selection of one correct answer from five choices. Read each question carefully, SELECT THE ANSWER that appears best (correct or most nearly correct) to you, and then mark the response you chose in the appropriate space on your answer sheet.
3. Mark only on the answer sheet. Be sure your marks are heavy and black. Erase completely any answer you wish to change. Complete as many statements as you can, but leave blank rather than make a wild guess.
4. Upon completion of the test, you must: return the original test, the answer sheet, and the marking pencil to your instructor.
5. If you have any general questions, ask them now, do not start until the examiner tells you to do so.

- 
1. The efficiency of which of the following systems is most important in extending the prime of life?
    - A. Musculature
    - \*B. Circulatory
    - C. Endocrine
    - D. Digestion
    - E. Reproduction
  2. The most important meal of the day for college students is:
    - \*A. breakfast
    - B. lunch
    - C. dinner
    - D. snacks
    - E. brunch

3. The basic responsibility for a person's health rests with the:  
A. health department                      D. family of the individual  
B. medical profession                      \*E. individual himself  
C. community
4. The problem of self medication is:  
A. it is expensive  
B. it masks serious symptoms  
\*C. proper treatment delayed causes death or permanent damage  
D. the medicine taken is valueless  
E. drugs cause other complications
5. Ovulation in the female normally occurs:  
A. at the beginning of the menstrual cycle  
\*B. at the mid-point of the menstrual cycle  
C. at the end of the menstrual cycle  
D. several times during the menstrual cycle  
E. just before the menstrual cycle begins
6. High tensions and frustrations in normal youth:  
\*A. increase the intensity of the sex drive  
B. diminish the intensity of the sex drive  
C. have no effect on the sex drive  
D. account for the increased birth rate  
E. can produce sterility
7. During menstruation, the female should:  
A. not go swimming                      D. stay in bed  
\*B. go about normal activities      E. reduce activities  
C. not take a bath
8. The leading causes of death today in the United States can be classified as:  
A. communicable diseases              D. contagious diseases  
\*B. degenerative diseases              E. functional diseases  
C. deficiency diseases
9. An ovum on its way to the exterior of the body follows which one of the following courses?  
A. Uterus, oviduct, vagina, ovary  
B. Oviduct, uterus, ovary, vagina  
C. Ovary, uterus, vagina, oviduct  
D. Oviduct, ovary, uterus, vagina  
\*E. Ovary, oviduct, uterus, vagina

10. The most important factor in successful social adjustment is:  
A. flattery  
B. aggressiveness  
\* C. interest in other people  
D. egocentricity  
E. timidity
11. The greatest health value of exercise has its effect upon:  
A. respiration  
B. strength  
C. endurance  
\* D. circulation  
E. flexibility of joints
12. Which of the following is regarded by health scientists as the most serious problem in the United States?  
\* A. Alcohol addiction  
B. Nicotine addiction  
C. Morphine addiction  
D. Barbiturate addiction  
E. Marihuana addiction
13. Metabolism is:  
A. building of cells  
B. tearing down of cells  
\* C. building up and tearing down in cells  
D. creation of energy  
E. rapid change in the cell
14. The greatest danger in traffic is the driver who is:  
A. color blind  
B. a woman  
C. deaf  
\* D. antisocial  
E. cautious
15. A person's behavior is the result of:  
A. hereditary tendencies  
B. environmental influences  
\* C. both heredity and environment  
D. social influences  
E. mental tendencies
16. Frequent sore throat in youth predisposes to:  
\* A. rheumatic fever  
B. heart disease  
C. arthritis  
D. tuberculosis  
E. cancer
17. The delay of sexual relations after biological maturity:  
A. prevents complete physical development  
B. increases probability of having children after marriage  
C. constitutes harmful repression of a natural instinct  
\* D. causes no physical or mental ill effects  
E. reduces fertility after marriage

18. Which of the following is classified as an organic disease?  
\*A. Diabetes meliitus                      D. Appendicitis  
B. Septic sore throat                      E. Sinusitis  
C. Smallpox
19. Every normal person:  
A. has no feeling of inferiority  
B. has no fear or apprehension of failure  
C. can reach perfection in mental health  
\*D. becomes emotionally disturbed  
E. can avoid all frustrations
20. Which of the following is NOT a body defense against infection?  
\*A. Alkalinity of the skin                      D. Fever  
B. Hydrochloric acid of the stomach      E. Mucous secretions  
C. Salinity of tears
21. Sex and reproduction differ in that:  
A. they are directly opposed to each other  
B. neither is biological  
C. one is natural, the other unnatural  
\*D. one is primarily emotional, the other biological  
E. sex occurs only in the male, and reproduction only in the female
22. Which of the following is correct?  
A. All social drinkers become alcoholics  
\*B. All alcoholics once were social drinkers  
C. In the United States more women than men are alcoholics  
D. Most alcoholics are social drinkers  
E. Most alcoholics could quit drinking if they wished
23. In which way are carbohydrates utilized by the body?  
A. To supply energy and build new tissues  
B. To regulate body processes  
\*C. To supply heat and energy  
D. To build and renew tissues  
E. To provide roughage
24. A recorded basal metabolism rate would be inaccurate if the patient was:  
\*A. digesting and absorbing food                      D. well rested  
B. lying down    E. free from illness  
C. of normal body temperature

25. Life expectancy at birth in the United States is:  
A. greater than that of any other country in the world  
B. lowest in the world  
C. greater than that of all European countries  
\* D. less than that of the Scandinavian countries  
E. below the average for the world
26. Vitamins:  
\* A. act as regulators  
B. provide heat energy  
C. provide cell building material  
D. are basic food for nerves  
E. can do all the above
27. Of the following the least important factor to mental health is:  
A. good physical health  
B. good social health  
\* C. exceptional intellectual capacity  
D. material security  
E. popularity with the opposite sex
28. A husband and wife are both heterozygous for a trait which neither they nor their two children exhibit. Therefore, the trait:  
A. is transmitted as a dominant  
B. is an example of incomplete dominance  
C. would have to be sex-linked  
\* D. is inherited as a recessive  
E. is certain to appear if a third child is born to this husband and wife
29. Medical authorities unanimously condemn coffee drinking by children because:  
A. caffeine tends to retard normal growth  
\* B. coffee in the diet would replace milk and fruit juices  
C. caffeine is an irritant to the delicate lining of the esophagus  
D. susceptibility to respiratory infections is increased by caffeine  
E. it is an unnecessary part of the diet
30. A person of normal health:  
A. never gets ill  
B. never gets tired  
\* C. shows variations in his physical condition  
D. never gets emotionally upset  
E. is always the same
31. Activity should be determined by:  
A. a person's physiological capacity  
B. his general health condition  
C. physiological fitness  
D. his interests  
\* E. all of the above



32. Puberty is a condition which normally occurs at the beginning of:
- A. menopause
  - B. early adult life
  - C. pregnancy
  - D. middle age
  - \*E. adolescence
33. The most important factor in the length of a person's life is:
- A. regular rest and plenty of exercise
  - B. the careful choice of foods and the avoidance of undue strains of any sort
  - \*C. one's inherited constitution
  - D. the avoidance of excessive use of stimulants and alcohol
  - E. the education and intelligence of the individual
34. A person of normal mental health never:
- A. gets angry
  - B. becomes upset
  - \*C. reaches his potential level
  - D. encounters frustration
  - E. acts in his own self-interest
35. Which of the following is NOT correct?
- A. A person always rests during sleep
  - B. A person rests only when he sleeps
  - C. People who move during sleep do not rest
  - D. A person who is really tired will go right to sleep
  - \*E. All of the above four
36. Studies show that people with high serum cholesterol levels have:
- A. a low incidence of atherosclerosis
  - B. few heart attacks
  - C. a diet low in fat
  - D. robust health
  - \*E. a higher incidence of atherosclerosis
37. Excessive thyroxin output results in a (an) :
- A. carotene deficiency
  - \*B. underweight condition
  - C. overweight condition
  - D. water imbalance
  - E. basal metabolism rate of less than minus 10
38. For the individual of normal mental health, disintegration of the personality:
- A. never occurs
  - B. is highly frequent
  - C. is of long duration
  - \*D. is of short duration
  - E. is of a major type

39. In America, sexual morality:
- A. is consistent among all of its people
  - \*B. varies with different social groups
  - C. is indicative of sexual precocity
  - D. is a relatively simple matter
  - E. does not matter
40. A poison which stops breathing is:
- A. carbon monoxide
  - \*B. a neurotoxin
  - C. a carcinogen
  - D. nicotine
  - E. a ptomaine
41. Dental caries are:
- A. the same as dental cavities
  - B. caused by drinking fluoridated water
  - \*C. a process of dissolving of tooth enamel
  - D. prevented entirely by the use of toothpaste
  - E. the result of dental cavities
42. The most egocentric period in life is between:
- \*A. birth and 5 years of age
  - B. 6 and 9 years of age
  - C. 10 and 14 years of age
  - D. 15 and 20 years of age
  - E. 31 and 35 years of age
43. An individual's degree of biological masculinity or femininity is:
- \*A. primary glandular
  - B. primarily social conditioning
  - C. due to dietary conditions
  - D. due to physical size
  - E. due to order of birth
44. The normal functioning of the thyroid gland is dependent upon adequate dietary amounts of:
- A. chlorine
  - B. cobalt
  - C. fluorine
  - \*D. iodine
  - E. potassium
45. In the light of present knowledge, the best way to keep one's self free from colds is to:
- A. take a laxative
  - B. take vitamin A in cod liver oil
  - C. get lots of rest and eat at regular times
  - D. use one of the various vapor treatments
  - \*E. avoid close contact with persons who have colds
46. An example of a positive emotion is:
- A. fear
  - B. anger
  - \*C. love
  - D. fright
  - E. remorse

47. The reason for NOT using patent medicines is:
- A. they cost too much for the good derived from them
  - \*B. they delay an individual from seeing a physician
  - C. they cause addiction
  - D. testimonials in favor of them are slanted
  - E. they perform to the extent of their advertisement
48. Which of the following is NOT true in sleep?
- A. Temperature of the body is lowered
  - \*B. Circulation rate is increased in order to remove wastes
  - C. Oxygen content of the brain area is reduced
  - D. The nervous system continues to work
  - E. The digestive system may continue actively
49. A course in general health places its major emphasis upon:
- A. symptoms of the various diseases
  - B. how to correct physical defects
  - C. memorization of specific statistics
  - \*D. understanding of health principles
  - E. anatomy and bacteriology
50. Continence or restraint in sexual responsiveness before marriage is:
- A. injurious to physical health
  - B. helpful to physical health
  - C. injurious to mental health
  - D. beneficial to mental health
  - \*E. in accordance with acceptable American social standards
51. In a certain marriage, neither parent has a certain disorder which is known to be inherited. The couple have two daughters who have the disorder. Therefore:
- A. the disorder is inherited as a dominant characteristic
  - \*B. the disorder is inherited as a recessive characteristic
  - C. the disorder is inherited as a sex-linked trait
  - D. no inheritance factor can be involved here
  - E. the disorder is developmental
52. Education of drivers is effective in reducing accidents when significant improvement is made in their:
- A. knowledge
  - B. skills
  - C. hand-eye-foot coordination
  - \*D. attitudes
  - E. strength

53. Conception begins:
- A. during sexual intercourse
  - B. during ovulation
  - \* C. when the sperm unites with the ovum
  - D. when the fertilized ovum reaches the uterus
  - E. when the ovum enters the oviduct
54. Pasteurization:
- A. reduces the nutritive value of milk
  - B. preserves vitamins
  - C. kills all bacteria
  - \* D. kills disease producing organisms
  - E. increases digestibility
55. The type of disorder which occurs when an inadequate release of emotional tension creates functional bodily disorders, such as headache and high blood pressure, is known as:
- \* A. psychosomatic condition
  - B. insanity
  - C. neurosis
  - D. psychosis
  - E. phobia
56. In the United States accidents, as a cause of death, are:
- \* A. of importance for all age groups
  - B. declining in importance
  - C. increasing in rate
  - D. of significance only for ages 1 to 29
  - E. first as a cause of death for all ages
57. It is humanly possible to:
- A. eliminate all hazards
  - B. make a completely safe world
  - \* C. markedly reduce unnecessary risks
  - D. prevent all accidental deaths
  - E. make all people adequately safety conscious
58. Chronic diseases are characterized by:
- \* A. slowly progressing symptoms
  - B. the patient being beyond the prime of life
  - C. recurring frequently
  - D. being caused by microorganisms
  - E. their rapidity in causing death

59. Emotions:
- A. should never be suppressed
  - B. should be given free expression
  - C. are properly used as a means of binding others to one's will
  - \* D. serve as powerful forces for creative work
  - E. are unrelated to physical well-being
60. Which of the following is least indicative of mental health?
- A. Objectivity
  - B. Orderliness
  - \* C. Sensitivity
  - D. Interest in other people
  - E. Life goal of service
61. In terms of health, which of the following outcomes of exercise is of least importance?
- A. Mental health
  - \* B. Powerful muscles
  - C. Physiological fitness
  - D. Extension of the prime of life
  - E. Improved efficiency of circulation
62. Amino acids are found in:
- A. carbohydrates
  - \* B. proteins
  - C. vitamins
  - D. minerals
  - E. fats
63. The normal heart:
- A. is often damaged by strenuous exercise
  - B. maintains a constant rate of contraction
  - \* C. changes output with varying body needs
  - D. contains three chambers
  - E. has valves which permit blood to flow in two directions alternately
64. Carbon monoxide poisoning:
- A. is due to the narcotic effect of the gas
  - \* B. is caused by carbon monoxide displacing oxygen
  - C. is due to the strangling effect of the gas
  - D. occurs abruptly
  - E. is always fatal
65. To gain weight, the least effective food is:
- \* A. proteins
  - B. carbohydrates
  - C. fats
  - D. starches
  - E. sugars

66. Sexual adjustment in marriage:
- A. must be 100 percent perfect to be acceptable
  - B. is never acceptable
  - C. is not a necessary aspect of successful marriage adjustment
  - D. is always satisfactory
  - \* E. can be satisfactory without being perfect
67. Health scientists would regard which of the following to be the most important contribution of exercise to health?
- A. Improvement of posture
  - B. Extension of the span of life
  - C. Coordination values
  - \* D. Mental health values
  - E. Muscular strength
68. Unsafe conditions:
- A. usually are due to unstable physical factors
  - B. are more difficult to correct than unsafe acts
  - \* C. are easier to correct than unsafe acts
  - D. cause more accidents than unsafe acts
  - E. are really not significant in the safety program
69. When botulism occurs, it is found to be due to:
- A. eating uncooked commercially canned foods
  - \* B. eating home canned foods not sufficiently heated before serving
  - C. eating commercially canned foods not sufficiently heated before serving
  - D. drinking bad liquor
  - E. drinking raw milk
70. Vitamin B helps produce healthy skin by:
- A. affecting the blood vessels in the skin
  - \* B. affecting the nerves of the skin
  - C. producing oil
  - D. preserving the elasticity of the skin
  - E. keeping the epithelial cells healthy
71. Fluorine is added to drinking water in some areas to:
- A. kill bacteria
  - B. soften water
  - C. prevent disease
  - \* D. reduce dental decay
  - E. prevent goiter



80. Chronic nephritis is a general term referring to diseases of the:  
A. spleen D. intestines  
B. pancreas E. nerves  
\*C. kidneys
81. The daily caloric need of the average college girl is about:  
A. 500 calories D. 2000 calories  
B. 1000 calories \*E. 2500 calories  
C. 1500 calories
82. Present levels of radioactive materials in the atmosphere:  
A. effect everyone alike  
\*B. are not a known hazard to human life  
C. come from atom bomb testing  
D. are serious because of their effect on the skin  
E. are from ultraviolet radiation
83. The group of conditions below which includes only degenerative diseases is:  
A. cancer, high blood pressure, syphilis, diabetes  
B. measles, apoplexy, arteriosclerosis  
C. appendicitis, stomach ulcers, cancer, heart failure  
D. whooping cough, pernicious anemia, rickets, delirium tremors  
\*E. arteriosclerosis, diabetes, apoplexy, atherosclerosis
84. Which of the following is NOT an attribute of a normal college student?  
A. Inferiority feeling  
B. Apprehension about a new experience  
C. Fear of the unfamiliar  
\*D. Total lack of self interest  
E. Some feeling of social inadequacy
85. A complete professional examination of the eyes is best made by a (an) :  
A. obstetrician \*D. ophthalmologist  
B. optician E. family physician  
C. optometrist
86. Which of the following does NOT involve a pathogenic organism?  
A. Wart \*D. Eczema  
B. Cold sore E. Boils  
C. Acne



87. The necessary vitamins would be best obtained from:  
A. fish liver oils                      \* D. natural foods  
B. vitamin concentrate                E. "health" foods supplement  
C. sunshine
88. Warts are caused by:  
A. an animal parasite  
\* B. a virus  
C. an abnormal condition of small surface blood vessels  
D. an overgrowth of one of the deeper pigmented layers of skin  
E. protein hypersensitivity
89. The principle use which the body makes of protein is:  
A. for quick energy  
B. to aid digestion  
\* C. for the growth and replacement of tissues  
D. to add bulk to the diet and thus prevent constipation  
E. to stimulate the flow of bile
90. Sexual arousal of the female is:  
A. nonexistent                                D. somewhat neutral  
\* B. less sensitive than in the male        E. entirely genital  
C. more sensitive than in the male
91. A toxin is a:  
A. drug                                        D. protozoan  
B. bacterium                                \* E. poison  
C. virus
92. Excessive pressure produced by fluid in the eye is the cause of:  
A. myopia                                    D. cataract  
B. hyperopia                                \* E. glaucoma  
C. astigmatism
93. For college women the most likely cause of death during the next four years is:  
A. pneumonia                                D. tuberculosis  
B. mononucleosis                        \* E. accidents  
C. poliomyelitis
94. 'Hypoglycemia' means:  
A. too much blood sugar  
B. sugar administration by hypodermic needle  
C. blood sugar mixed with water  
D. glycerin  
\* E. too little blood sugar

95. All "catching" diseases have in common the following characteristics; they:
- A. are transmitted from person to person by nose and mouth discharge
  - B. have a high mortality
  - C. tend to come to a "crisis"
  - \* D. are caused by some organism
  - E. are more severe in tropical countries
96. The most important factor in assuring success in marriage is:
- A. physical maturity
  - D. moral maturity
  - \* B. emotional maturity
  - E. vocational maturity
  - C. social maturity
97. Which of the following has no scientific support?
- A. Smoking by the expectant mother effects the fetus adversely
  - B. Nicotine can diffuse from the mother's blood to the blood of the fetus
  - \* C. Children of smoking mothers will not live as long as children of non-smoking mothers
  - D. Smoking can increase the heart rate
  - E. Smoking can increase the blood pressure
98. In a sex-linked characteristic the:
- A. same condition cannot occur in females
  - B. genetic factor is present in the female
  - \* C. effective gene is part of a sex chromosome
  - D. condition is congenital
  - E. gene operates as a dominant
99. Degenerative diseases are best postponed by:
- A. increased consumption of vitamins
  - \* B. use of available scientific knowledge of health
  - C. a diet high in vegetables
  - D. glandular transplants
  - E. use of tranquilizing drugs
100. Which of the following is NOT correct ?
- A. All female germ cells contain an X chromosome
  - B. One-half of all male germ cells contain an X chromosome
  - C. One-half of all male germ cells contain Y chromosomes
  - \* D. All male germ cells contain a Y chromosome
  - E. All germ cells contain one sex chromosome

\* correct answer