A CURRICULAR STUDY IN BEGINNING MICROBIOLOGY TAUGHT IN TEXAS JUNIOR/COMMUNITY COLLEGES

DISSERTATION

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by

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The purpose of this study was to determine what knowledge and skills are currently being taught in beginning microbiology in junior/community colleges in Texas. This information was determined from a survey questionnaire sent to junior/community college teachers of beginning microbiology. Also surveyed were senior college teachers who teach courses which require beginning microbiology as a prerequisite. This additional survey was to determine what preparation is needed for students progressing from beginning microbiology to upper level microbiology courses. Information gathered from the two populations of teachers was then compared to determine if any differences exist in the depth of coverage assigned by these teachers.

The curricular information was gathered by a survey questionnaire which consisted of 188 items distributed in 14 topics. The survey questionnaire was designed with Likert-type scaling, with responses in five categories based upon the varying depths of coverage to which the teachers assigned each item. A test-retest was run to determine the reliability of the test items. Chi square was calculated to compare first

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responses to second responses. This analysis revealed 179 reliable test items on the survey questionnaire. Chi square was also calculated to determine the homogeneity of responses of the two populations of teachers. Of the 79 items where differences occurred, senior college teachers assigned more depth of coverage to 58 of the items. Most of the items in which senior college teachers indicated more depth of coverage was needed were in five topic areas, history of microbiology, chemistry, microbial genetics, microbial activities in nature and laboratory activities.

Moderate coverage or more was assigned 142 items by 50% or more of the senior college teachers. These items were identified as common elements. These common elements need to be taught in beginning microbiology so that students who take upper level microbiology courses will possess the knowledge and skills which will aid their mastery of the more complex knowledge and skills of upper level microbiology courses.

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CHAPTER I

INTRODUCTION

Most post-secondary academic schools in Texas offer a beginning microbiology course for freshmen and sophomores. A prerequisite of three or four hours of college biology is usually required before a student can take the course. The course gives four hours of college credit to the student and includes a three-hour lecture and either a weekly three-hour laboratory or a twice weekly two-hour laboratory. While a number of different majors may take the course, most students who take it are either biology majors or are majoring in some allied health field. The course may be the terminal course in microbiology required for the student, or may serve as a prerequisite for microbiology courses offered to students in their junior or senior year. These higher level microbiology courses may be designed to serve the needs of allied health majors or of biology majors.

The curriculum is a concern of every teacher of beginning microbiology. Designing curriculum begins with student outcomes (Bergquist, et al., 1981). What knowledge and laboratory skills should be acquired by the student in beginning microbiology? Presently, the curriculum is

determined the same way the curricula of most other college courses is determined--by each individual teacher (Rudolph, 1977). Resource materials include textbooks and laboratory manuals written for the course, current articles in magazines and research journals, meetings and seminars, discussions held between faculty members, and the teacher's own training and prejudices in the area. The curriculum of the course may also be modified by a concern for the type of students traditionally enrolled in the course. Their needs and expectations may be considered. The local community may also influence curriculum with its own needs and expectations. Finally, transfer students' needs to be prepared for subsequent microbiology courses have to be taken into account (The Carnegie Foundation for the Advancement of Teaching, 1987). With so many different directions for a teacher to take, with so many different pressures to take the course in different directions, one might believe that no two courses are alike. Indeed, a number of beginning microbiology courses are so different from other beginning microbiology courses that the two may be hard to recognize as the same course.

In the past, the diversity of opportunity that existed between schools has been considered to be one of the great strengths of American higher education (The Carnegie Foundation, 1985). However, there seems to be a growing

concern that this diversity may not be all good, since this diversity also accounts for the absence of common standards and expectations (The Carnegie Council Series, 1977). Should teachers of microbiology courses that have the beginning microbiology course as a prerequisite expect their students to have certain skills and knowledge when they enter their courses? If not, then why have a prerequisite? The Rising Juniors Exam, which is a standardized test used in some states to qualify college students for their junior year, also indicates that certain knowledge and skills are expected of students who advance in their education, and that needed knowledge and skills are not always being taught (Hanford, 1986). Here in Texas, the state legislature has mandated the formation of TASP, Texas Academic Skills Program, which includes an exam that serves as an example of such a test in our state (Texas Education Agency & Texas Higher Education Coordinating Board, 1988).

The Rising Juniors Exam in other states, and TASP in Texas, is essentially a continuation of a process which began a few years ago in our public schools. Dropping Scholastic Aptitude Test (SAT) scores and American College Testing Assessment (ACT) scores of graduating high school seniors over the past decade (Astin, 1976) have spurred the continuing debate on curriculum and education (Levine, 1981). Perhaps the "market street" curriculum (The Carnegie

Foundation for the Advancement of Teaching, 1987) of the 70's which included so much diversity has led to such a variety of standards and expectations that certain basic skills and knowledge deemed necessary for a person to be educated were de-emphasized, if not dropped completely from the curriculum of particular courses. Students who miss out on certain basic knowledge and skills in early years find it difficult to develop this knowledge and those skills when they reach a point where teachers expect them already to possess this knowledge and those skills. This loss of the proper sequencing in the curriculum has been blamed for many problems in our educational system today (Menacker, 1975) (The Carnegie Foundation, 1985). In order to establish common standards and to insure that proper sequencing of knowledge and skills be accomplished in our public schools, the Texas legislature mandated that particular knowledge and skills be taught in particular courses in our public schools. The particular knowledge and skills required are called <u>essential elements</u> (Gratz, 1986). Texas teachers are now required to teach these <u>essential elements</u> in particular courses (Texas Education Agency, 1981). This has certainly limited the teacher's flexibility in the public schools. This is an infringement on a teacher's academic freedom, but is considered necessary to insure that students develop a set of common knowledge and skills that is deemed important

for a graduating high school senior to possess.

The same problem faces higher education today. Too many college graduates do not possess the knowledge and skills that should be common to educated individuals. Complaints from private industry have become increasingly strident that college graduates are not truly educated. Some companies have even gone to the extreme of establishing their own schools to educate their employees (The Carnegie Foundation for the Advancement of Teaching, 1987). There has been a great concern in Texas that even our public school teachers are not truly educated. This led to the development of an exam that Texas public school teachers had to pass in order to retain their positions as teachers. This teacher's exam will now be replaced with the test developed by TASP. All Texas students beginning the fall of 1989 will have to pass the test developed by TASP before they can progress further with their education.

As students progress with their education, the proper sequencing of their knowledge and skills is important. Before students move from grade school to middle school they should possess certain skills and knowledge. Before they progress from middle school to high school, they should possess certain skills and knowledge. Before they progress from high school to college, they should possess certain skills and knowledge. Now the emphasis on proper sequencing

has finally reached the college level. Before students progress to their junior year in college, they should possess certain skills and knowledge. Critics of the junior/community college contend that the two-year colleges are not doing a good job of producing transfer students to the four-year colleges (Mitchell & Grafton, 1985). Is it time to establish essential elements in the first two years of college to insure proper sequencing of knowledge and skills for students transfering to their junior year?

Establishing essential elements in college would bring to the college level a loss of academic freedom. Academic freedom is such an important ingredient in higher education that no one would espouse such a radical idea. Yet, such a thing has happened to our public schools. Might it not also happen to the first two years of higher education? Junior/community colleges with their open door policies must struggle to turn out competent products, students who can move on to senior colleges and be successful. In Texas, TASP was designed to help insure that students do progress only if they are competent to do so. But what if this plan fails? What if colleges continue to graduate inferior products? Might we not then go a step further and install essential elements in the first two years of college level work? The erosion of academic freedom must be stopped. There is an alternative to establishing essential elements

for college courses. Freshman and sophomore level courses that are used as prerequisites for upper level courses in college do need to be examined to see what knowledge and skills are required of those students who continue on to those upper level courses. But instead of developing a set of knowledge and skills that have to be taught, there should be a set of knowledge and skills expected of students who transfer to upper level courses. The knowledge and skills common for transfer students could be called common elements rather than essential elements. Teachers would then have a valuable guide to help them decide on the curriculum of the course that they teach.

Teachers of beginning microbiology should be supplied with such a guide to help them decide what their particular curriculum should include. This study provides that guide. It involves a survey of junior/community college teachers of beginning microbiology to find out what they teach. This study also involves a survey of senior college teachers who teach some course which requires the beginning microbiology course as a prerequisite. This study determines what these senior college teachers expect from students who continue their education in microbiology. The results of this study indicate a number of common elements (rather than essential elements) regarding the expectations of these senior college teachers. Using the results of this study, teachers of the

beginning microbiology course can now take these common elements into account in determining the curricula for their courses.

Statement of the Problem

This study is concerned with the curriculum of beginning microbiology as practiced and preferred by microbiology teachers in Texas.

Purpose of the Study

The purpose of this study is to determine what particular knowledge and skills are taught in the beginning microbiology course in Texas junior/community colleges. This study in also concerned with what particular knowledge and skills are expected to be taught to students who use the beginning microbiology course as a prerequisite to upper level courses.

Significance of the Study

This study focuses upon the curriculum of beginning microbiology. First time teachers of any course must be concerned with determining what is to be taught. First time teachers of beginning microbiology can use the results of this study to find out what other teachers of this course teach. Continuing teachers of beginning microbiology can use the results of this study to compare their own curriculum with that of other teachers of the same course.

This study also focuses on the knowledge and skills students are expected to be able to transfer with them to upper level microbiology courses. Use of this information when developing curricula of the beginning microbiology course should insure continuity between the beginning microbiology course and upper level microbiology courses. This should help in sequencing students' knowledge and skills in microbiology so students can successfully perform those more complex tasks expected of them in the upper level courses. The information from this study can also serve as a guide for writing a laboratory manual and/or for writing a textbook for the beginning microbiology course. This study can also be used as a model for similar studies in other courses.

Definition of Terms

The following terms will be used in this investigation and are here defined to insure that certain terms, that have similarities in names, are kept separate in meaning.

1. Essential elements--are used in the same way as currently applied to public schools. Courses taught must concentrate on these individual elements and students must learn these particular elements before they may move on to other courses.

2. Common elements--are used in this investigation to indicate particular knowledge and skills which are expected

to be acquired by students who take particular courses. But these common elements would not be required to be taught. Rather, they would serve as a consideration for the teacher who determines the curriculum for his particular course.

3. Critical value--is the term used to indicate the number which represents the probability that a particular test item is different or the same. The number is derived from Chi Square and the proper degrees of freedom for each individual item tested in this study. This term is used to indicate both the probability level that indicates the test-retest items are different as well as the probability level that indicates the responses of junior/community college teachers and senior college teachers are similar.

4. Purposive or judgmental sampling--are terms used to indicate that individuals of a population are chosen who best meet the purposes of the study.

Limitations

This investigation is subject to all the limitations recognized in collecting data by mailed questionnaires (Bailey, 1987). Subjects selected to be surveyed were chosen by school rather than as particular individuals.

Basic Assumptions

It is assumed that the responses received on the survey instrument were an honest evaluation of what is actually

taught in the classroom, and that no attempt was made by individual respondents to make their particular program look better than it actually is. It is assumed that the construction and content of the survey instrument itself did not adversely influence the respondent.

Research Questions

Questions that will be asked in the research are as follows:

1. What knowledge/skills can be considered to be common elements in the topic History of Microbiology?

2. What knowledge/skills can be considered to be common elements in the topic Microscopy?

3. What knowledge/skills can be considered to be common elements in the topic Eukaryote Microbes?

4. What knowledge/skills can be considered to be common elements in the topic Taxonomy of Bacteria?

5. What knowledge/skills can be considered to be common elements in the topic Bacterial Anatomy and Stains?

6. What knowledge/skills can be considered to be common elements in the topic Chemistry?

7. What knowledge/skills can be considered to be common elements in the topic Cultivation of Microbes?

8. What knowledge/skills can be considered to be common elements in the topic Microbial Genetics?

9. What knowledge/skills can be considered to be

common elements in the topic Viruses?

10. What knowledge/skills can be considered to be common elements in the topic Microbial Activities in Nature?

11. What knowledge/skills can be considered to be common elements in the topic Host Defenses and Treatment Against Disease?

12. What knowledge/skills can be considered to be common elements in the topic Microbial Diseases According to Organs/Systems?

13. What knowledge/skills can be considered to be common elements in the topic Microbial Diseases According to Microbial Groups?

14. What knowledge/skills can be considered to be common elements in the topic Laboratory Activities?

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CHAPTER II

SYNTHESIS OF RELATED LITERATURE

A major element that affects educational standards is the curriculum (Resnick & Resnick, 1983). What is taught determines what is learned. Both the content of instruction and the extent to which all students should study the same material have been continuing sources of debate over the past century. Yet, with all the attention that has been given to curriculum, there has been little attempt to establish any common elements that should be taught in individual courses. Perhaps the most specific attempt is to be found in E. D. Hirsch's best-seller, Cultural Literacy: What Every American Needs to Know, which lists specific things everyone should know (and thus should be taught to all students) (Hirsch, 1987). Still, even this specific list does not tell us in what courses these items should be taught. United States Secretary of Education William J. Bennett in his report "To Reclaim a Legacy" supports Hirsch's goal of establishing a curriculum which enables students to learn about and become participants in a common culture. Bennett then urges the development of a common curriculum with the humanities at the core. While Bennett

recommends certain books, authors and historical documents, he leaves to each institution the responsibility of determining what that particular institution considers an educated person to be and what knowledge that person should possess (Bennett, 1984). Instead of discussing curricula in broad general terms (as with Bennett), or even in somewhat more specific terms (as with Hirsch), now seems to be a propitious time for present day educators to become even more specific and examine curricula of specific courses.

The curriculum of a particular college course is the responsibility of the teacher (Rudolph, 1977). Designing curricula begins with student outcomes (Bergquist, 1981). What knowledge and skills should be acquired by the student in a particular academic course? Different students have different needs. When determining student needs and student outcomes, teachers need to include the knowledge and skills that are required of students when they progress from one course to the next (The Carnegie Foundation for the Advancement of Teaching, 1987). Proper sequencing of student knowledge and skills is needed to correct many problems that exist today in our educatinal system (Menacker, 1975) (The Carnegie Foundation, 1985).

Two major elements determine the curriculum of any particular academic course in college: the textbook and the experiences and knowledge of the teacher of that particular

course. Textbooks which cover a particular subject in college may vary considerably, and it is not unusual for a teacher to survey as many as ten or even twenty different textbooks to find one suited to his particular prejudices and interests. The teacher may still not find a book he feels does justice to the subject and so does without one or feels obligated to write his own. Even in the same school, different teachers of the same course may use different textbooks. Rather than this being a weakness, it is considered to be a strength of higher education, for it is important for a college teacher to have the academic freedom to choose what he thinks is most important to be taught. This investigation is certainly not an attack on academic freedom. This investigation is, however, a call for the establishment of common elements that should help give direction to teachers of the freshman and sophomore level courses, whether in senior colleges or in junior/community colleges. These common elements would give a level of commonality not only within a particular school, but also from one school to the next. Schools that receive transfer students would also know that students who transfer particular courses would in all probability have covered (at least a few) common segments of information/skills.

Once these common elements for a particular course are established, how would they be used? Not as mandated

information (essential elements) to be taught (Gratz, 1986). But rather as a consideration to be used by any teacher of that particular course when he develops his own course curriculum. If he is not teaching something that others in his field thinks should be taught, at least he is aware of it from the results of studies similar to the one proposed here.

Content is the first consideration in teaching. Bloom tells us that simple knowledge is the lowest level of learning, and that analysis, synthesis and evaluation are much more complex skills to teach and learn (Bloom, 1964). This investigator certainly agrees with Bloom's heirarchy of learning. Nevertheless, each course begins with content. Let us start with the common elements that a particular course should include, the higher levels of learning can then be built on these common elements. Any academic discipline taught in the freshman and sophomore level in undergraduate education will serve as a good example of the need for establishing common elements. For example, let us consider mathematics. Is there mathematical literacy, a common core of knowledge that every American needs to know about mathematics? Mathematics is a subject in which the knowledge base is not changing very rapidly. There is an orderly progression from one course to the next, from one knowledge base to the next. In order that a student

understands and deals with the subject matter in one course, it is necessary that the student understand and be able to deal with the subject matter of the previous course. Students are expected to progress from one course to the next, like climbing a ladder, one rung (or course) at a time. So, given that subject matter of mathematics does not rapidly change, and given that progress depends upon the previous course, one would expect that there are a number of common elements to be found in mathematic courses.

In algebra, for example, some common elements would probably be solving equations with variables, dealing with exponents and square roots, graphing equations with linear functions, and working with quadratic equations. But today, with remedial courses being taught in many community colleges, there are a number of algebra courses. There is basic algebra, intermediate algebra, and college algebra. The question arises regarding not only what common elements are taught in a particular algebra course, but also to what depth. And what are these common elements? In trigonometry, for example, is the unit circle approach necessary for the understanding of the subsequent calculus courses, or will the triangle approach suffice? These kinds of questions are now answered individually by teachers and by schools with very little guidance regarding how teachers at other schools are answering these same questions. Surely

the type of survey suggested here would be helpful to teachers of mathematics.

What happens to the student who transfers to another school? Transfer student grades usually drop a letter grade their first semester, and then the second semester they usually reassert themselves. But with no proper sequencing between schools, the student not only has to deal with a new environment, but also a new curriculum in which the teacher has certain expectations of the student which the student is not capable of fulfilling. No wonder the student has a hard time that first semester. Surely the type of survey suggested here would be helpful not only for developing curricula, but also for developing transfer students more adequately prepared for upper level courses.

In mathematics, too, the winds of change are starting to blow again. In the past we have seen the theory of teaching mathematics change from the traditional approach,to modern mathematics, and back to basics. In the future we may see more emphasis on applications in the teaching of mathematics, and some even suggest no mathematics might be acceptable (Meux, 1987). Before we completely change our direction in mathematics, would it not be better to get an opinion from a number of experts in the field, that is, from the teachers of the subjects themselves?

Freshman biology can also serve as a good example of

the need for establishing common elements. Is there biological literacy, a common core of knowledge that every American needs to know about biology? If a student takes freshman biology at one community college and then transfers to another, is there any information/skill that the recipient school is justified in expecting the student to possess? For today there seems to be a plethora of different freshman biology course curricula. One school may emphasize ecology and man in his environment. Another may emphasize the traditional models of botany and zoology. At another school there will be great emphasis on hands-on type learning with laboratory dissections, microscopy studies and demonstrations. At another school the freshman biology course may not require any laboratory work. Many schools offers one course for science majors and a different course for non-science majors. There seems to be a movement away from having separate courses for science majors and non-science majors. Clearly, a study is badly needed to explore these questions!

It is possible that there is not a set of common elements that can be agreed on in freshman biology. Perhaps there is so much information considered to be the prerogative of freshman biology that not even one common element can be agreed on that needs to be taught. If this is so, then even this is valuable to know. Colleges that

receive transfer students can be aware that a student, even with rigorous training in freshman biology, may not have any of the same knowledge base common to nontransfer students. If, however, there are some common elements that students should transfer with them to upper level courses, then teachers of the freshman course need to be made aware of those common elements so they have the option to teach them or not.

When possible, establishing common elements would seem to be helpful in determining the curriculum of any course. This study advocates establishing common elements in the beginning college microbiology course. Upon observation, one might think there would be many common elements in a course with such restricted scope of information. But are there really? In microbiology, should students study microorganisms other than bacteria? Is it necessary to study protozoans, algae, fungi, viruses, and even multicellular parasites? If so, how much laboratory work should be done? How much detail should there be in the study of bacteria? Should students know scientific names of microbes such as Staphylococcus aureus? If so, how many different organisms and which ones should students know? Should they know which are Gram positive and which are Gram negative? Should they know which are acid-fast and which are not? Should they know which ones have spores, are

motile, have plasmids, carry out transformation, conjugation, and so forth? Should this particular level microbiology course be concerned with the manipulation of deoxyribonucleic acid in genetic transfers to form chimeras (genetic recombinants), or should the course be concerned with medical aspects of disease and infection?

Laboratory experiences have traditionally been considered to be an important part of microbiology. But even here, which skills should be taught? Surely students would have to be able to use aseptic techniques when working with bacteria. But what about the Gram stain? How about the acid-fast stain, the fat stain, the metachromatic-granule stain? Should the students be able to determine the identification of an unknown bacterium? Should microbiology students be able to develop flow charts for determining the identity of unknown bacteria? Should the students be able to carry out the various biochemical tests and various stains that are required to work their way through a flow chart for determining unknown organisms? If so, will the traditional biochemical tests that require different test tubes for each test suffice, or should students become competent with the identification tests that are used in hospital settings where they use commercial biochemical testing with things like API strips (analytical profile index) and computer assisted identification techniques?

Thus, even in a course such as microbiology, there are still a number of different approaches and ideas of what should be taught.

It is up to the teacher to set the standards and curriculum of the course. When doing this, it should prove helpful to the teacher to be able to consider a study report that delineates common elements that other professionals think should be included. Subject matter and learning in a course depend largely on the experiences, expertise and enthusiasm of the teacher. A consideration of common elements can help the teacher include in the curriculum the knowledge and skills which insure a standard of educational quality expected by other professionals.

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CHAPTER III

PROCEDURES FOR COLLECTION OF DATA

In order to accomplish the goals of this study, curricular information concerning beginning microbiology was needed from two populations of teachers. This curricular information was collected by use of a survey questionnaire which was sent to more than one-half of the two populations of teachers.

Populations

Samples of two populations of college microbiology teachers from Texas were surveyed. One population consisted of microbiology teachers at Texas senior colleges. When sampling this population it became evident that there were over 100 such teachers in Texas. A total of 79 senior college teachers were surveyed. The second population consisted of beginning microbiology teachers at Texas junior/community colleges. There are 66 junior/community college campuses in Texas as listed in the 1988 Membership Directory of the American Association of Community and Junior Colleges. Most campuses have one microbiology teacher. However, some campuses have two teachers of

beginnning microbiology and some have none. Thus, this population of junior/community college teachers consisted of approximately 66 teachers. A total of 42 junior/community college teachers were surveyed.

Selection of the Sample

A purposive sampling (Kerlinger, 1973) of the senior colleges of Texas was made. The larger universities (senior colleges) known for their research and training in microbiology, size of the department, participation in professional meetings, publications and recognized leaders in the field were used to supply teachers of the upper level microbiology courses. Ten senior colleges were selected to furnish teachers to help establish the reliability of the survey instrument. The following senior colleges were selected: Southwest Texas State University, Texas Christian University, Stephen F. Austin State University, Corpus Christi State University, Austin College, West Texas State University, the University of Texas at Tyler, The University of Texas at El Paso, East Texas State University, and Southwestern University. The teachers' names were obtained from the department chairperson or the registrar of the school. A total of 16 teachers responded to both the test and retest. Another seven universities were selected to provide teachers for the final survey. The schools involved were The University of Texas at Austin, Baylor University,

The University of Houston, Texas Tech University, Abilene Christian University, The University of North Texas and Texas A & M University. These seven universities furnished 58 teachers to be surveyed. Included with the data collected from the respondents from these 58 teachers were the data collected from the first response of the additional 16 senior college teachers who responded to the test-retest.

Systematic sampling (Bailey, 1987) was used to supply the Texas junior/community college teachers of beginning microbiology. There are 66 Texas junior/community college campuses listed in the 1988 Membership Directory of the American Association of Community and Junior Colleges (Palmer, 1988). One-third, or almost one-third, of these schools were selected to supply teachers to survey for the test-retest performed to determine the reliability of the items on the survey. A total of 21 campuses were selected to supply teachers for test-retest purposes. Names of the microbiology teachers at these schools were obtained from the department chairperson or registrar. Only full time teachers were used for the survey. Another one-third, or 22 of these schools were selected to supply teachers for the final survey by picking every third school from the alphabetecal listing in the directroy.

The following junior/community colleges were used to supply twenty-one teachers of beginning microbiology for the

test-retest: College of the Mainland, San Antonio College, Alvin Community College, Angelina College, Cooke County College, Houston Community College System, Galveston College, Jacksonville College, Kilgore College, Laredo Junior College, Mountain View College, and North Lake College. The following junior/community colleges were selected to supply 21 microbiology teachers to be sent the final survey: Wharton County Junior College, Victoria College, Trinity Valley Community College, Texarkana College, Tarrant County Junior College District--Northwest, San Jacinto College District--South, San Jacinto College District--North, San Jacinto College District--Central, Richland College, Navarro College, Midland College, Lamar University--Orange, Howard County Junior College District, Grayson County Junior College, Del Mar College, Collin County Community College District, Cisco Junior College, Brookhaven College, Bee County College and Amarillo College. Names of the teachers were obtained by phoning the department chairperson of the school involved.

Instrument

The instrument used in this study is a survey questionnaire. The survey instrument is included in this paper in APPENDIX B, pages 102-111. Survey questionnaires are useful tools of inquiry and perhaps are best suited to measuring individual opinions and values (Haller, 1979).

The questionnaire is divided into three sections. The first section consists of a one page questionnaire and is used to gather demographic information from respondents as well as some preferences in approach to teaching particular subjects in microbiology.

The second section of the questionnaire consists of a comprehensive list of items which pertain to certain knowledge and skills that are associated with microbiology. These items were assembled after a review of current textbooks in microbiology, from syllabi from other instructors, from questionnaires from textbook companies, from personal knowledge, and from a panel of experts used to validate the instrument. A search was also made of educational documents such as Dissertation Index and Abstract International to see if similar studies have been conducted on this subject area. This second section has 188 items divided into fourteen parts or general topic areas to help organize subject matter and skills. The fourteen general topic areas contain from five sub-item elements to 36 sub-item elements. A small space was left at the bottom of each topic area for any comments respondents may have wanted to add on that particular topic.

The third section consists of an optional, open-ended section which gave room for respondents to add any comments they desired.

Scaling: Likert-type scaling was developed to obtain information from the respondents on the knowledge/skills section of the questionnaire. Each item in this section has five possible responses which are 1, 2, 3, 4 and 5. Respondents are instructed to circle the appropriate number that describes the coverage teachers give (or should give in the case of upper level microbiology teachers) to particular topics. Number one indicates very detailed coverage of the topic, number two indicates detailed coverage of the topic, number three indicates moderate coverage of the topic, number four indicates brief coverage of the topic, and number five indicates no coverage of the topic.

Validation: The questionnaire was submitted to a panel of six experts in the area of microbiology for the purpose of testing the content validity of the instrument. The experts were asked to identify items in the instrument that were valid or not valid based on the purpose of the study. Each item that was identified as valid by a majority of the panel members was retained in the instrument. The experts included Dr. Billye Weaver, Director of the Temple Junior College Medical Laboratory Technology program; Dr. Anne P. Newton, Chairperson of the Biology Department at Temple Junior College and former teacher of microbiology; Dr. Tom Huber, President of the American Society for Microbiology, Texas Branch and Department Head of Microbiology at the

Veterans Hospital in Temple, Texas; and three members of the Biology Department at the University of North Texas, Dr. Stephen P. Fracek, Dr. Gerard A. O'Donovan, and Dr. Mark S. Shanley.

Internal Consistency Reliability: The reliability of the questions was checked by conducting a pilot study involving a test-retest method. The instrument was submitted to 42 individuals from the population that was to be sampled in the study. Twenty-one individuals were junior/community college teachers of beginning microbiology and 21 individuals were senior college teachers that use beginning microbiology as a prerequisite to some course that they teach. The questionnaire with a cover letter, both in an addressed envelope with the teacher's name on it, was mailed directly to that individual at his school. A self-addressed, stamped envelope addressed to Temple Junior College Biology Department accompanied each questionnaire. A five dollar check was also included as a token honorarium in the hope it would help insure a high return rate. As the first survey was returned, a second identical survey instrument was mailed to the same individuals for the retest. Samples of cover letters are in APPENDIX A, pages 102-106. A total of 26 individuals responded to both test and retest within three weeks. Percentage frequencies for responses to depth of coverage for each item were determined

and chi square was computed to measure the agreement between the first and second responses. Only variables with a significant ($p<.05$) association were considered to be reliable (Huck, 1974).

A final survey was made to collect more data. Samples of both populations were surveyed using the same survey instrument used in the test-retest. The questionnaire with a cover letter, both in an addressed envelope with the teacher's name on it, was mailed directly to that individual at his school. A self-addressed, stamped envelope addressed to Temple Junior College Biology Department accompanied each questionnaire. A five dollar check was also included in the hope it would help insure a high return rate. A total of 54 individuals responded to this final survey within four weeks. The first responses from teachers involved with the test-retest were included with the responses of the teachers in the final survey. However, junior/community college teachers' responses were kept separate from those of the senior college teachers. Percentage frequencies for responses to depth of coverage for each item were determined for the two populations of teachers. Chi square was computed to measure the homogeneity of the responses between the two populations of teachers. Those items having a significant ($p>.05$) association were considered to have been given the same depth of coverage by the two populations of teachers (McGhee, 1985).

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CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

This study was conducted to determine what knowledge and skills are currently being taught in the beginning microbiology course in junior/community colleges in Texas. This information was determined from a survey questionnaire sent to junior/community college teachers of beginning microbiology. Also surveyed were senior college teachers who teach courses which require beginning microbiology as a prerequisite. This additional survey was to determine what preparation is needed for students progressing from beginning microbiology to upper level courses which require beginning microbiology as a prerequisite. The information gathered from the two populations of teachers was then compared to determine if any differences exist in the depth of coverage assigned by these teachers in various items of the curriculum.

The information was gathered by a survey questionnaire which consisted of 188 items distributed in 14 topics. The survey questionnaire was designed with Likert-type scaling, with responses in five categories based upon the varying depths of coverage to which the teachers assigned each item. The reliability of the items in the survey instrument

was determined by conducting a pilot study involving a test-retest method. For this purpose, the survey instrument was sent to 21 junior/community college teachers and 21 senior college teachers. An identical survey questionnaire was immediately sent again to those teachers who responded to the first survey questionnaire. A total of 23 teachers responded to both the test and retest within four weeks. Percentage frequencies for each item were determined for the five different depths of coverage for both the test and retest. A chi square was computed on each item to measure the agreement between the first and second responses. Results of these computations were used to test the hypothesis that there was no difference between first responses and second responses on each item. For this study, the item is considered to be reliable if the calculated chi square has a level of significance whose critical value is equal to or less than 0.05. A critical value greater than 0.05 indicates an unreliable item (Huck, 1974).

The survey questionnaire was subsequently sent to another twenty-one junior/community college teachers and 53 senior college teachers. Including the 42 teachers surveyed in the pilot study, a total of 116 teachers were surveyed. Data were assembled and analyzed from the responses of 80 teachers who had responded by the end of the 1989 spring semester. The first responses of the teachers surveyed in

the pilot study were included in the final study. Responses by the junior/community college teachers were compiled and percentage frequencies of the responses were determined for all five categories of responses dealing with depth of coverage for each item. The same was done for senior college teacher responses. The chi square test of homogeneity of proportions was used to determine if the responses of junior/community college teachers were the same or significantly different from those of the senior college teachers. In this case, the hypothesis to be tested is that the two populations of teachers assigned the different items to proportionately the same depth of coverage. If the calculated chi square has a level of significance whose critical value is greater than 0.05, then there is no difference between the two populations of teachers when they assigned a particular item to depth of coverage. If the critical value is equal to or less than 0.05, then there is a difference between how the two populations of teachers assigned a particular item to various depths of coverage (McGhee, 1984).

The responses were also combined in two ways to form three categories of responses rather than five for purposes of further analysis. One method of combining the responses was by grouping very detailed coverage and detailed coverage to form one category of grouped responses, leaving moderate coverage as a separate category, and by grouping brief

coverage and no coverage to form the third category of grouped responses (1-2, 3, 4-5). The second method of combining responses was by combining very detailed coverage and detailed coverage to form a category of grouped responses, combining moderate coverage and brief coverage to form a second category of grouped responses, and leaving the response category no coverage as a third category (1-2, 3-4, 5). Percentage frequencies of responses for these categories were determined for both the test and retest responses. The same statistical anaylsis was used on the combined responses as was done on the uncombined ones for both test-retest purposes and for purposes of comparison of depth of coverage between the two populations of teachers.

Tables containing complete information concerning each item in the topic microscopy are included in APPENDIX C, pages 119-168. APPENDIX C requires six tables for each item, or 30 tables to describe the statistical information on all five items in this topic. Since there are 188 items on the survey instrument, 1,128 tables were examined so that the responses could be fully evaluated. Only the 30 tables concerning the items in the topic microscopy are included in this paper. Tables in appendices D, E, F, and G are used to summarize the information on all 1,128 tables. Two basic types of tables are presented in APPENDIX C. Tables showing the results of the test-retest for each item are presented in this Appendix. Also tables showing the comparison

between the responses of junior/community college teachers and senior college teachers for each item are located here. These tables indicate the number of responses in each category (depth of coverage) for a particular item. These tables also show calculated percentage frequencies, Chi square and critical value for that particular item. Tables showing the same calculations for the combined responses are also located in this appendix. The tables in APPENDIX C were obtained using the computer program SPSS/PC+ which is made available by the Department of Foundations of Education for analysis of educational research at The University of North Texas.

Tables summarizing reliability of the test items and the homogeneity of proportions are included in APPENDIX D, pages 170-184. Each item is numbered according to its order of occurrence in the topic. Six columns are necessary for each item to show the results for grouped and ungrouped responses.

APPENDIX E, page 186, contains a table which summarizes the tables in APPENDIX D. This table summarizes all the data statistically analyzed. It includes the number of items in each topic, how many of each topic were reliable and how many were not reliable, and the number of items in each topic on which junior/community and senior college teachers agreed when assigning depth of coverage.

Depth of coverage assigned to the individual items by

both populations of teachers is summarized in tables in APPENDIX F, pages 187-204, and APPENDIX G, pages 205-222. Tables in APPENDIX F use essentially the same five categories for depth of coverage as was used on the survey instrument. However, depth of coverage was indicated only when more than 50% of the teachers of each population fell in that particular category. Tables in APPENDIX G combine the depth of coverage categories into three categories. Again, depth of coverage was indicated only when more than 50% of the teachers of each population fell in that particular category. For all tables in appendices F and G, an X before the item number indicates that item was unreliable on the uncombined responses. An asterisk after the item number indicates that the two populations of teachers assigned that item to a significantly different depth of coverage. The letter J indicates junior/community college teachers' responses and the letter S indicates senior college teachers' responses. Whichever letter is placed first in the same column indicates which population assigned greater depth of coverage for that particular item. A dollar sign ($) placed after the number of an item indicates those items that can be considered as <u>common elements</u>. The placement of the dollar sign should coincide with those items that were assigned moderate coverage or more by 50% or more of the senior college teachers.

The rest of this chapter is used to examine the

responses to the survey questionnaires. All 188 items on the survey questionnaire are discussed in their topic areas. The depth of coverage that was assigned all 188 items of the survey are discussed in detail, summarized in a summary paragraph at the end of each topic area, and summarized in summary tables for that topic. Unreliable items as discovered by the test-retest survey are indicated. Items that were assigned by more than 50% of the senior college teachers to moderate coverage or more are identified as common elements. These common elements are defined as items that need to be taught to students who continue their education by taking courses which require beginning microbiology as a prerequisite. Of the 179 reliable items on this survey, 142 of them can be identified as common elements.

Results of History of Microbiology

The test-retest item analysis to determine reliability of the test items revealed that the item, protoplasmic theory, is unreliable in the ungrouped responses. However, in both grouped responses this item is reliable. Germ theory of disease is also unreliable when the responses are grouped 1-2, 3, 4-5.

Responses of junior college teachers differed from that of the senior college teachers on all but four items in this topic. Agreement was reached on founders of the branches of

microbiology, researchers and their contributions, germ theory of disease and cell theory.

Both junior/community college teachers and senior college teachers agreed closely on the first item, founders of the branches of microbiology. This item was assigned to moderate or brief coverage by over 80% of both populations of teachers.

Researchers and their contributions were assigned similarly to the item above with 80% of the junior/community college teachers and 79.2% of the senior college teachers assigning this item to moderate or brief coverage.

Nobel laureates in microbiology were assigned no coverage by 66.7% of the junior/community college teachers and to brief coverage by another 26.7%. This item was assigned a little more depth of coverage by senior college teachers, with 58.3% assigning it brief coverage and another 18.8% assigning it moderate coverage.

The item, abiogenesis and biogenesis, was also assigned to more depth of coverage by senior college teachers. This item was assigned to brief or no coverage by 53.3% of the junior/community college teachers while 77.2% of the senior college teachers assigned it to moderate coverage or more.

More than 50% of both populations of teachers assigned the item, germ theory of disease, to detailed coverage or more.

Cell theory was assigned to moderate coverage or more

by 53.4% of the junior/community college teachers and by 81.2% of the senior college teachers.

Protoplasmic theory was assigned to more depth of coverage by senior college teachers than by junior/community college teachers. This item was assigned to brief or no coverage by 76.7% of the junior/community college teachers while 56.5% of the senior college teachers assigned this item to moderate coverage or more.

Oparin's heterotroph hypothesis was given no coverage by 70% of the junior/community college teachers. Two-thirds of the senior college teachers assigned this item to at least brief coverage or more.

Evolutionary theory was assigned to brief coverage or less by 86.6% of the junior/community college teachers while 89.2% of the senior college teachers assigned it to moderate coverage or more.

Unit membrane theory on developing cell complexity was given no coverage by 50% of the junior/community college teachers while 76.6% of the senior college teachers assigned it to moderate coverage or more.

Mutualistic theory on developing cell complexity was assigned brief or no coverage by 76.7% of the junior/community college teachers while 65.9% of the senior college teachers assigned this item to moderate or more coverage.

Summary of Results of History of Microbiology

Only one item, the germ theory of disease, in this topic was assigned to detailed or more coverage by more than 50% of both populations of teachers. One item, the cell theory, was assigned to detailed or more coverage by greater than 50% of the senior college teachers. This item was assigned to moderate or greater coverage by more than 50% of the junior/community college teachers.

Moderate or more coverage was assigned by both populations to two more items, founders of the branches of microbiology and researchers and their contributions. Five more items were assigned moderate or more coverage by the senior college teachers: abiogenesis and biogenesis, the protoplasmic theory, the evolutionary theory, the unit membrane theory on developing cell complexity and the mutualistic theory on developing cell complexity.

Eight reliable items in this topic can be identified as <u>common elements</u>: founders of the branches of microbiology, researchers and their contributions, abiogenesis and biogenesis, germ theory of disease, cell theory, evolutionary theory, unit membrane theory on developing cell complexity, and mutualistic theory on developing cell complexity.

Results for Microscopy

All items in this topic are reliable as shown by the

test-retest item analysis.

Junior/community and senior college teachers assigned all but three items in this topic to similar depth of coverage. The three items where differences occurred are parts, care, and proper use of the compound microscope, metric system, and phase-contrast microscope.

The first item of this topic, principles of the compound microscope, was assigned by 70% of the junior/community college teachers and by 52% of the senior college teachers to detailed coverage or more.

Parts, care, and proper use of the compound microscope was assigned to detailed coverage or more by 70% of the junior/community college teachers and by 50% of the senior college teachers. Another 30% of the senior college teachers assigned this topic to moderate coverage.

Metric system was assigned to moderate or brief coverage by 70% of the junior/community college teachers. However, 50% of the senior college teachers assigned this item to detailed coverage or more.

Fluorescent microscope was assigned brief coverage by 66.7% of the junior/community college teachers and by 51% of the senior college teachers.

Phase contrast microscope was assigned brief coverage by 53.3% of the junior college teachers and 53.1% of the senior college teachers.

Ultraviolet microscope was assigned brief or no

coverage by 83.3% of the junior/community college teachers and 83.6% of the senior college teachers.

Transmission electron microscope was assigned to brief coverage by 60% of the junior/community college teachers and by 55.1% of the senior college teachers.

Scanning electron microsope was assigned to brief coverage by 63.3% of the junior/community college teachers and by 55.1% of the senior college teachers.

Summary of results of Microscopy

The first two items of this topic, principles of the compound microscope and parts, care and proper use of the compound microscope were assigned by 50% or more of both populations of teachers to detailed coverage or more. Exactly 50% of the senior college teachers assigned metric system to detailed coverage or more. The rest of the items in this topic were assigned by 50% or more of both populations of teachers to brief coverage or less.

Three reliable items in this topic can be identified as common elements: principles of the compound microscope, parts, care, and proper use of the compound microscope, and metric system.

Results of Eukaryote Microbes

The second item in this topic, prokaryotes versus eukaryotes, is unreliable in all three ways of analyzing the data. The third item, cytology, and the eighth item

protozoans, are unreliable when the responses are grouped 1-2, 3, 4-5. The sixth item, fungi, is unreliable when responses are grouped 1-2, 3-4, and 5.

Junior/community college teachers and senior college teachers responded differently to five items in this topic, physiological transport mechanisms into and out of cells, slime molds, life cycle of yeast, life cycle of mushroom, and life cycle of wheat rust.

The first item of this topic, colloids, was assigned no coverage by 63.3% of the junior/community college teachers. This item was assigned no coverage by 34.4% of the senior college teachers and another 34.4% assigned this item to brief coverage.

Prokaryotes versus eukaryotes was an unreliable survey item.

Cytology was assigned moderate coverage or more by 70% of the junior/community college teachers and by 87.8% of the senior college teachers.

Physical transport mechanisms into and out of cells was assigned moderate coverage or more by 76.7% of the junior/community college teachers and by 83% of the senior college teachers.

Physiological transport mechanisms into and out of cells was assigned moderate coverage or more by 66.7% of the junior/community college teachers and by 92% of the senior college teachers.

Fungi were assigned moderate coverage or more by 80% of the junior/community college teachers and by 72% of the senior college teachers.

The topic, slime molds, was assigned no coverage by 43.3% of the junior/community college teachers and to brief coverage by another 40%. This item was assigned to brief coverage by 40% of the senior college teachers and to moderate coverage by another 30%.

Protozoans were assigned moderate coverage or more by 80% of the junior/community college teachers and by 64% of the senior college teachers.

Algae were assigned brief or no coverage by 66.7% of the junior/community college teachers but was assigned to moderate or more coverage by 53.1% of the senior college teachers.

Multicellular parasites received brief or no coverage by 60% of the junior/community college teachers and by 55.1% of the senior college teachers.

Life cycle of yeast was assigned brief or no coverage by 76.7% of the junior/community college teachers but was assigned moderate coverage or more by 54% of the senior college teachers.

Life cycle of bread mold was assigned brief or no coverage by 80% of the junior/community college teachers and by 57.1% of the senior college teachers.

Life cycle of mushroom was assigned no coverage by

56.7% of the junior/community college teachers and by 24.5% of the senior college teachers. This item was assigned to brief coverage by 38.8% of the senior college teachers.

Life cycle of wheat rust was assigned no coverage by 80% of the junior/community college teachers and brief or no coverage by 74% of the senior college teachers.

Life cycle of Entamoeba histolytica was assigned brief or no coverage by 56.7% of the junior college teachers and by 57.1% of the senior college teachers.

Life cycle of Plasmodium was assigned brief or no coverage by 56.7% of the junior college teachers and by 54% of the senior college teachers.

Summary of Results of Eukaryote Microbes

One item in this topic was assigned to detailed coverage or more by both populations of teachers. However, it was the unreliable item prokaryotes vs. eukaryotes. Five more items were assigned moderate or more coverage by more than 50% of both populations. These five items were cytology, physical transport mechanisms into and out of cells, physiological transport mechanisms into and out of cells, fungi and protozoans. Three items, algae, multicellular parasites, and life cycle of yeast, were assigned to moderate coverage or more by over 50% of the senior college teachers but by less than 50% of the junior/community college teachers.

Seven reliable items in this topic can be identified as common elements: cytology, physical transport mechanisms into and out of cells, physiological transport mechanisms into and out of cells, fungi, protozoans, algae, and life cycle of yeast.

Results of Taxonomy of Bacteria

The fourth item in this topic, numerical taxonomy, was adjudged to be an unreliable item except for the grouping of responses 1-2, 3, 4-5.

Junior/community college teachers responded differently from senior college teachers in the first three items of this topic, phylogenetic classification, phenetic classification, and DNA homology taxonomy.

Phylogenetic classification was assigned moderate coverage by 46.7% of the junior/community college teachers and by 47.94% of the senior college teachers. However, 37.5% of the senior college teachers assigned this item to detailed coverage or more while just 13.3% of the junior/community college did.

Phenetic classification was assigned no coverage by 39.3% of the junior/community college teachers. This item was assigned to brief coverage by 41.7% of the senior college teachers.

DNA homology taxonomy was assigned no coverage by 46.7% of the junior/community college teachers but was assigned

moderate coverage or more by 67.3% of the senior college teachers.

Numerical taxonomy was assigned brief coverage or less by 73.3% of the junior college teachers and by 61.2% of the senior college teachers.

Bergey's 29 Sections were assigned moderate coverage or more by 56.7% of the junior college teachers and by 53.1% of the senior college teachers.

Summary of the Results of Taxonomy of Bacteria

Two items in this topic, phylogenetic classification and Bergey's 29 Sections, were assigned to moderate coverage or more by both populations of teachers. DNA homology taxonomy split the two populations with most of the junior/community college teachers assigning this item to brief coverage or less and most of the senior college teachers assigning this item to moderate coverage or more.

Three reliable items in this topic can be identified as <u>common elements</u>: phylogenetic classification, DNA homology taxonomy, and Bergey's 29 sections.

Results of Bacterial Anatomy and Stains

All the items in this topic are reliable test items when the responses are not grouped. However, three items, bacterial cell structures and their functions, simple stain, and Gram stain, are unreliable when the responses are

grouped by either method used. Finally, another item, capsule stain, Gin´s method, is unreliable when the responses are grouped 1-2, 3, 4-5.

Junior/community college teachers and senior college teachers agreed with the depth of coverage in all items of this topic but three, chemical composition of bacterial cell walls, simple stain, and fat stain.

The first item in this topic, chemical composition of bacterial cell walls, was assigned detailed coverage or more by 63.3% of the junior/community college teachers and by 61.2% of the senior college teachers.

Contrast between Gram positive and Gram negative cell walls was assigned detailed coverage or more by 73.3% of the junior/community college teachers and by 69.4% of the senior college teachers.

Bacterial cell structures and their functions was assigned to detailed coverage by 80% of the junior/community college teachers and by 83.7% of the senior college teachers.

Basic and acidic dyes was assigned to moderate coverage or more by 76.7% of the junior/community college teachers and by 67.3% of the senior college teachers.

Simple stain was assigned to moderate coverage or more by 93.3% of the junior/community college teachers and by 71.4% of the senior college teachers.

Gram stain was assigned to detailed coverage or more by

80% of the junior/community college teachers and by 53.1% of the senior college teachers. Another 34.7% of the senior college teachers placed this item in the moderate coverage category.

Acid-fast stain was assigned to detailed coverage or more by 66.7% of the junior/community college teachers and to moderate coverage by another 23.3%. This item was assigned to detailed coverage or more by 42.9% of the senior college teachers and to moderate coverage by another 30.6%.

Flagellar stain was assigned brief coverage or less by 66.7% of the junior/community college teachers. However, 67.1% of the senior college teachers assigned this item to moderate coverage or more.

Capsule stain, negative stain was assigned moderate coverage or more by 80% of the junior/community college teachers and by 71.4% of the senior college teachers.

Capsule stain, Gin´s method was assigned to brief coverage or less by 73.3% of the junior/community college teachers and by 55.1% of the senior college teachers.

Metachromatic granule stain was assigned to brief coverage or less by 73.3% of the junior/community college teachers and by 55.1% of the senior college teachers.

Fat stain was assigned no coverage by 76.7% of the junior/community college teachers and to brief or no coverage by 61.2% of the senior college teachers.

Endospore stain was assigned moderate or more coverage

by 70% of the junior/community college teachers and by 73.5% of the senior college teachers.

Summary of Results of Bacterial Anatomy and Stains

Four items in this topic, chemical composition of bacterial cell walls, contrast between Gram positive and Gram negative cell walls, bacterial cell structures and their functions, and Gram stain, were stressed by both populations of teachers when more than 50% of each population assigned these items to detailed coverage or more. Five other items in this topic were assigned to moderate coverage or more by more than 50% of both populations of teachers, basic and acidic dyes, simple stain, acid-fast stain, capsule stain, negative stain, and endospore stain. The item, flagellar stain, was assigned to brief coverage or less by 66.7% of the junior/community college teachers while 57% of the senior college teachers assigned this item to moderate coverage or more.

Ten reliable items in this topic can be identified as <u>common elements</u>: chemical composition of bacterial cell walls, contrast between Gram positive and Gram negative cell walls, bacterial cell structures and their functions, basic and acidic dyes, simple stain, Gram stain, acid-fast stain, flagellar stain, capsule stain, negative stain, and endospore stain.

Results of Chemistry

All items in this topic are reliable.

Junior/community college teachers and senior college teachers assigned all but two items in this topic to different depths of coverage. Agreement was reached only on the items aerobic and anaerobic metabolism and fermentation. Senior college teachers assigned more depth of coverage for all sixteen items on which the two populations of teachers differed.

The first item of this topic, basic chemistry such as atoms, molecules, acids, bases, chemical bonding, etc., was assigned brief or no coverage by 63.3% of the junior/community college teachers while 56% of the senior college teachers assigned this item detailed or more coverage. Another 18% of the senior college teachers assigned this item to moderate coverage. While most junior/community college teachers did not assign this item much coverage, there were 30% which assigned this item to detailed coverage or greater.

Oxidation and reduction was assigned by 60% of the junior/community college teachers to brief coverage or less. The same percentage of senior college teachers assigned this item to detailed coverage or more.

Isomers and stereoisomers was assigned by 76.7% of the junior/community college teachers to brief coverage or less. This item was assigned by 66% of the senior college teachers to moderate coverage or more.

Van der Waals forces were assigned by 70% of the

junior/community college teachers to no coverage with another 13.3% assigning it to brief coverage. This item was assigned by 50% of the senior college teachers to moderate coverage or more.

Hydrogen (polar) bonds was assigned to brief or no coverage by 66.7% of the junior/community college teachers while 70% of the senior college teachers assigned this item to moderate coverge or more.

Fibrous and globular proteins was assigned by 53.3% of the junior/community college teachers to no coverage and by another 13.3% to brief coverage. However, 72% of the senior college teachers assigned this item to moderate coverage or more.

Enzyme action was assigned to moderate coverage by 70% of the junior/community college teachers and by 94% of the senior college teachers.

Aerobic and anaerobic metabolism was assigned to moderate coverage or more by 83.3% of the junior/community college teachers and by 98% of the senior college teachers.

Fermentation was assigned to moderate coverage or more by 83.3% of the junior/community college teachers and by 98% of the senior college teachers.

Oxidative phosphate pentose pathway was assigned to no coverage by 53.3% of the junior/community college teachers and to brief coverage by another 13.3%. This item was assigned by 74% of the senior college teachers to moderate

coverage or more.

Hexose monophosphate pathway was assigned to no coverage by 50% of the junior/community college teachers and to brief coverage by another 13.3%. This item was assigned by 74% of the senior college teachers to moderate coverage or more.

Embden-Meyerhof pathway was assigned to brief or no coverage by 51.7% of the junior/community college teachers. However, 34.5% of the junior/community college teachers assigned this item to detailed or more coverage. This item was assigned by 58% of the senior college teachers to detailed coverage or more. Another 34% assigned this item to moderate coverage.

Krebs' cycle was assigned to moderate coverage or more by 66.7% of the junior/community college teachers and by 92% of the senior college teachers.

Electron transport was assigned to moderate coverage or more by 73.3% of the junior/community college teachers and by 96% of the senior college teachers.

Mitchell's chemiosmotic coupling hypothesis was assigned to no coverage by 60% of the junior/community college teachers and to brief coverage by another 16.7%. This item was assigned by 78% of the senior college teachers to moderate coverage or more.

Photosynthesis was assigned to brief or no coverage by 69% of the junior/community college teachers and to moderate

coverage or more by 79.2% of the senior college teachers.

Anoxygenic photosynthesis was assigned to brief or no coverage by 76.7% of the junior/community college teachers and to moderate coverage or more by 62% of the senior college teachers.

Methanogenesis was assigned to no coverage by 50% of the junior/community college teachers and brief coverage by another 33.3%. This item was assigned to moderate coverage or more by 58% of the senior college teachers.

Summary of the results for Chemistry

Every item in this topic was assigned to more coverage by senior college teachers than junior/community college teachers. Every item in this topic was assigned by 50% or more of the senior college teachers to moderate coverage or more. Only five of the 18 items were assigned to moderate coverage or more by more than 50% of the junior/community college teachers. These five items were: enzyme action, aerobic and anaerobic metabolism, fermentation, Krebs' cycle, and electron transport. The item, Embden-Meyerhof pathway, was assigned to moderate coverage or more by 48.3% of the junior/community college teachers.

All eighteen items in this topic are reliable and can be identified as <u>common elements</u>.

Results of Cultivation of Microbes

The first item of this topic, autotrophic versus

heterotrophic bacteria, was assigned to moderate coverage or more by 90% of the junior/community college teachers and by 94% of the senior college teachers.

Preparation of bacteriological media was assigned to moderate coverage or more by 76.7% of the junior/community college teachers and by 78% of the senior college teachers.

Nutritional requirements was assigned to moderate coverage or more by 100% of the junior/community college teachers and by 90% of the senior college teachers.

Conditions of incubation was assigned to moderate coverage or more by 93.3% of the junior/community college teachers and by 84% of the senior college teachers.

Aseptic techniques was assigned to very detailed coverage by 50% of the junior/community college teachers and by 42% of the senior college teachers. This item was assigned to moderate coverage or more by all of the junior/community college teachers and by 94% of the the senior college teachers.

Growth curve was assigned to moderate coverage or more by 90% of the junior/community college teachers and by 96% of the senior college teachers.

Synchronous growth was assigned to no coverage by 43.3% of the junior/community college teachers and to brief coverage by another 20%. This item was assigned by 70% of the senior college teachers to moderate coverage or more.

Selective, differential, minimal, and complex media was

assigned to moderate coverage or more by 83.3% of the junior/community college teachers and by 96% of the senior college teachers.

Physical and chemical methods of microbial control was assigned to detailed coverage by 46.7% of the junior/community college teachers and another 23.3% assigned this item to detailed coverage. This item was assigned by 27.7% of the senior college teachers to very detailed coverage. Another 27.7% assigned this item to detailed coverage. Finally, 38.3% of the senior college teachers assigned this item to moderate coverage, resulting in 95.5% of the senior college teachers assigning this item to moderate coverage or more.

Summary of Results for Cultivation of Microbes

All items in this topic except for one was assigned to moderate coverage or more by 77% or more by both junior/community and senior college teachers. Synchronous growth was assigned to brief coverage or less by 53.3% of the junior/community college teachers. However, 70% of the senior college teachers assigned this item to moderate coverage or more.

All nine items in this topic are reliable and can be identified as common elements.

Results of Microbial Genetics

The first item in this topic, structure of DNA, was

assigned to detailed coverage or more by 50% of the junior/community college teachers and by 78% of the senior college teachers. Another 20% of the junior/community college teachers and 16% of the senior college teachers assigned this item to moderate coverage. Thus, 70% of the junior/community college teachers assigned this item to moderate coverage or more while 94% of the senior college teachers assigned this item to moderate coverage or more.

Replication of DNA was assigned to detailed coverage or more by 43.6% of the junior/community college teachers and by 76% of the senior college teachers. A total of 66.7% of the junior/community college teachers and 92% of the senior college teachers assigned this item to moderate coverage or more.

The item, continuous and discontinuous replication, was assigned to brief coverage or less by 60% of the junior/community college teachers. However, 76% of the senior college teachers assigned this item to moderate coverage or more.

The item, Okazaki fragments, was assigned to no coverage by 60% of the junior/community college teachers and to brief coverage by another 10%. However, 70% of the senior college teachers assigned this item to moderate coverage or more.

The item, transcription and translation, was assigned to moderate coverage or more by 83.3% of the

junior/community college teachers and by 88% of the senior college teachers.

The item, embryonic DNA and cell development, was assigned no coverage by 56.7% of the junior/community college teachers and to brief coverage by another 23.3%. However, 54% of the senior college teachers assigned this item to moderate coverage or more.

The operon was assigned to brief coverage or less by 56.7% of the junior/community college teachers. However, 90% of the senior college teachers assigned this item to moderate coverage or more.

Inducible and repressible enzymes were assigned to brief coverage or less by 53.4% of the junior/community college teachers and to moderate coverage or more by 94% of the senior college teachers.

Constitutive enzymes were assigned to brief coverage or less by 63.4% of the junior/community college teachers and to moderate coverage or more by 88% of the senior college teachers.

Suppressor genes received brief coverage or less by 66.6% of the junior/community college teachers and moderate coverage or more by 76% of the senior college teachers.

Oncogenes received brief coverage or less by 56.7% of the junior/community college teachers and moderate coverage or more by 64% of the senior college teachers.

The item, mutations and gene repair, was assigned to

moderate coverage or more by 76.7% of the junior/community college teachers and by 86% of the senior college teachers.

Plasmids and episomes received moderate coverage or more by 66.7% of the junior/community college teachers and by 96% of the senior college teachers.

Transformation, conjugation, transduction received moderate coverage or more by 86.7% of the junior/community college teachers and by 92% of the senior college teachers.

Recombinant DNA technology was assigned to moderate coverage by 66.7% of the junior/community college teachers and by 90% of the senior college teachers.

Summary of Results for Microbial Genetics

All items in this topic were assigned to more depth of coverage by the senior college teachers than by the junior/community college teachers. All items in this topic were assigned to moderate coverage or more by more than 50% of the senior college teachers. Only seven of the items were similarly assigned to moderate coverage or more by the junior/community college teachers. The items, structure of DNA, replication of DNA, transcription and translation, mutations and gene repair, plasmids and episomes, transformation, conjugation, transduction, and finally recombinant DNA technology, were assigned moderate coverage or more by more than 50% of both junior/community and senior college teachers.

All fifteen items is this topic are reliable and can be identified as common elements.

Results of Viruses

One item in this topic proved to be unreliable on all three methods of groupings for test analysis. Multiplication of animal viruses exceeded the 0.05 range for reliability with all three groupings.

Junior/community and senior college teachers differed significantly on only three items in this topic, one-step growth curve, viral diseases, and laboratory exercises on viruses.

The first item of this topic, history, was assigned by 73.3% of the junior/community college teachers and 85.5% of the senior college teachers to either moderate coverage or brief covearage. However, 56.6% of the junior/community college teachers assigned this item to brief coverage or less while 52.1% of the senior college teachers assigned this item to moderate coverage or more.

Types, shapes, structures were assigned to moderate coverage or more by 80% of the junior/community college teachers and by 75% of the senior college teachers.

Classification was assigned to moderate coverage or more by 76.7% of the junior/community college teachers and by 61.1% of the senior college teachers.

RNA single stranded viruses were assigned moderate

coverage or brief coverage by 63.3% of the junior/community college teachers and by 66.8% of the senior college teachers. However, 63.4% of the junior/community college teachers and 75.1% of the senior college teachers assigned this item to moderate coverage or more.

Junior/community college teachers assigned the next item, RNA double stranded viruses, the same way they assigned RNA single stranded viruses. Senior college teachers gave almost the same assignment as before, but this time 63.3% of them assigned this item to moderate coverage or brief coverage and 64.7% of them assigned this item to moderate coverage or more.

DNA single stranded viruses received moderate coverage or brief coverage by 63.3% of the junior/community college teachers and by 58.3% of the senior college teachers. However, 60% of the junior/community college teachers and 64.6% of the senior college teachers assigned this item to moderate coverage or more.

DNA double stranded viruses received moderate coverage or brief coverage by 63.3% of the junior/community college teachers and by 62.5% of the senior college teachers. However, 66.7% of the junior/community college teachers and 72.9% of the senior college teachers assigned this item to moderate coverage or more.

Lytic and lysogenic cycles were assigned to moderate coverage or more by 76.7% of the junior/community college

teachers and by 85.4% of the senior college teachers.

One-step growth curve was assigned to no coverage by 48.3% of the junior/community college teachers and to brief coverage by another 20.7%. However, 72.9% of the senior college teachers assigned this item to moderate coverage or more.

Multiplication of animal viruses was an unreliable test item.

Viral diseases were assigned to moderate coverage or more by 93.4% of the junior/community colleges and by 70.9% of the senior college teachers.

RNA tumor viruses were assigned to moderate coverage or more by 56.7% of the junior/community college teachers and by 66.6% of the senior college teachers.

AIDS virus was assigned to moderate coverage or more by 90% of the junior/community college teachers and by 75% of the senior college teachers.

Retroviruses received moderate coverage or more by 70% of the junior/community college teachers and by 75.1% of the senior college teachers.

Antiviral agents were assigned to moderate coverage or more by 63.4% of the junior/community college teachers and by 58.4% of the senior college teachers.

Laboratory exercises on viruses received no coverage by 76.7% of the junior/community college teachers. Senior college teachers gave this item a little more coverage by

31.9% assigning it moderate coverage and 44.7% assigning it brief coverage. However, 57.5% of the senior college teachers assigned this item to brief coverage or less.

Identification of viruses was assigned to no coverage by 56.7% of the junior/community college teachers and to brief coverage by another 16.7%. This item was assigned by 75.1% of the senior college teachers to brief coverage or less.

Cultivation of viruses was assigned to brief coverage or less by 60% of the junior/community college teachers and by 52.1% of the senior college teachers.

Viroids and prions received brief or no coverage by 73.3% of the junior/community college teachers and by 60.5% of the senior college teachers.

Oncogenic viruses were assigned to moderate or more coverage by 50% of the junior/community college teachers and by 56.3% of the senior college teachers.

Summary of Results on Viruses

A total of 13 out of 20 items received moderate coverage or more by 50% or better of both populations of teachers. Four items were assigned by both populations of teachers to brief coverage or less. One item, one-step growth curve, was given brief coverage or less by 31% of the junior/community college teachers but was given moderate coverage or more by 72.9% of the senior college teachers.

The two populations of teachers actually agreed fairly closely on assigning the very first item in this topic. However, the topic history, was assigned to brief coverage or less by 43.4% of the junior/community college teachers and to moderate coverage or more by 52.1% of the senior college teachers.

Fifteen reliable items in this topic can be idenified as common elements: history, types, shapes, structures, classification, RNA single stranded viruses, RNA double stranded viruses, DNA single stranded viruses, DNA double stranded viruses, lytic and lysogenic cycles, one-step growth curve, viral diseases, RNA tumor viruses, AIDS virus, retroviruses, antiviral agents, and oncogenic viruses.

Results of Microbial Activities in Nature

All test items in this topic are reliable as determined by the test-retest item analysis.

Junior/community and senior college teachers agreed closely on the depth of coverage to be given to two items of this topic, microbes in food and microbes in insects. Agreement was also reached somewhat on three other items, microbes in air, microbes in water and microbes in soil. Junior/community and senior college teachers disagreed on the depth of coverage on six items, Carbon, nitrogen and other biogeochemical cycles, Mycorrhizae, aquatic microbiology and sewage treatment, microbes in milk,

microbes in industry and microbes in space.

The first item of this topic, carbon, nitrogen and other biogeochemical cycles was assigned to brief coverage or less by 63.3% of the junior/community college teachers. However, 79.6% of the senior college teachers assigned this item to moderate coverage or more.

Mycorrhizae were assigned to no coverage by 63.3% of the junior/community college teachers and to brief coverage by another 26.7%. This item was assigned by 55.1% of the senior college teachers to brief or no coverage, with only 20.4% giving it no coverage.

Aquatic microbiology and sewage treatment received brief coverage or less by 66.6% of the junior/community college teachers and to moderate coverage or more by 67.3% of the senior college teachers.

Microbes in food were assigned to moderate coverage or more by 60% of the junior/community college teachers and by 71.4% of the senior college teachers.

Microbes in air were assigned to brief coverage or less by 53.3% of the junior/community college teachers. However, 65.3% of the senior college teachers assigned this item to moderate coverage or more.

The item, microbes in water, was assigned to moderate coverage or more by 53.3% of the junior/community college teachers and by 69.4% of the senior college teachers.

The item, microbes in soil, was assigned to brief

coverage or less by 56.7% of the junior/community college teachers. However, 67.4% of the senior college teachers assigned this item to moderate coverage or more.

The item, microbes in milk, was assigned to brief coverage or less by 56.7% of the junior/community college teachers and to moderate coverage or more by 71.4% of the senior college teachers.

The item, microbes in industry, was assigned to brief coverage or less by 66.7% of the junior/community college teachers. However, 69.4% of the senior college teachers assigned this item to moderate coverage or more.

The item, microbes in insects, was assigned to brief or no coverage by 80% of the junior/community college teachers and by 69.4% of the senior college teachers.

Microbes in space received no coverage by 73.3% of the junior/community college teachers with another 20% giving it brief coverage. This item was assigned by 75.5% of the senior college teachers to brief coverage or less.

Summary of Results for Microbial Activities in Nature

Only two items, microbes in food and microbes in water were assigned to moderate coverage or more by both populations of teachers. Six items were assigned moderate coverage or more by 50% or more of the senior college teachers alone, carbon, nitrogen and other biogeochemical cycles, aquatic microbiology and sewage treatment, microbes

in air, microbes in soil, microbes in milk and microbes in industry. Three other items were assigned by more than 50% of both populations of teachers to brief coverage or less, Mycorrhizae, microbes in insects and microbes in space.

Eight reliable items in this topic can be identified as common elements: carbon, nitrogen and other biogeochemical cycles, aquatic microbiology and sewage treatment, microbes in food, microbes in air, microbes in water, microbes in soil, microbes in milk, and microbes in industry.

Results for Host Defenses and Treatment Against Disease

The test-retest method for determining the reliablility of the test items indicates that all but one test item in this topic are reliable. The second test item, cellular defenses, is also reliable if no grouping of the depth of coverage categories is done.

Only two items in this topic were not agreed on by both junior/community and senior college teachers, inflammatory response and hypersensitivity. Here again agreement was reached if no grouping is done of the response categories.

The first item of this topic, mechanical barriers such as the skin, was assigned to detailed coverage or more by 63.3% of the junior/community college teachers and to moderate coverage by another 30%. This item was assigned by 42.8% of the senior college teachers to detailed coverage or more and to moderate coverage by another 30.6%.

The item, cellular defenses, was assigned to moderate coverage or more by 93.3% of the junior/community college teachers and by 93.7% of the senior college teachers.

Chemical defenses received moderate coverage or more by 96.7% of the junior/community college teachers and by 89.6% of the senior college teachers.

Antigens and antibodies received very detailed coverage by 40% of the junior/community college teachers and to detailed coverage by another 30%. This item was assigned by 67.6% of the senior college teachers to detailed coverage or more with only 20.8% assigning it to very detailed coverage.

B cells, T cells, lymphokines received moderate or more coverage by 83.4% of the junior/community college teachers and by 91.6% of the senior college teachers.

Inflamatory response was assigned to detailed coverage or more by 70% of the junior/community college teachers and by 31.7% of the senior college teachers. This item was assigned to moderate coverage by 20% of the junior/community college teachers and 43.8% of the senior college teachers.

Hypersensitivity was assigned to moderate coverage or more by 83.3% of the junior/community college teachers and 75.1% of the senior college teachers.

Immunity against disease was assigned to moderate coverage or more by 90% of the junior/community college teachers and by 89.5% of the senior college teachers.

Antimicrobial drugs were assigned to moderate coverage

or more by 86.7% of the junior/community college teachers and by 89.6% of the senior college teachers.

Summary of Results of Host Defenses and Treatment Against Disease

All nine items in this topic were reliable and were assigned to moderate coverage or more by well over 50% of both populations of teachers. Thus, all nine items can be identified as common elements.

Results of Microbial Diseases According to Organs/Systems

Three items in this topic, respiratory system, digestive tract, and urogenital system were not reliable according to the test-retest analysis in the first two groupings. However, all three were reliable if one only considers the third grouping. The item, microbial diseases of plants and insects, was not reliable when using the last two groupings, but is reliable when all five categories are used.

All items in this topic were assigned similar depth of coverage by both populations of teachers.

The first six items in this topic were assigned by more than 50% of both populations of teachers to moderate or brief coverage.

The first item in this topic, skin and eye, was assigned to moderate depth or brief coverage by 53.3% of the junior/community college teachers and by 70.2% of the senior

college teachers. However, 66.7% of the junior/community college teachers and 53.2% of the senior college teachers assigned this item to moderate coverage or more.

Nervous system was also assigned by most teachers to the moderate to brief coverage, with 56.6% of the junior/community college teachers and 76.6% of the senior college teachers responding in this manner. However, 66.7% of the junior/community college teachers and 48.9% of the senior college teachers assigned this item to moderate coverage or more.

Cardiovascular and lymphatic systems received 40% of the junior/community college teachers and 34% of the senior college teachers to moderate coverage. Another 34% of the senior college teachers assigned this item to brief coverage. However, 66.4% of the junior/community college teachers and 51.2% of the senior college teachers assigned this item to moderate coverage or more.

Respiratory system was assigned to moderate or brief coverage by 53.3% of the junior/community college teachers and by 63.8% of the senior college teachers.

Digestive tract was assigned to moderate or brief coverage by 53.3% of the junior/community college teachers and by 57.4% of the senior college teachers.

Urogenital system was assigned to moderate or brief coverage by 53.3% of the senior college teachers and by 58.7% of the junior/community college teachers.

Microbial diseases of plants and insects were assigned to no coverage by 50% of the junior/community college teachers. This item was assigned to brief or no coverage by 86.7% of the junior/community college teachers and by 73% of the senior college teachers.

Microbial diseases of other organisms were assigned to brief or no coverage by 80% of the junior/community college teachers and by 73% of the senior college teachers.

Summary or Results of Microbial Diseases According to Organs/Systems

The first six items of this topic were assigned to moderate coverage or more by more than 50% of both populations of teachers. The last two items were assigned by most teachers of both populations to brief coverage or less.

Two reliable items in this topic can be identified as common elements: skin and eye and cardiovascular and lymphatic systems.

Results of Microbial Diseases According to Microbial Groups

The third item of this topic, Spirochetes, was not a reliable test item when the responses were not grouped. However, this item was reliable when grouped by either method of grouping responses. All other items were reliable.

Junior/community and senior college responses were

different in five items of ungrouped responses, Gram negative bacilli and cocci, Gram positive bacilli and cocci, Rickettsiae, Mycobacteria and Chlamydiae. These same five items plus the item Spirochetes were assigned different depth of coverage when the responses were grouped 1-2, 3-4 and 5. However, only the item Chlamydiae was assigned differently between the two populations of teachers when their responses were grouped 1-2, 3, and 4-5.

The first item of the topic, Gram negative bacilli and cocci, was assigned to detailed coverage or more by 40% of the junior/community college teachers and by 38.8% of the senior college teachers. Another 16.7% of the junior/community college teachers and 30.6% of the senior college teachers assigned this item to moderate coverage. Adding these percentages up we see that this item was assigned to moderate coverage or more by 56.7% of the junior/community college teachers and by 69.4% of the senior college teachers. However, 36.7% of the junior/community college teachers assigned this item to no coverage.

A similar assignment was given the topic Gram positive bacilli and cocci. Moderate coverage or more was assigned this topic by 60% of the junior/community college teachers and 67.3% of the senior college teachers. However, this item was assigned no coverage by 36.7% of the junior/community college teachers.

Rickettsiae received no coverage by 30% of the

junior/community college teachers. This item was assigned to moderate coverage by 23.3% of the junior/community college teachers and by 44.9% of the senior college teachers. This item was assigned moderate coverage or more by 56.7% of the junior/community college teachers and by 65.3% of the senior college teachers.

Mycobacteria received moderate coverage by 30% of the junior/community college teachers and by 40.8% of the senior college teachers. Another 30% of the junior/community college teachers assigned this item no coverage. This item was assigned by 71.4% of the senior college teachers to moderate or brief coverage.

Chlamydiae were assigned brief coverage or less by 53.3% of the junior/community college teachers and by 47.9% of the senior college teachers. This item was assigned by 77.1% of the senior college teachers to moderate or brief coverage.

Fungi were assigned to moderate coverage or more by 60% of the junior/community college teachers and by 51% of the senior college teachers.

Protozoans were assigned to moderate coverage or more by 53.3% of the junior/community college teachers and by 49% of the senior college teachers.

Multicellular parasites were assigned no coverage by 50% of the junior/community college teachers and by 30.6% of the senior college teachers. This item was assigned to

moderate coverage or more by 30% of the junior/community college teachers and 41.8% of the senior college teachers.

Summary of Results for Microbial Diseases According to Microbial Groups

The first two items of this topic were the only two receiving much depth of coverage, with 40% of the the junior/community college teachers assigning each item to detailed coverage or more. The first item was assigned by 38.8% of the senior college teachers to detailed coverage or more. The second item was assigned by 32.5% of the senior college teachers to detailed coverage or more. Multicellular parasites was assigned the least depth of coverage. It was assigned to brief coverage or less by 70% of the junior/community college teachers and 58.2% of the senior college teachers. The rest of the items in this topic were generally assigned to moderate coverage.

Six reliable items in this topic can be identified as <u>common elements</u>: Gram negative bacilli and cocci, Gram positive bacilli and cocci, Rickettsiae, Mycobacteria, Chlamydiae, and fungi.

Results for Laboratory Activities

Only one item in this topic, Gram negative pathogens, was not reliable from the test-retest results when applied to non-grouped categories. However, both grouped categories for this item were reliable. Another item, identifying

unknown bacteria in pure culture, was unreliable only in the grouped category 1-2, 3, 4-5. One other item, aseptic use of serological pipet, was unreliable from the grouped category 1-2, 3-4, 5.

A number of items in this topic were assigned to significantly different depth of coverage by junior/community and senior college teachers.

The first item of this topic, wet mount or hanging drop slide, was assigned to different depths of coverage by the two populations of teachers. This item was assigned to very detailed coverage by 40% of the junior/community college teachers and to detailed coverage by another 30%. This item was assigned to moderate coverage by 49% of the senior college teachers.

Aseptic use of a serological pipet was assigned about the same depth of coverage by both populations of teachers. This item was assigned to detailed or more coverage by 58.6% of the junior/community college teachers and by 73.4% of the senior college teachers.

The item, pour plates, was also given the same depth of coverage by both populations of teachers. This item was assigned to detailed or more coverage by 63.3% of the junior/community college teachers and by 59.2% of the senior college teachers.

Quebec colony counter was assigned the same depth of coverage by both populations of teachers. However, no

consensus was reached on any particular categories, with all categories receiving about the same percentage of coverage. This item was assigned by 66.7% of the junior/community college teachers and by 85% of the senior college teachers to moderate coverage or more.

The next item, quantitative determination of bacterial numbers in milk, was assigned similarly to the item above. This item was assigned to moderate coverage or more by 60% of the junior/community college teachers and by 73.4% of the senior college teachers.

Cultivation of anaerobes was treated differently by the two populations of teachers. This item was assigned to brief coverage or less by 58.6% of the junior/community college teachers, but to moderate coverage or more by 62.5% of the senior college teachers.

Effects of ultraviolet radiation on bacteria received similar depths of coverage by the two populations of teachers. This item was assigned to detailed coverage or more by 50% of the junior/community college teachers and by 38.6% of the senior college teachers. This item was assigned to moderate coverage or more by 66.7% of the junior/community college teachers and 71.5% of the senior college teachers.

Effects of antibiotics on bacteria were assigned similar depths of coverage by the two populations of teachers. This item was assigned to detailed coverage or

more by 66.7% of the junior/community college teachers and by 55.1% of the senior college teachers. This item was assigned to moderate coverage or more by 93.3% of the junior/community college teachers and 91.9% of the senior college teachers.

Starch and gelatin hydrolysis was given more depth of coverage by junior/community college teachers than by senior college teachers. This item was assigned to detailed coverage or more by 53.3% of the junior/community college teachers and by only 28.6% of the senior college teachers. However, 40.8% of the senior college teachers assigned this item to moderate coverage.

Carbohydrate fermentation was assigned about the same amount of coverage by the two populations of teachers. This item was assigned to detailed coverage or more by 66.7% of the junior/community college teachers and by 48.9% of the senior college teachers.

The two populations of teachers assigned the next item, nitrate reduction, to different depths of coverage. This item was assigned no coverage by 46.7% of the junior/community college and by only 6.1% of the senior college teachers. This item was assigned by 71.5% of the senior college teachers to moderate coverage or more.

Urea hydrolysis was also assigned to no coverage by a large percentage of junior/community college teachers (36.7%) and by a small percentage (6.1%) of senior college

teachers. However, moderate or more coverage was assigned this item by 56.6% of the junior/community college teachers and by 69.5% of the senior college teachers.

Litmus milk reactions was given more depth of coverage by senior college teachers than by junior/community college teachers. This item was assigned no coverage by 40% of the junior/community college teachers and by only 16.3% of the senior college teachers. This item was assigned to moderate coverage or more by 43.4% of the junior/community college teachers and by 57.1% of the senior college teachers.

Hydrogen sulfide production was assigned to detailed coverage or more by 63.3% of the junior/community college teachers and by 44.9% of the senior college teachers.

Junior/community college teachers assigned the item, IMViC tests, greater depth of coverage than did their senior college counterparts. This item was assigned to detailed or more coverage by 63.3% of the junior/community college teachers and by 48.9% of the senior college teachers.

Catalase test was assigned to detailed coverage or more by 53.3% of the junior/community college teachers and by 46.9% of the senior college teachers.

Coagulase test was assigned to no coverage by 36.7% of the junior/community college teachers and by only 14.3% of the senior college teachers. This item was assigned to moderate coverage or more by 46.7% of the junior/community college teachers and by 67.4% of the senior college

teachers.

Effectiveness of hand scrubbing was assigned to moderate coverage or more by 73.3% of the junior/community college teachers and by 69.4% of the senior college teachers.

Dental caries susceptibility was given no coverage by 43.3% of the junior/community college teachers and by 22.4% of the senior college teachers. However, 51.3% of the junior/community college teachers assigned this item to moderate coverage or more and 49% of the senior college teachers did likewise.

Urine culture was assigned no coverage by 43.3% of the junior/community college teachers and by 28.6% of the senior college teachers. This item was assigned to brief coverage or less by 50% of the junior/community college teachers and by 53.1% of the senior college teachers.

Throat culture was assigned to no coverage by 30% of the junior/community college teachers and by 14.3% of the senior college teachers. This item was assigned to moderate coverage or more by 50% of the junior/community college teachers and by 67.3% of the senior college teachers.

Gram negative intestinal pathogens was assigned no coverage by 33.3% of the junior/community college teachers. However, this item was assigned to moderate coverage or more by 53.3% of the junior/community college teachers and by 63.5% of the senior college teachers.

Phage typing was assigned different coverage between the to populations of teachers. This item was assigned no coverage by 80% of the junior/community college teachers and by 28.6% of the senior college teachers. However, 53.1% of the senior college teachers assigned this item to brief coverage or less.

Isolation of bacteria from various environments was assigned to moderate coverage or more by 66.7% of the junior/community college teachers and by 89.8% of the senior college teachers.

Isolation of pure culture from a mixture was assigned to detailed coverage or more by 66.7% of the junior/community college teachers and by 70.8% of the senior college teachers.

Junior/community and senior college teachers assigned the next three items to different depths of coverage for the next three items, bacterial agglutination tests, ABO blood groups and Rh factor. All three items were given very little coverage by junior/community college teachers and were assigned to moderate coverage or more by more than 50% of the senior college teachers.

Bacterial agglutination tests were given no coverage by 63.3% of the junior/community college teachers while the same item was assigned to moderate coverage by 51% of the senior college teachers.

ABO blood groups and Rh factor was given no coverage by

70% of the junior/community college teachers while 51% of the senior college teachers assigned this item to moderate coverage or more.

Precipitin tests was assigned no coverage by 73.3% of the junior/community college teachers while 55.1% of the senior college teachers assigned this item to moderate coverage or more.

Identifying unknown bacteria in pure culture was assigned to moderate coverage or more by 76.7% of the junior/community college teachers and by 87.8% of the senior college teachers. This item was assigned to detailed coverage or more by 61.2% of the senior college teachers.

Identifying unknown bacteria in mixed culture was assigned to moderate coverage or more by 66.7% of the junior/community college teachers and by 79.6% of the senior college teachers.

Commercial biochemical testing (API, Minitek, Enterotube) was given no coverage by 60% of the junior/community college teachers. This item was assigned moderate or brief coverage by 63.3% of the senior college teachers. This item was assigned to moderate coverage or more by 33.4% of the junior/community college teachers and by 55.3% of the senior college teachers.

Computer assisted identification of bacteria was given no coverage by 83.3% of the junior/community college teachers and by 22.4% of the senior college teachers. Brief

coverage or less was assigned this item by 57.1% of the senior college teachers.

Intestinal pathogens in the family Enterobacteriaceae received moderate coverage or more by 63.3% of both populations of teachers.

Pathogenic Staphylococcus aureus was assigned to moderate coverage or more by 66.7% of the junior/community college teachers and by 63.3% of the senior college teachers.

Hemolytic streptococci were assigned to moderate coverage or more by 60% of the junior/community college teachers and by 71.4% of the senior college teachers.

Platyhelminthes and nematodes was given no coverage by 63.3% of the junior/community college teachers and by 42.9% of the senior college teachers. This item was assigned to brief coverage or less by 80% of the junior/community college teachers and by 75.5% of the senior college teachers.

Summary of Results of Laboratory Activities

All but five items, dental caries susceptibility, urine culture, phage typing, computer assisted identification of bacteria, and platyhelminthes and nematodes, were assigned to moderate coverage or more by more than 50% of the senior college teachers. These same items were also assigned by 50% or more of the junior/community college teachers to

brief coverage or less. Junior/community college teachers also included in this assignment eight more items, cultivation of anaerobes, nitrate reduction, litmus milk reactions, coagulase test, bacterial agglutination tests, ABO blood groups and Rh factor, precipitin tests, and commercial biochemical testing (API, Minitek, Enterotube).

Fourteen items were assigned to detailed coverage by more than 50% of one population or the other. These items are wet mount or hanging drop slide, aseptic use of a serological pipet, pour plates, effects of ultraviolet radiation on bacteria, effects of antibiotics on bacteria, starch and gelatin hydrolysis, carbohydrate fermentation, hydrogen sulfide production, IMViC tests, catalase test, effectiveness of hand scrubbing, isolation of pure cultures from a mixture, identifying unknown bacteria in pure culture and identifying unknown bacteria in mixed culture.

A total of 29 reliable items in this topic can be identified as <u>common elements</u>: wet mount or hanging drop slide, aseptic use of a serological pipet, pour plates, Quebec colony counter, quantitative determination of bacterial numbers in milk, cultivation of anaerobes, effects of ultraviolet radiation on bacteria, effects of antibiotics on bacteria, starch and gelatin hydrolysis, carbohydrate fermentation, nitrate reduction, urea hydrolysis, litmus milk reactions, hydrogen sulfide production, IMViC tests, catalase test, coagulase test, effectiveness of hand

scrubbing, throat culture, isolation of bacteria from various environments, isolation of pure cultures from a mixture, bacterial agglutination tests, ABO blood groups and Rh factor, precipitin tests, identifying unknown bacteria in pure culture, identifying unknown bacteria in mixed culture, commercial biochemical testing (API, Minitek, Enterotube), intestinal pathogens in the family Enterobacteriaceae, pathogenic Staphylococcus aureus, and hemolytic streptococci.

Major Findings

1. Of the 179 reliable items on the survey questionnaire, 142 can be identified as common elements.

2. Of the 179 reliable items on the survey questionnaire, junior/community college and senior college teachers disagreed on depth of coverage on 79 items.

3. Senior college teachers assigned more depth of coverage to 58 of the 79 items than did junior/community college teachers.

4. Most of the 58 items which were assigned more depth of coverage by senior college teachers were found in five topic areas: history of microbiology, chemistry, microbial genetics, microbial activities in nature and laboratory activities.

5. Most of the 21 items that were assigned more depth of coverage by junior/community college teachers were in

areas related to disease, as evidenced by the depth of coverage assigned to the items in the topic, microbial diseases according to microbial groups.

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CHAPTER V

SUMMARY, FINDINGS AND CONCLUSIONS, AND IMPLICATIONS AND RECOMMENDATIONS

This chapter presents a summary of the study and how the data were collected and analysed. The findings and conclusions of the study as well as the implications and recommendations are also included.

Summary

The purpose of this study was to determine what knowledge and skills are currently being taught in beginning microbiology in junior/community colleges in Texas. This information was then compared to what senior college teachers, who teach a course requiring beginning microbiology as a prerequisite, think should be taught in beginning microbiology. Results of this study gives teachers of beginning microbiology information concerning what other junior/community teachers teach in beginning microbiology and what senior college teachers expect to be taught.

Data Collection and Analysis

Curricular information in beginning microbiology was gathered through a survey questionnaire. This instrument

was constructed from numerous sources including textbooks, textbook company surveys, course syllabi from junior/community college teachers, and personal knowledge. The instrument was designed with a Likert-type scale to determine depth of coverage of different knowledge and skills (items) which might be considered to be in the domain of beginning microbiology. The final survey instrument contained fourteen topics with a total of 188 items distributed in the various topics. The instrument was validated by a panel of microbiologists and reliability of the test items was determined by a test-retest method. Twenty-three teachers out of 42 responded to both the test and retest surveys. Chi square was used to analyse these data comparing first responses with second responses. The hypothesis tested was that there was no significant difference between first and second responses. A large chi square indicates a large degree of agreement between first and second responses on the test-retest items. The larger the chi square is for an item, the smaller the item's critical value. Items with a small critical value ($p < 0.0500$) indicate a low probability of any differences between first and second responses on that item. Nine items out of the 188 had a low critical value ($p < 0.0500$) indicating that these items were probably not reliable.

The survey questionnaire was sent to microbiology teachers during the spring semester, 1989. Before the end

of the semester, a total of 80 teachers (30 out of 42 or 71% of the junior community college teachers and 50 out of 74 or 68% of the senior college teachers) out of 116, or 69%, responded who had been sent the survey questionnaire. Percentage frequencies of responses to each survey item were determined for the two populations of teachers. Chi square was used to analyse the data to determine the homogeneity of proportions between the two populations of teachers for each item. The hypothesis tested was that the two populations of teachers assigned different depths of coverage to each item. The homogeneity of responses between the two populations was indicated by a small chi square and a large critical value ($p > 0.0500$). Items with a small critical value ($p < 0.0500$) indicate a difference in depth of coverage between the two populations of teachers.

Discussion of Findings

Analysis of the test-retest indicated that nine of the 188 survey items were unreliable. Junior/community and senior college teachers agreed on depth of coverage for only 100 items of the remaining 179 reliable items, giving homogeneity of proportions on 56% of the reliable items. The two populations of teachers disagreed on depth of coverage on 79 items, or on 44% of the surveyed items. Of the 79 items where differences occurred, senior college teachers thought more depth of coverage should be given to

58, leaving 21 items in which junior/community college teachers indicated more depth of coverage was needed. A preponderance of the items in which senior college teachers indicated more depth of coverage was needed was in five topic areas, history of microbiology, chemistry, microbial genetics, microbial activities in nature and laboratory activities.

Some differences were expected between what junior/community college teachers stress in beginning microbiology and what senior college teachers think should be stressed. However, differences on 44% of the items appears to be significant. A number of differences in depth of coverage were expected since junior/community college teachers teach to a unique population of students. In many cases, the microbiology students taught by the junior/community college teachers never plan to attend a senior college and will not need certain information and skills required in higher level courses in the area of microbiology. Many of these students are allied health majors and perhaps the most needed training for these vocationally oriented students is in the areas of health and disease. Senior college teacher responses may have differed if they had been asked to consider a curriculum based on students who do not plan to continue training in biology.

Biology prerequisites are required for many of the microbiology courses taught in junior/community colleges.

Many of the differences on depth of coverage for knowledge and skills might be due to the junior/community college teachers recognizing that certain knowledge and skills are taught before students take beginning microbiology. This could be true especially in the topic of chemistry where many of the items referred to concepts in basic chemistry. However, even acknowledging these exceptions, the differences in depth of coverage between the two populations are large.

One of the goals of this study was to identify some common elements in the different topic areas of beginning microbiology. Common elements are certain knowledge and skills (items) students need to be taught in beginning microbiology if they take upper level microbiology courses. These common elements are identified in this study as those items having been assigned moderate or more coverage by 50% or more of the senior college teachers who responded to the survey questionnaire. Of the 179 reliable items on this survey, 142 common elements were agreed to by senior college teachers. These 142 common elements are indicated in the summary tables located in appendices F and G.

Major Findings

1. Of the 179 reliable items on the survey questionnaire, 142 can be identified as common elements.

2. Of the 179 reliable items on the survey

questionnaire, junior/community college and senior college teachers disagreed on depth of coverage on 79 items.

3. Senior college teachers assigned more depth of coverage to 58 of the 79 items than did junior/community college teachers.

4. Most of the 58 items which were assigned more depth of coverage by senior college teachers are found in five topic areas: history of microbiology, chemistry, microbial genetics, microbial activites in nature and laboratory activities.

5. Most of the 21 items that were assigned more depth of coverage by junior/community college teachers are in areas related to disease, as evidenced by the depth of coverage assigned to the items in the topic, microbial disesases according to microbial groups.

Major Conclusions

1. Junior/community college teachers teach beginning microbiology significantly different from what senior college teachers think they should.

2. Junior/community college teachers emphasize knowledge and skills concerned with disease and treatment of disease.

3. Senior college teachers prefer students be taught knowledge and skills which enable students to understand and use modern research techniques.

Implications and Recommendations

It is evident from this study that quite a few differences exist between the depth of study to which numerous curricular items in beginning microbiology are assigned by junior/community and senior college teachers. One might question if the same is true for numerous other courses taught in junior/community colleges. Hopefully, beginning microbiology is a special case since so many vocational students who do not plan to pursue further educational goals take this course. However, studies similar to this need to be done in other courses.

Many of the junior/community college teachers who responded to this survey commented that the knowledge and skills that they teach are dictated by the needs of their particular students. These teachers claimed that most, if not all of their students, are allied health majors, thus justifying a curriculum with an emphasis on health and disease. Most of these students will not take more courses in microbiology. Instead, they will use their training to care for the sick and aged. Unless a senior college has a course designed for the same type of students, junior/community college teachers may well do a better job serving these students.

Since senior college teachers assign more depth of coverage to certain items and topics, junior/community

college students who do transfer to senior colleges may lack knowledge and skills expected of them by senior college teachers. Junior/community college teachers should not only provide the proper training for their students that are allied health majors, they should also provide the proper training for any students who might continue to upper level microbiology courses. The junior/community college teachers can now examine a large number of curricular items (142 common elements) that senior college teachers expect students to have been taught in beginning microbiology. Junior/community college teachers can now know possible deficiencies their students may have when they transfer to senior colleges. Using this study, junior/community college teachers can examine the 58 items assigned greater depth of coverage by the senior college teachers and make curricular changes needed. Junior/community college teachers can also examine the 21 items in which senior college teachers gave less depth of coverage. This study provides material that microbiology teachers can use to find out what teachers across the state of Texas are teaching or what teachers think should be taught in beginning microbiology.

Possibly junior/community college teachers need to serve all their clients rather than serve only the assumed larger population of allied health majors. Apparently, a number of students are not being served by junior/community college teachers.

The information gathered in this study needs to be used to write a textbook and a laboratory manual which will better serve the needs of teachers of beginning microbiology. National and even international surveys need to be done using this or a similar instrument. The results could again be used to improve curricula as well as improving textbooks and laboratory manuals.

APPENDIX A

SAMPLE LETTERS TO TEACHERS

February 27, 1989

Dr. Edward Lansford
Southwestern University
Department of Biological Sciences
Georgetown, Texas

Dear Dr. Lansford,

Your time is valuable. The five dollar check is to help compensate for your time and impress on you the importance I place on the enclosed questionnaire.

The enclosed questionnaire is being developed to help determine what information/skills junior college students should possess when they transfer into upper level microbiology courses. A test-retest is necessary to insure reliability of this instrument. Please help me. I need you to answer and return the enclosed questionnaire as soon as possible (before spring break please). I will then send you the questionnaire again for the retest. A second five dollar check will be enclosed with the retest.

The data I gather on the reliable questions will become part of the data used in this study. If you have any suggestions or additions to make please do so. Your help will be greatly appreciated. Enclose the completed questionnaire in the envelope supplied and return to me.

Thanks for your help.

Sincerely,

Pat H. Simpson
Biology Department

March 3, 1989

Mr. Ferrel Pollard
Biology Department
Jacksonville College
500 Pine Street
Jacksonville, TX 75766

Dear Mr. Pollard,

Your time is valuable. The five dollar check is to help compensate for your time and impress on you the importance I place on the enclosed questionnaire.

The enclosed questionnaire is being developed to help determine what information/skills are currently being taught in beginning microbiology. A test-retest is necessary to insure reliablility of this instrument. Please help me. I need you to answer and return the enclosed questionnaire as soon as possible (before spring break please). I will then send you the questionnaire again for the retest. A second five dollar check will be enclosed with the retest.

The data I gather on the reliable questions will become part of the data used in this study. If you have any suggestions or additions to make please do so. Your help will be greatly appreciated. Enclose the completed questionnaire in the envelope supplied and return to me.

Thanks for your help.

Sincerely,

Pat H. Simpson
Biology Department

March 20, 1989

Dr. Peppy Mugando-Ojaiku
Biology Department
University of Texas at El Paso
University Avenue at Hawthorne
El Paso, TX 79968

Dear Dr. Mugando-Ojaiku,

Thanks very much for the fast return of the questionnaire. I know you are busy and hate to bother you again, but in order to insure my questionnaire is reliable, I need for you to answer it this second time. Please return this second survey as soon as possible.

I really appreciate your help. If I can ever be of any service to you, please do not hesitate to ask for my help.

Sincerely,

Pat H. Simpson
Biology Department

April 7, 1989

Robert Bauman
Biology Department
Amarillo College
P. O. Box 447
Amarillo, TX 79178

Dear Mr. Bauman:

Your time is valuable. The enclosed five dollar check is to help compensate for your time and impress on you the importance I place on the enclosed questionnaire.

The enclosed questionnaire will be used to help determine what information/skills are currently being taught in beginning microbiology. Please take the time to complete the questionnaire as accurately as possible. Your completion of this questionnaire is important to its validity and your efforts in this will be greatly appreciated. Enclose the completed survey in the envelope supplied and return to me.

Thanks for your help.

Sincerely,

Pat H. Simpson
Biology Department

Temple Junior College
2600 South 1st Street
Temple, TX 76504
April 7, 1989

Dr. John Evans
Department of Biology
The University of Houston
4800 Calhoun Blvd.
Houston, Texas 77204-5513

Dear Dr. Evans,

Your time is valuable. The enclosed five dollar check is to help compensate for your time and impress on you the importance I place on the enclosed questionnaire.

The enclosed questionnaire will be used to help determine what information/skills junior college students should possess when they transfer into upper level microbiology courses. Please take the time to complete the questionnaire as accurately as possible. Your completion of this questionnaire is important to its validity and your efforts in this will be greatly appreciated. Enclose the completed survey in the envelope supplied and return to me.

Thanks for your help.

Sincerely,

Pat H. Simpson
Biology Department

APPENDIX B

SURVEY INSTRUMENT

Please fill in the requested information and return this page with the questionnaire.

School_____

Name_____

Your area(s) of specialization_____

Number of years you have taught_____

Does beginning microbiology have a prerequisite at your school?

If so, what and how many hours?_____

_____

Do you prefer microbial diseases to be taught from:

A. Organs/systems approach (diseases of the digestive system)
or
B. Microbial groups (diseases caused by spirochetes)
or
C. Both

Should unknown bacteria be given to beginning microbiology students for them to determine what they are?

A. No

B. One organism

C. Two organisms in different cultures

D. Mixture of two organisms

E. Other_____

The emphasis in beginning miorobiology should be on

A. a general survey of all microbes

B. bacteria

C. allied health subjects

Thanks again for your help.

Circle the appropriate number to describe the depth of coverage of the subjects listed. At the bottom of each topic is room for any additions or comments you might want to make.

Number one indicates very detailed coverage of the topic.
Number two indicates detailed coverage of the topic.
Number three indicates moderate coverage of the topic.
Number four indicates brief coverage of the topic.
Number five indicates no coverage of the topic.

HISTORY OF MICROBIOLOGY

1	2	3	4	5	Founders of the branches of microbiology
1	2	3	4	5	Researchers and their contributions
1	2	3	4	5	Nobel Laureates in microbiology
1	2	3	4	5	Abiogenesis and biogenesis
1	2	3	4	5	Germ theory of disease
1	2	3	4	5	Cell theory
1	2	3	4	5	Protoplasmic theory
1	2	3	4	5	Oparin's heterotroph hypothesis
1	2	3	4	5	Evolutionary theory
1	2	3	4	5	Unit membrane theory on developing cell complexity
1	2	3	4	5	Mutualistic theory on developing cell complexity

Comments or Additions_____

MICROSCOPY

1	2	3	4	5	Principles of the compound microscope
1	2	3	4	5	Parts, care, and proper use of the compound microscope
1	2	3	4	5	Metric system
1	2	3	4	5	Fluorescent microscope
1	2	3	4	5	Phase-contrast microscope

1	2	3	4	5	Ultraviolet microscope
1	2	3	4	5	Transmission electron microscope
1	2	3	4	5	Scanning electron microscope

Comments or Additions_____

EUKARYOTE MICROBES

1	2	3	4	5	Colloids
1	2	3	4	5	Prokaryotes vs. eukaryotes
1	2	3	4	5	Cytology
1	2	3	4	5	Physical transport mechanisms into and out of cells
1	2	3	4	5	Physiological transport mechanisms into and out of cells
1	2	3	4	5	Fungi
1	2	3	4	5	Slime molds
1	2	3	4	5	Protozoans
1	2	3	4	5	Algae
1	2	3	4	5	Multicellular parasites
1	2	3	4	5	Life cycle of yeast
1	2	3	4	5	Life cycle of bread mold
1	2	3	4	5	Life cycle of mushroom
1	2	3	4	5	Life cycle of wheat rust
1	2	3	4	5	Life cycle of Entamoeba histolytica
1	2	3	4	5	Life cycle of Plasmodium

Comments or Additions_____

TAXONOMY OF BACTERIA

1	2	3	4	5	Phylogenetic classification

1 2 3 4 5	Phenetic classification
1 2 3 4 5	DNA homology taxonomy
1 2 3 4 5	Numerical taxonomy
1 2 3 4 5	Bergey's 29 Sections (the four volumes published in 1984)

Comments or Additions_____

BACTERIAL ANATOMY AND STAINS

1 2 3 4 5	Chemical composition of bacterial cell walls
1 2 3 4 5	Contrast between Gram + and Gram - cell walls
1 2 3 4 5	Bacterial cell structures and their functions
1 2 3 4 5	Basic and acidic dyes
1 2 3 4 5	Simple stain
1 2 3 4 5	Gram stain
1 2 3 4 5	Acid-fast stain
1 2 3 4 5	Flagellar stain
1 2 3 4 5	Capsule stain, negative stain
1 2 3 4 5	Capsule stain, Gin's method
1 2 3 4 5	Metachromatic granule stain
1 2 3 4 5	Fat stain
1 2 3 4 5	Endospore stain

Comments or Additions_____

CHEMISTRY

1 2 3 4 5	Basic chemistry such as atoms, molecules, acids, bases, chemical bonding, etc.
1 2 3 4 5	Oxidation and reduction
1 2 3 4 5	Isomers and sterioisomers

1 2 3 4 5	Van der Waals forces
1 2 3 4 5	Hydrogen (polar) bonds
1 2 3 4 5	Fibrous and globular proteins
1 2 3 4 5	Enzyme action
1 2 3 4 5	Aerobic and anaerobic metabolism
1 2 3 4 5	Fermentation
1 2 3 4 5	Oxidative phosphate pentose pathway
1 2 3 4 5	Hexose monophosphate pathway
1 2 3 4 5	Embden-Meyerhof pathway
1 2 3 4 5	Krebs' cycle
1 2 3 4 5	Electron transport
1 2 3 4 5	Mitchell's chemiosmotic coupling hypothesis
1 2 3 4 5	Photosynthesis
1 2 3 4 5	Anoxygenic photosynthesis
1 2 3 4 5	Methanogenesis

Comments or Additions_____

CULTIVATION OF MICROBES

1 2 3 4 5	Autotrophic vs. heterotrophic bacteria
1 2 3 4 5	Preparation of bacteriological media
1 2 3 4 5	Nutritional requirements
1 2 3 4 5	Conditions of incubation
1 2 3 4 5	Aseptic techniques
1 2 3 4 5	Growth curve
1 2 3 4 5	Synchronous growth
1 2 3 4 5	Selective, differential, minimal, and complex media

1 2 3 4 5 Physical and chemical methods of microbial control

Comments or Additions_____

MICROBIAL GENETICS

1 2 3 4 5 Structure of DNA

1 2 3 4 5 Replication of DNA

1 2 3 4 5 Continuous and discontinuous replication

1 2 3 4 5 Okazaki fragments

1 2 3 4 5 Transcription and translation

1 2 3 4 5 Embryonic DNA and cell development

1 2 3 4 5 Operon

1 2 3 4 5 Inducible and repressible enzymes

1 2 3 4 5 Constitutive enzymes

1 2 3 4 5 Supressor genes

1 2 3 4 5 Oncogenes

1 2 3 4 5 Mutations and gene repair

1 2 3 4 5 Plasmids and episomes

1 2 3 4 5 Transformation, conjugation, transduction

1 2 3 4 5 Recombinant DNA technology

Comments or Additions_____

VIRUSES

1 2 3 4 5 History

1 2 3 4 5 Types, shapes, structures

1 2 3 4 5 Classification

1 2 3 4 5 RNA single stranded viruses

1 2 3 4 5 RNA double stranded viruses

1	2	3	4	5	DNA single stranded viruses
1	2	3	4	5	DNA double stranded viruses
1	2	3	4	5	Lytic and lysogenic cycles
1	2	3	4	5	One-step growth curve
1	2	3	4	5	Multiplication of animal viruses
1	2	3	4	5	Viral diseases
1	2	3	4	5	RNA tumor viruses
1	2	3	4	5	AIDS virus
1	2	3	4	5	Retroviruses
1	2	3	4	5	Antiviral agents
1	2	3	4	5	Laboratory exercises on viruses
1	2	3	4	5	Identification of viruses
1	2	3	4	5	Cultivation of viruses
1	2	3	4	5	Viroids and prions
1	2	3	4	5	Oncogenic viruses

Comments or Additions_____

MICROBIAL ACTIVITIES IN NATURE

1	2	3	4	5	Carbon, nitrogen and other biogeochemical cycles
1	2	3	4	5	Mycorrhizae
1	2	3	4	5	Aquatic microbiology and sewage treatment
1	2	3	4	5	Microbes in food
1	2	3	4	5	Microbes in air
1	2	3	4	5	Microbes in water
1	2	3	4	5	Microbes in soil
1	2	3	4	5	Microbes in milk
1	2	3	4	5	Microbes in industry

1	2	3	4	5	Microbes in insects
1	2	3	4	5	Microbes in space

Comments or Additions_____

HOST DEFENSES AND TREATMENT AGAINST DISEASE

1	2	3	4	5	Mechanical barriers such as the skin
1	2	3	4	5	Cellular defenses
1	2	3	4	5	Chemical defenses
1	2	3	4	5	Antigens and antibodies
1	2	3	4	5	B cells, T cells, lymphokines
1	2	3	4	5	Inflamatory response
1	2	3	4	5	Hypersensitivity
1	2	3	4	5	Immunity against disease
1	2	3	4	5	Antimicrobial drugs

Comments or Additions_____

MICROBIAL DISEASES ACCORDING TO ORGANS/SYSTEMS

1	2	3	4	5	Skin and eye
1	2	3	4	5	Nervous system
1	2	3	4	5	Cardiovascular and lymphatic systems
1	2	3	4	5	Respiratory system
1	2	3	4	5	Digestive tract
1	2	3	4	5	Urogenital system
1	2	3	4	5	Microbial diseases of plants and insects
1	2	3	4	5	Microbial diseases of other organisms

Comments or Additions

MICROBIAL DISEASES ACCORDING TO MICROBIAL GROUPS

1	2	3	4	5	Gram - bacilli and cocci
1	2	3	4	5	Gram + bacilli and cocci
1	2	3	4	5	Spirochetes
1	2	3	4	5	Rickettsiae
1	2	3	4	5	Mycobacteria
1	2	3	4	5	Chlamydiae
1	2	3	4	5	Fungi
1	2	3	4	5	Protozoans
1	2	3	4	5	Multicellular parasites

Comments or Additions_____

LABORATORY ACTIVITIES

1	2	3	4	5	Wet mount or hanging drop slide
1	2	3	4	5	Aseptic use of a serological pipet
1	2	3	4	5	Pour plates
1	2	3	4	5	Quebec colony counter
1	2	3	4	5	Quantitative determination of bacterial numbers in milk
1	2	3	4	5	Cultivation of anaerobes
1	2	3	4	5	Effects of ultraviolet radiation on bacteria
1	2	3	4	5	Effects of antibiotics on bacteria
1	2	3	4	5	Starch and gelatin hydrolysis
1	2	3	4	5	Carbohydrate fermentation
1	2	3	4	5	Nitrate reduction
1	2	3	4	5	Urea hydrolysis
1	2	3	4	5	Litmus milk reactions
1	2	3	4	5	Hydrogen sulfide production

1	2	3	4	5	IMViC tests
1	2	3	4	5	Catalase test
1	2	3	4	5	Coagulase test
1	2	3	4	5	Effectiveness of hand scrubbing
1	2	3	4	5	Dental caries susceptibility
1	2	3	4	5	Urine culture
1	2	3	4	5	Throat culture
1	2	3	4	5	Gram - intestinal pathogens
1	2	3	4	5	Phage typing
1	2	3	4	5	Isolation of bacteria from various environments
1	2	3	4	5	Isolation of pure cultures from a mixture
1	2	3	4	5	Bacterial agglutination tests
1	2	3	4	5	ABO blood groups and Rh factor
1	2	3	4	5	Precipitin tests
1	2	3	4	5	Identifying unknown bacteria in pure culture
1	2	3	4	5	Identifying unknown bacteria in mixed culture
1	2	3	4	5	Commercial biochemical testing (API, Minitek, Enterotube)
1	2	3	4	5	Computer assisted identification of bacteria
1	2	3	4	5	Intestinal pathogens in the family Enterobacteriaceae
1	2	3	4	5	Pathogenic Staphylococcus aureus
1	2	3	4	5	Hemolytic streptococci
1	2	3	4	5	Platyhelminthes and nematodes

Comments or Additions_____

If you have any additional comments to make concerning what is taught, what should be taught, or what should not be taught in beginning microbiology, please do so. Feel free to use the back of this questionnaire survey.

APPENDIX C

TABLES OF RESULTS

APPENDIX C

The following 48 tables are included in this paper to serve as an example of the 1,128 tables that were generated from the data gathered from the responses by the two populations of teachers to the survey questionnaire. These 48 tables deal with only one of the 14 topics found on the survey questionnaire. This topic, microscopy, consisted of 8 items (knowledge and skills). Six tables were required to present all the information generated by each item.

Two basic types of tables were generated. The first 14 tables, tables I-XXIV show the results of the test-retest for each item. These tables indicate the number of responses in each category (depth of coverage) for both the test and retest, show percentage frequencies of these responses, indicate the calculated chi square determined from comparing percentage frequencies of first responses to second responses on the various categories of depth of coverage, and indicate the critical value of that item. Critical values greater that 0.05 indicate that the item has a high probability of not being reliable. The eight items required three tables since the responses were either not grouped (1, 2, 3, 4, 5), or grouped (1-2, 3, 4-5), or grouped (1-2, 3-4, 5).

Tables XXV-XXXXVIII show the depth of coverage that both populations of teachers assigned the different items in the topic, microscopy. Again, the responses were either not grouped (1, 2, 3, 4, 5), or grouped (1-2, 3, 4-5), or grouped (1-2, 3-4, 5). For each item, the number of responses for each depth of coverage are indicated and the percentage frequency of these responses are determined. Chi square is calculated to indicate the homogeneity of the responses of the two populations of teachers. A chi square with a critical value greater than 0.05 indicates that the two populations of teachers responded approximately the same when assigning depth of coverage to a particular item.

TABLE I

TOPIC: MICROSCOPY

ITEM 1 Principles of the compound microscope

RESULTS: Test-retest of ungrouped responses (1, 2, 3, 4, 5)

Page 76 SPSS/PC+ 5/9/88

Crosstabulation: MSY1 By MSY2

MSY1	MSY2-> 1	2	3	4	Row Total
1	3 / 60.0	2 / 40.0			5 / 21.7
2		4 / 44.4	5 / 55.6		9 / 39.1
3		1 / 11.1	3 / 33.3	5 / 55.6	9 / 39.1
Column Total	3 / 13.0	7 / 30.4	8 / 34.8	5 / 21.7	23 / 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
23.27381	6	.0007	.652	12 OF 12 (100.0%)

Number of Missing Observations = 0

TABLE II

TOPIC: MICROSCOPY

ITEM 2: Parts, care, and proper use of the compound microscope

RESULTS: Test-retest of ungrouped responses (1, 2, 3, 4, 5)

Page 77 SPSS/PC+ 5/9/88

Crosstabulation: MSY3 By MSY4

MSY3	Count / Row Pct	MSY4 1	MSY4 2	MSY4 3	MSY4 4	Row Total
1		3 75.0	1 25.0			4 17.4
2			5 55.6	4 44.4		9 39.1
3			1 14.3	6 85.7		7 30.4
4			1 50.0		1 50.0	2 8.7
5					1 100.0	1 4.3
Column Total		3 13.0	8 34.8	10 43.5	2 8.7	23 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
37.97054	12	.0002	.087	20 OF 20 (100.0%)

Number of Missing Observations = 0

TABLE III

TOPIC: MICROSCOPY

ITEM 3: Metric system

RESULTS: Test-retest of ungrouped responses (1, 2, 3, 4, 5)

Page 78 SPSS/PC+ 5/9/88

Crosstabulation: MSY5
By MSY6

MSY6-> / MSY5	Count / Row Pct	2	3	4	5	Row Total
1		1 100.0				1 5.0
2		2 66.7	1 33.3			3 15.0
3		1 16.7	5 83.3			6 30.0
4			2 28.6	5 71.4		7 35.0
5					3 100.0	3 15.0
Column Total		4 20.0	8 40.0	5 25.0	3 15.0	20 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
39.46429	12	.0001	.150	20 OF 20 (100.0%)

Number of Missing Observations = 3

TABLE IV

TOPIC: MICROSCOPY

ITEM 4: Fluorescent microscope

RESULTS: Test-retest of ungrouped responses (1, 2, 3, 4, 5)

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Crosstabulation: MSY7 By MSY8

MSY7	Count / Row Pct	2	3	4	5	Row Total
1		1 100.0				1 4.3
2			1 100.0			1 4.3
3			4 80.0	1 20.0		5 21.7
4		1 7.7	2 15.4	10 76.9		13 56.5
5				1 33.3	2 66.7	3 13.0
Column Total		2 8.7	7 30.4	12 52.2	2 8.7	23 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
35.29475	12	.0004	.087	19 OF 20 (95.0%)

Number of Missing Observations = 0

TABLE V

TOPIC: MICROSCOPY

ITEM 5: Phase-contrast microscope

RESULTS: Test-retest of ungrouped responses (1, 2, 3, 4, 5)

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Crosstabulation: MSY9 By MSY10

MSY10-> / MSY9	Count / Row Pct	2	3	4	5	Row Total
1		1 100.0				1 4.3
2			1 100.0			1 4.3
3			5 100.0			5 21.7
4		1 8.3	1 8.3	10 83.3		12 52.2
5				1 25.0	3 75.0	4 17.4
Column Total		2 8.7	7 30.4	11 47.8	3 13.0	23 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
44.64340	12	.0000	.087	19 OF 20 (95.0%)

Number of Missing Observations = 0

TABLE VI

TOPIC: MICROSCOPY

ITEM 6: Ultraviolet microscope

RESULTS: Test-retest of ungrouped responses (1, 2, 3, 4, 5)

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Crosstabulation: MSY11 By MSY12

MSY11 \ MSY12->	2	3	4	5	Row Total
1	1 100.0				1 4.5
2		1 100.0			1 4.5
3		3 100.0			3 13.6
4	1 11.1		7 77.8	1 11.1	9 40.9
5			2 25.0	6 75.0	8 36.4
Column Total	2 9.1	4 18.2	9 40.9	7 31.8	22 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
41.24515	12	.0000	.091	20 OF 20 (100.0%)

Number of Missing Observations = 1

TABLE VII

TOPIC: MICROSCOPY

ITEM 7: Transmission electron microscope

RESULTS: Test-retest of ungrouped responses (1, 2, 3, 4, 5)

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Crosstabulation: MSY13 By MSY14

MSY14-> / MSY13	Count / Row Pct	1	2	3	4	5	Row Total
1		1 100.0					1 4.5
2		1 33.3	2 66.7				3 13.6
3		3 75.0	1 25.0				4 18.2
4			2 18.2	9 81.8			11 50.0
5					3 100.0		3 13.6
Column Total		1 4.5	4 18.2	5 22.7	9 40.9	3 13.6	22 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
62.77500	16	.0000	.045	25 OF 25 (100.0%)

Number of Missing Observations = 1

TABLE VIII

TOPIC: MICROSCOPY

ITEM 8: Scanning electron microscope

RESULTS: Test-retest of ungrouped responses (1, 2, 3, 4, 5)

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Crosstabulation: MSY15 By MSY16

MSY15	Count / Row Pct	1	2	3	4	5	Row Total
1		1 100.0					1 4.5
2			1 33.3	2 66.7			3 13.6
3			3 75.0	1 25.0			4 18.2
4				2 18.2	9 81.8		11 50.0
5						3 100.0	3 13.6
Column Total		1 4.5	4 18.2	5 22.7	9 40.9	3 13.6	22 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
82.77500	16	.0000	.045	25 OF 25 (100.0%)

Number of Missing Observations = 1

TABLE IX

TOPIC: MICROSCOPY

ITEM 1: Principles of the compound microscope

RESULTS: Test-retest of grouped responses (1-2, 3, 4-5)

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Crosstabulation: MSY1 By MSY2

MSY1	Count / Row Pct	1 AND 2 (1)	3 (2)	4 AND 5 (3)	Row Total
1 AND 2	1	9	5		14
		64.3	35.7		60.9
3	2	1	3	5	9
		11.1	33.3	55.6	39.1
	Column Total	10	8	5	23
		43.5	34.8	21.7	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
11.34940	2	.0034	1.957	5 OF 6 (83.3%)

Number of Missing Observations = 0

TABLE X

TOPIC: MICROSCOPY

ITEM 2: Parts, care, and proper use of the compound microscope

RESULTS: Test-retest of grouped responses

(1-2, 3, 4-5)

Crosstabulation: MSY3 By MSY4

MSY3	Count / Row Pct	1 AND 2 (1)	3 (2)	4 AND 5 (3)	Row Total
1 AND 2	1	9	4		13
		69.2	30.8		56.5
3	2	1	6		7
		14.3	85.7		30.4
4 AND 5	3	1		2	3
		33.3		66.7	13.0
	Column Total	11	10	2	23
		47.8	43.5	8.7	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
21.01632	4	.0003	.261	7 OF 9 (77.8%)

Number of Missing Observations = 0

TABLE XI

TOPIC: MICROSCOPY

ITEM 3: Metric system

RESULTS: Test-retest of grouped responses (1-2, 3, 4-5)

Crosstabulation: MSY5 By MSY6

MSY5	Count / Row Pct	MSY6-> 1 AND 2 (1)	3 (2)	4 AND 5 (3)	Row Total
1 AND 2	1	3	1		4
		75.0	25.0		20.0
3	2	1	5		6
		16.7	83.3		30.0
4 AND 5	3		2	8	10
			20.0	80.0	50.0
	Column Total	4	8	8	20
		20.0	40.0	40.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
20.12500	4	.0005	.800	9 OF 9 (100.0%)

Number of Missing Observations = 3

TABLE XII

TOPIC: MICROSCOPY

ITEM 4: Fluorescent microscope

RESULTS: Test-retest of grouped responses (1-2, 3, 4-5)

Crosstabulation: MSY7 By MSY8

MSY7	Count / Row Pct	1 AND 2 (1)	3 (2)	4 AND 5 (3)	Row Total
1 AND 2	1	1	1		2
		50.0	50.0		8.7
3	2		4	1	5
			80.0	20.0	21.7
4 AND 5	3	1	2	13	16
		6.3	12.5	81.3	69.6
	Column Total	2	7	14	23
		8.7	30.4	60.9	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
14.12857	4	.0069	.174	8 OF 9 (88.9%)

Number of Missing Observations = 0

TABLE XIII

TOPIC: MICROSCOPY

ITEM 5: Phase-contrast microscope

RESULTS: Test-retest of grouped responses (1-2, 3, 4-5)

Crosstabulation: MSY9 By MSY10

MSY9	Count / Row Pct	1 AND 2 (1)	3 (2)	4 AND 5 (3)	Row Total
1 AND 2	1	1	1		2
		50.0	50.0		8.7
3	2		5		5
			100.0		21.7
4 AND 5	3	1	1	14	16
		6.3	6.3	87.5	69.6
	Column Total	2	7	14	23
		8.7	30.4	60.9	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
21.87054	4	.0002	.174	8 OF 9 (88.9%)

Number of Missing Observations = 0

TABLE XIV

TOPIC: MICROSCOPY

ITEM 6: Ultraviolet microscope

RESULTS: Test-retest of grouped responses (1-2, 3, 4-5)

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Crosstabulation: MSY11 By MSY12

MSY11	Count / Row Pct	1 AND 2 (1)	3 (2)	4 AND 5 (3)	Row Total
1 AND 2	1	1	1		2
		50.0	50.0		9.1
3	2		3		3
			100.0		13.6
4 AND 5	3	1		16	17
		5.9		94.1	77.3
	Column Total	2	4	16	22
		9.1	18.2	72.7	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
24.10294	4	.0001	.182	8 OF 9 (88.9%)

Number of Missing Observations = 1

TABLE XV

TOPIC: MICROSCOPY

ITEM 7: Transmission electron microscope

RESULTS: Test-retest of grouped responses (1-2, 3, 4-5)

Crosstabulation: MSY13 By MSY14

MSY13	Count / Row Pct	1 (1 AND 2)	2 (3)	3 (4 AND 5)	Row Total
1 AND 2	1	2	2		4
		50.0	50.0		18.2
3	2	3	1		4
		75.0	25.0		18.2
4 AND 5	3		2	12	14
			14.3	85.7	63.6
	Column Total	5	5	12	22
		22.7	22.7	54.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
17.91429	4	.0013	.909	8 OF 9 (88.9%)

Number of Missing Observations = 1

TABLE XVI

TOPIC: MICROSCOPY

ITEM 8: Scanning electron microscope

RESULTS: Test-retest of grouped responses (1-2, 3, 4-5)

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Crosstabulation: MSY15 By MSY16

MSY15	Count / Row Pct	MSY16-> 1 AND 2 (1)	3 (2)	4 AND 5 (3)	Row Total
1 AND 2	1	2	2		4
		50.0	50.0		18.2
3	2	3	1		4
		75.0	25.0		18.2
4 AND 5	3		2	12	14
			14.3	85.7	63.6
	Column Total	5	5	12	22
		22.7	22.7	54.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
17.91429	4	.0013	.909	8 OF 9 (88.9%)

Number of Missing Observations = 1

TABLE XVII

TOPIC: MICROSCOPY

ITEM 1: Principles of the compound microscope

RESULTS: Test-retest of grouped responses (1-2, 3-4, 5)

Crosstabulation: MSY1 By MSY2

MSY2-> / MSY1	Count / Row Pct	1 AND 2 COMBINED 1	3 AND 4 COMBINED 2	Row Total
1 AND 2 COMBINED	1	9	5	14
		64.3	35.7	60.9
3 AND 4 COMBINED	2	1	8	9
		11.1	88.9	39.1
	Column Total	10	13	23
		43.5	56.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
4.32514	1	.0376	3.913	1 of 4 (25.0%)
6.30324	1	.0121	(Before Yates Correction)	

Number of Missing Observations = 0

TABLE XVIII

TOPIC: MICROSCOPY

ITEM 2: Parts, care, and proper use of the compound microscope

RESULTS: Test-retest of grouped responses

(1-2, 3-4, 5)

Crosstabulation: MSY3
By MSY4

MSY3	Count / Row Pct	1 AND 2 COMBINED 1	3 AND 4 COMBINED 2	Row Total
1 AND 2 COMBINED	1	9	4	13
		69.2	30.8	56.5
3 AND 4 COMBINED	2	2	7	9
		22.2	77.8	39.1
5	3		1	1
			100.0	4.3
	Column Total	11	12	23
		47.8	52.2	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
5.66809	2	.0588	.478	4 OF 6 (66.7%)

Number of Missing Observations = 0

TABLE XIX

TOPIC: MICROSCOPY

ITEM 3: Metric system

RESULTS: Test-retest of grouped responses (1-2, 3-4, 5)

Crosstabulation: MSY5 By MSY6

MSY5	Count / Row Pct	1 AND 2 COMBINED (1)	3 AND 4 COMBINED (2)	5 (3)	Row Total
1 AND 2 COMBINED	1	3	1		4
		75.0	25.0		20.0
3 AND 4 COMBINED	2	1	12		13
		7.7	92.3		65.0
5	3			3	3
				100.0	15.0
	Column Total	4	13	3	20
		20.0	65.0	15.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
29.06065	4	.0000	.450	8 OF 9 (88.9%)

Number of Missing Observations = 3

TABLE XX

TOPIC: MICROSCOPY

ITEM 4: Fluorescent microscope

RESULTS: Test-retest of grouped responses (1-2, 3-4, 5)

Crosstabulation: MSY7 By MSY8

MSY7	Count / Row Pct	1 AND 2 COMBINED 1	3 AND 4 COMBINED 2	5 3	Row Total
1 AND 2 COMBINED	1	1	1		2
		50.0	50.0		8.7
3 AND 4 COMBINED	2	1	17		18
		5.6	94.4		78.3
5	3		1	2	3
			33.3	66.7	13.0
	Column Total	2	19	2	23
		8.7	82.6	8.7	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
19.16667	4	.0007	.174	8 OF 9 (88.9%)

Number of Missing Observations = 0

TABLE XXI

TOPIC: MICROSCOPY

ITEM 5: Phase-contrast microscope

RESULTS: Test-retest of grouped responses (1-2, 3-4, 5)

Crosstabulation: MSY9 By MSY10

MSY9	Count / Row Pct	1 AND 2 COMBINED 1	3 AND 4 COMBINED 2	5 3	Row Total
1 AND 2 COMBINED	1	1	1		2
		50.0	50.0		8.7
3 AND 4 COMBINED	2	1	18		17
		5.9	94.1		73.9
5	3		1	3	4
			25.0	75.0	17.4
	Column Total	2	18	3	23
		8.7	78.3	13.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
20.87663	4	.0003	.174	8 OF 9 (88.9%)

Number of Missing Observations = 0

TABLE XXII

TOPIC: MICROSCOPY

ITEM 6: Ultraviolet microscope

RESULTS: Test-retest of grouped responses (1-2, 3-4, 5)

Crosstabulation: MSY11 By MSY12

MSY11	Count / Row Pct	1 AND 2 COMBINED 1	3 AND 4 COMBINED 2	5 3	Row Total
1 AND 2 COMBINED	1	1	1		2
		50.0	50.0		9.1
3 AND 4 COMBINED	2	1	10	1	12
		8.3	83.3	8.3	54.5
5	3		2	6	8
			25.0	75.0	36.4
	Column Total	2	13	7	22
		9.1	59.1	31.8	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
14.61630	4	.0056	.182	6 OF 9 (66.6%)

Number of Missing Observations = 1

TABLE XXIII

TOPIC: MICROSCOPY

ITEM 7: Transmission electron microscope

RESULTS: Test-retest of grouped responses (1-2, 3-4, 5)

Crosstabulation: MSY13 By MSY14

MSY13	Count / Row Pct	1 AND 2 COMBINED 1	3 AND 4 COMBINED 2	5 3	Row Total
1 AND 2 COMBINED	1	2 50.0	2 50.0		4 18.2
3 AND 4 COMBINED	2	3 20.0	12 80.0		15 68.2
5	3			3 100.0	3 13.6
	Column Total	5 22.7	14 63.6	3 13.6	22 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
23.69714	4	.0001	.409	8 OF 9 (88.9%)

Number of Missing Observations = 1

TABLE XXIV

TOPIC: MICROSCOPY

ITEM 8: Scanning electron microscope

RESULTS: Test-retest of grouped responses (1-2, 3-4, 5)

Crosstabulation: MSY15 By MSY16

MSY15	Count / Row Pct	1 AND 2 COMBINED 1	3 AND 4 COMBINED 2	5 3	Row Total
1 AND 2 COMBINED	1	2	2		4
		50.0	50.0		18.2
3 AND 4 COMBINED	2	3	12		15
		20.0	80.0		68.2
5	3			3	3
				100.0	13.6
	Column Total	5	14	3	22
		22.7	63.6	13.6	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
23.69714	4	.0001	.409	8 OF 9 (88.9%)

Number of Missing Observations = 1

TABLE XXV

TOPIC: MICROSCOPY

ITEM 1: Principles of the compound microscope

RESULTS: Homogeneity of two populations of teachers

Responses not grouped (1, 2, 3, 4, 5)

Crosstabulation: MSY1
By GROUP

MSY1	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1		10	7	17
		33.3	14.0	21.3
2		11	19	30
		36.7	38.0	37.5
3		6	17	23
		20.0	34.0	28.8
4		3	7	10
		10.0	14.0	12.5
Column Total		30	50	80
		37.5	62.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
4.82519	3	.1851	3.750	1 OF 8 (12.5%)

Number of Missing Observations = 0

TABLE XXVI

TOPIC: MICROSCOPY

ITEM 2: Parts, care, and proper use of the compound microscope

RESULTS: Homogeneity of two populations of teachers

Responses not grouped (1, 2, 3, 4, 5)

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Crosstabulation: MSY2 By GROUP

MSY2 / GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1		14	8	22
		46.7	16.0	27.5
2		7	17	24
		23.3	34.0	30.0
3		5	15	20
		16.7	30.0	25.0
4		4	6	10
		13.3	12.0	12.5
5			4	4
			8.0	5.0
Column Total		30	50	80
		37.5	62.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
10.88323	4	.0279	1.500	3 OF 10 (30.0%)

Number of Missing Observations = 0

TABLE XXVII

TOPIC: MICROSCOPY

ITEM 3: Metric system

RESULTS: Homogeneity of two populations of teachers

Responses not grouped (1, 2, 3, 4, 5)

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Crosstabulation: MSY3 By GROUP

MSY3	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1		3	12	15
		10.0	25.0	19.2
2		1	12	13
		3.3	25.0	16.7
3		9	9	18
		30.0	18.8	23.1
4		12	7	19
		40.0	14.6	24.4
5		5	8	13
		16.7	16.7	16.7
Column Total		30	48	78
		38.5	61.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
13.26855	4	.0100	5.000	None

Number of Missing Observations = 2

TABLE XXVIII

TOPIC: MICROSCOPY

ITEM 4: Fluorescent microscope

RESULTS: Homogeneity of two populations of teachers

Responses not grouped (1, 2, 3, 4, 5)

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Crosstabulation: MSY4
By GROUP

MSY4 GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1		1	1	2
		3.3	2.0	2.5
2			5	5
			10.2	6.3
3		4	13	17
		13.3	26.5	21.5
4		20	25	45
		66.7	51.0	57.0
5		5	5	10
		16.7	10.2	12.7
Column Total		30	49	79
		38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
8.10370	4	.1915	.759	5 OF 10 (50.0%)

Number of Missing Observations = 1

TABLE XXIX

TOPIC: MICROSCOPY

ITEM 5: Phase-contrast microscope

RESULTS: Homogeneity of two populations of teachers

Responses not grouped (1, 2, 3, 4, 5)

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Crosstabulation: MSY5
By GROUP

MSY5 / GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1	Count	1		1
	Col Pct	3.3		1.3
2	Count		7	7
	Col Pct		14.3	8.9
3	Count	5	13	18
	Col Pct	16.7	26.5	22.8
4	Count	16	26	42
	Col Pct	53.3	53.1	53.2
5	Count	8	3	11
	Col Pct	26.7	6.1	13.9
Column Total		30	49	79
		38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
12.35422	4	.0149	.380	5 OF 10 (50.0%)

Number of Missing Observations = 1

TABLE XXX

TOPIC: MICROSCOPY

ITEM 6: Ultraviolet microscope

RESULTS: Homogeneity of two populations of teachers

Responses not grouped (1, 2, 3, 4, 5)

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Crosstabulation: MSY6
By GROUP

MSY6 / GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1		1	1	2
		3.3	2.0	2.5
2			2	2
			4.1	2.5
3		4	5	9
		13.3	10.2	11.4
4		15	30	45
		50.0	61.2	57.0
5		10	11	21
		33.3	22.4	26.6
Column Total		30	49	79
		38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
2.74807	4	.6008	.759	5 OF 10 (50.0%)

Number of Missing Observations = 1

TABLE XXXI

TOPIC: MICROSCOPY

ITEM 7: Transmission electron microscope

RESULTS: Homogeneity of two populations of teachers

Responses not grouped (1, 2, 3, 4, 5)

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Crosstabulation:
MSY7
By
GROUP

GROUP-> / Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY7 1	1	2	3
	3.3	4.1	3.8
2		7	7
		14.3	8.9
3	7	7	14
	23.3	14.3	17.7
4	18	27	45
	60.0	55.1	57.0
5	4	8	10
	13.3	12.2	12.7
Column Total	30	49	79
	38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
5.26846 (50.0%)	4	.2608	1.139	5 OF 10

Number of Missing Observations = 1

TABLE XXXII

TOPIC: MICROSCOPY

ITEM 8: Scanning electron microscope

RESULTS: Homogeneity of two populations of teachers

Responses not grouped (1, 2, 3, 4, 5)

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Crosstabulation:
MSY8
By
GROUP

GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY8				
1		1	2	3
		3.3	4.1	3.8
2			5	5
			10.2	6.3
3		7	9	16
		23.3	18.4	20.3
4		19	27	46
		63.3	55.1	58.2
5		3	6	9
		10.0	12.2	11.4
	Column Total	30	49	79
		38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
3.61407	4	.4607	1.139	5 OF 10 (50.0%)

Number of Missing Observations = 1

TABLE XXXIII

TOPIC: MICROSCOPY

ITEM 1: Principles of the compound microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3, 4-5)

Page1440 SPSS/PC+ 5/10/88

Crosstabulation: MSY1
By GROUP

MSY1 / GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1 AND 2	1	21	26	47
		70.0	52.0	58.8
3 ONLY	2	6	17	23
		20.0	34.0	28.8
4 AND 5	3	3	7	10
		10.0	14.0	12.5
	Column Total	30	50	80
		37.5	62.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
2.55230	2	.2791	3.750	1 OF 6 (16.7%)

Number of Missing Observations = 0

TABLE XXXIV

TOPIC: MICROSCOPY

ITEM 2: Parts, care, and proper use of the compound microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3, 4-5)

Page1441 SPSS/PC+ 5/10/89

Crosstabulation: MSY2 By GROUP

GROUP-> / MSY2	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1 AND 2	1	21	25	46
		70.0	50.0	57.5
3 ONLY	2	5	15	20
		16.7	30.0	25.0
4 AND 5	3	4	10	14
		13.3	20.0	17.5
	Column Total	30	50	80
		37.5	62.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
3.11387	2	.2108	5.250	None

Number of Missing Observations = 0

TABLE XXXV

TOPIC: MICROSCOPY

ITEM 3: Metric system

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3, 4-5)

Page1442 SPSS/PC+ 5/10/89

Crosstabulation: MSY3 By GROUP

GROUP-> / Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY3			
1 AND 2 (1)	4	24	28
	13.3	50.0	35.9
3 ONLY (2)	9	9	18
	30.0	18.8	23.1
4 AND 5 (3)	17	15	32
	56.7	31.3	41.0
Column Total	30	48	78
	38.5	61.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
10.83382	2	.0044	6.923	None

Number of Missing Observations = 2

TABLE XXXVI

TOPIC: MICROSCOPY

ITEM 4: Fluorescent microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3, 4-5)

Page1443 SPSS/PC+ 5/10/89

Crosstabulation: MSY4
By GROUP

GROUP-> / MSY4	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1 AND 2	1	1 3.3	6 12.2	7 8.9
3 ONLY	2	4 13.3	13 26.5	17 21.5
4 AND 5	3	25 83.3	30 61.2	55 69.6
	Column Total	30 38.0	49 62.0	79 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
4.48021	2	.1064	2.658	2 OF 6 (33.3%)

Number of Missing Observations = 1

TABLE XXXVII

TOPIC: MICROSCOPY

ITEM 5: Phase-contrast microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3, 4-5)

Page1444 SPSS/PC+ 5/10/89

Crosstabulation: MSY5 By GROUP

GROUP-> / MSY5	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1 AND 2	1	1	7	8
		3.3	14.3	10.1
3 ONLY	2	5	13	18
		16.7	26.5	22.8
4 AND 5	3	24	29	53
		80.0	59.2	67.1
	Column Total	30	49	79
		38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
4.20081	2	.1224	3.038	2 OF 6 (33.3%)

Number of Missing Observations = 1

TABLE XXXVIII

TOPIC: MICROSCOPY

ITEM 6: Ultraviolet microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3, 4-5)

Page1445 SPSS/PC+ 5/10/89

Crosstabulation: MSY6
By GROUP

GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY6				
1 AND 2	1	1 3.3	3 6.1	4 5.1
3 ONLY	2	4 13.3	5 10.2	9 11.4
4 AND 5	3	25 83.3	41 83.7	66 83.5
	Column Total	30 38.0	49 62.0	79 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
.44608	2	.8001	1.519	3 OF 6 (50.0%)

Number of Missing Observations = 1

TABLE XXXIX

TOPIC: MICROSCOPY

ITEM 7: Transmission electron microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3, 4-5)

Page1446 SPSS/PC+ 5/10/89

Crosstabulation: MSY7 By GROUP

GROUP-> / MSY7	Count / Col Pct	JR COL 1	UNIV 2	Row Total
1 AND 2	1	1	9	10
		3.3	18.4	12.7
3 ONLY	2	7	7	14
		23.3	14.3	17.7
4 AND 5	3	22	33	55
		73.3	67.3	69.6
	Column Total	30	49	79
		38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
4.27782	2	.1178	3.797	1 OF 6 (16.7%)

Number of Missing Observations = 1

TABLE XL

TOPIC: MICROSCOPY

ITEM 8: Scanning electron microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3, 4-5)

Page1447 SPSS/PC+ 5/10/89

Crosstabulation: MSY8 By GROUP

GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY8				
1 AND 2	1	1 / 3.3	7 / 14.3	8 / 10.1
3 ONLY	2	7 / 23.3	9 / 18.4	16 / 20.3
4 AND 5	3	22 / 73.3	33 / 67.3	55 / 69.6
	Column Total	30 / 38.0	49 / 62.0	79 / 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
2.52652	2	.2827	3.038	2 OF 6 (33.3%)

Number of Missing Observations = 1

TABLE XLI

TOPIC: MICROSCOPY

ITEM 1: Principles of the compound microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3-4, 5)

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SPSS/PC+ 5/10/89

Crosstabulation:
MSY1
By
GROUP

GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY1				
1 AND 2	1	21 / 70.0	26 / 52.0	47 / 58.8
3 AND 4	2	9 / 30.0	24 / 48.0	33 / 41.3
	Column Total	30 / 37.5	50 / 62.5	80 / 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
1.81904	1	.1774	12.375	None
2.50677	1	.1134	(Before Yates Correction)	

Number of Missing Observations = 0

TABLE XLII

TOPIC: MICROSCOPY

ITEM 2: Parts, care, and proper use of the compound microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3-4, 5)

Page1250
SPSS/PC+ 5/10/89

Crosstabulation:
MSY2
By
GROUP

GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY2				
1 AND 2	1	21	25	46
		70.0	50.0	57.5
3 AND 4	2	9	21	30
		30.0	42.0	37.5
5 ONLY	3		4	4
			8.0	5.0
	Column Total	30	50	80
		37.5	62.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
4.42435 (33.3%)	2	.1095	1.500	2 OF 6

Number of Missing Observations = 0

TABLE XLIII

TOPIC: MICROSCOPY

ITEM 3: Metric system

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3-4, 5)

Page1251
SPSS/PC+ 5/10/89

Crosstabulation:
MSY3
By
GROUP

GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY3				
1 AND 2	1	4	24	28
		13.3	50.0	35.9
3 AND 4	2	21	16	37
		70.0	33.3	47.4
5 ONLY	3	5	8	13
		16.7	16.7	16.7
	Column Total	30	48	78
		38.5	61.5	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
12.14672	2	.0023	5.000	None

Number of Missing Observations = 2

TABLE XLIV

TOPIC: MICROSCOPY

ITEM 4: Fluorescent microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3-4, 5)

Page1252
SPSS/PC+ 5/10/89

Crosstabulation:
MSY4
By
GROUP

GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY4				
1 AND 2	1	1	6	7
		3.3	12.2	8.9
3 AND 4	2	24	38	62
		80.0	77.6	78.5
5 ONLY	3	5	5	10
		16.7	10.2	12.7
	Column Total	30	49	79
		38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
2.29590	2	.3173	2.658	3 OF 6
(50.0%)				

Number of Missing Observations = 1

TABLE XLV

TOPIC: MICROSCOPY

ITEM 5: Phase-contrast microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3-4, 5)

Page1253
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Crosstabulation:
MSY5
By
GROUP

GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY5				
1 AND 2	1	1	7	8
		3.3	14.3	10.1
3 AND 4	2	21	39	60
		70.0	79.6	75.9
5 ONLY	3	8	3	11
		26.7	6.1	13.9
	Column Total	30	49	79
		38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
8.06990 (50.0%)	2	.0177	3.038	3 OF 6

Number of Missing Observations = 1

TABLE XLVI

TOPIC: MICROSCOPY

ITEM 6: Ultraviolet microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3-4, 5)

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Crosstabulation:
MSY6
By
GROUP

GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY6				
1 AND 2	1	1	3	4
		3.3	6.1	5.1
3 AND 4	2	19	35	54
		63.3	71.4	68.4
5 ONLY	3	10	11	21
		33.3	22.4	26.6
	Column Total	30	49	79
		38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
1.29356 (33.3%)	2	.5237	1.519	2 OF 6

Number of Missing Observations = 1

TABLE XLVII

TOPIC: MICROSCOPY

ITEM 7: Transmission electron microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3-4, 5)

Page1255
SPSS/PC+ 5/10/89

Crosstabulation:
MSY7
By
GROUP

GROUP->	Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY7				
1 AND 2	1	1	9	10
		3.3	18.4	12.7
3 AND 4	2	25	34	59
		83.3	69.4	74.7
5 ONLY	3	4	6	10
		13.3	12.2	12.7
	Column Total	30	49	79
		38.0	62.0	100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
3.82448 (33.3%)	2	.1477	3.797	2 OF 6

Number of Missing Observations = 1

TABLE XLVIII

TOPIC: MICROSCOPY

ITEM 87: Scanning electron microscope

RESULTS: Homogeneity of two populations of teachers

Grouped responses (1-2, 3-4, 5)

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SPSS/PC+

Crosstabulation:
MSY8
By
GROUP

GROUP-> / Count / Col Pct	JR COL 1	UNIV 2	Row Total
MSY8 1 AND 2	1 / 3.3	7 / 14.3	8 / 10.1
3 AND 4	28 / 86.7	38 / 73.5	62 / 78.5
5 ONLY	3 / 10.0	6 / 12.2	9 / 11.4
Column Total	30 / 38.0	49 / 62.0	79 / 100.0

Chi-Square	D.F.	Significance	Min E.F.	Cells with E.F.< 5
2.69943 (50.0%)	2	.2593	3.038	3 OF 6

Number of Missing Observations = 1

APPENDIX D

APPENDIX D

Appendix D consists of fourteen tables with each table representing a different topic used in the survey questionnaire. The tables contain the critical value of chi square for determining the reliability of the test retest for each item surveyed. The tables also contain the critical value of chi square used to determine the homogeneity of proportions between the junior/community college teachers' answers and the senior college teachers answer to the individual items of each topic. Each table shows these results mentioned above for the grouped responses as well as the non-grouped responses. An asterisk (*) is used to indicate those critical values that are significant.

TABLE IL

Topic: History of microbiology

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0000	.7912	.0000	.8719	.0000	.7645
2.	.0000	.9277	.0061	.6579	.0000	.9237
3.	.0032	*.0001	.0036	*.0361	.0017	*.0000
4.	.0353	*.0204	.0013	*.0063	.0071	*.0251
5.	.0177	.2285	*.0853	.4927	.0001	.8723
6.	*.0628	.0697	.0012	*.0291	.0004	.1244
7.	*.0575	*.0043	.0017	*.0077	.0335	*.0028
8.	.0012	*.0126	.0071	*.0446	.0002	*.0040
9.	.0000	*.0000	.0000	*.0000	.0002	*.0000
10.	.0018	*.0008	.0090	*.0007	.0006	*.0002
11.	.0020	*.0011	.0068	*.0002	.0016	*.0222

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TABLE L

Topic: Microscopy

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0007	.1851	.0034	.2791	.0376	.1774
2	.0002	*.0279	.0003	.2108	.0121 *.0588	.1134 .1095
3	.0001	*.0100	.0005	*.0044	.0000	*.0023
4	.0004	*.1915	.0069	.1044	.0007	.3173
5	.0000	*.0149	.0002	.1224	.0003	*.0177
6	.0000	.6008	.0001	.8001	.0056	.5237
7	.0000	.2608	.0013	.1178	.0001	.1477
8	.0000	.4607	.0013	.2827	.0001	.2593

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TABLE LI

Topic: Eukaryote microbes

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0000	.1192	.0082	.1125	.0002	*.0437
2	*.2102	.1261	.0012 *.4707	.5476	.0000 *.4709	1.0000
3	.0304	.1835	.2113 *.0571	.1344	.2113 .0460	.8900 .8525
4	.0011	.4676	.0017	.1782	.0000	.3170
5	.0008	*.0278	.0013	*.0056	.0001	.0528
6	.0042	.1294	.0006	.2667	.0739	.1277
7	.0001	*.0388	.0080	*.0359	.0030	*.0471
8	.0326	.0924	.0002 *.0539	*.0456	.0007 .0310	.1729
9	*.0050	.2741	.0370	.2235	.0077	.6774
10	.0003	.8071	.0085 .0005	.8542	.0015 .0022	.9687
11	.0036	*.0474	.0035	*.0154	.0131	*.0236
12	.0010	.1101	.0007	.1152	.0030	.2434
13	.0361	*.0140	.0156	.1445	.0261	*.0125
14	.0000	*.0092	.0255	.1908	.0211	*.0069
15	.0000	.5785	.0000 .0000	.3363	.0050 .0000	.4113
16	.0002	.6758	.0000	.5283	.0000	.4368

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TABLE LII

Topic: Taxonomy of bacteria

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	*.1230	*.0133	*.1055	*.0127	.0421	*.0025
2	.0035	*.0022	.0006	.1158	.0013	*.0019
3	.0000	*.0003	.0000	*.0021	.0000	*.0001
4	*.1070	*.0011	.0467	.5178	*.1124	*.0004
5	.0074	.2242	.0004	.6113	.0027	.1274

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TABLE LIII

Topic: Bacterial anatomy and stains

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3,4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0013	*.0125	.0023	*.0059	.0004	.4072
2	.0002	.8904	.0363	.7348	.0001 .0363	.7079
3	.0167	.6444	.0099 *.2031	.4349	.2031 *.2031	.4349
4	.0004	.7976	.0431 .0115	.6608	.0431 .0000	.7841
5	.0108	*.0448	*.6528	*.0324	*.6764	.0915
6	.0179	.1113	*.0532	.0524	.3819 .0619	*.0300
7	.0040	.2373	.0101	.0864	.0154 .0085	.0159 .1152
8	.0000	.2289	.0003	.1180	.0021 .0001	.1467
9	.0007	.2538	.0020	.3463	.0191	.3303
10	.0496	.0701	*.0519	.1902	.0054 .0311	.2025
11	.0001	.0549	.0001	.0624	.0017	*.0226
12	.0000	*.0034	.0000	*.0170	.0001	*.0007
13	.0000	.2068	.0002	.6505	.0001	.3251

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TABLE LIV

Topic: Chemistry

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0007	*.0122	.0000	*.0040	.0000	.0704
2	.0000	*.0004	.0001	*.0002	.0000	*.0040
3	.0000	*.0013	.0000	*.0007	.0000	*.0005
4	.0000	*.0010	.0000	*.0114	.0000	*.0001
5	.0092	*.0205	.0007	*.0037	.0001	*.0058
6	.0000	*.0056	.0000	*.0032	.0001	*.0017
7	.0029	*.0408	.0049	*.0103	.0156	.0868
8	.0008	.0653	.0080	*.0327	.0289	.0573
9	.0002	.1478	.0004	*.0453	.0015	.1976
10	.0001	*.0002	.0000	*.0016	.0000	*.0000
11	.0000	*.0001	.0000	*.0041	.0000	*.0000
12	.0002	*.0014	.0000	*.0005	.0000	*.0013
13	.0000	*.0089	.0000	*.0151	.0000	*.0366
14	.0000	*.0008	.0000	(.0006	.0000	*.0026
15	.0001	*.0000	.0009	*.0000	.0000	*.0000
16	.0000	*.0007	.0000	*.0001	.0000	*.0152
17	.0000	*.0013	.0000	*.0029	.0000	*.0002
18	.0000	*.0023	.0000	*.0014	.0000	*.0017

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TABLE LV

Topic: Cultivation of microbes

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0000	.3192	.	.4760	.	.2216
2	.0005	.3891	.	.8310	.	.8089
3	.0001	.1685	.	.1874	.	.5446
4	.0000	.0746	.	.4381	.	.4381
5	.0002	.4870	.	.2893	.	.6738
6	.0003	.5260	.	.5328	.	.9337
7	.0009	*.0043	.	*.0118	.	*.0009
8	.0010	.0574	.	.0533	.	.6149
9	.0043	.1301	.	.1060	.	.4328

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TABLE LVI

Topic: Microbial genetics

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0002	*.0077	.0019	*.0084	.0013	*.0331
2	.0034	*.0062	.0053	*.0085	.0003 .0013	*.0210
3	.0327	*.0029	.0060	*.0055	.0003 .0005	*.0050
4	.0025	*.0005	.0008	*.0023	.0003	*.0001
5	.0027	*.0278	.0146	.0836	*.0724	*.0451
6	.0064	*.0043	*.0616	*.0017	.0017	*.0070
7	.0044	*.0001	.0014	*.0000	.0002	*.0001
8	.0011	*.0000	.0017	*.0000	.0007	*.0001
9	.0009	*.0001	.0004	*.0000	.0001	*.0001
10	.0086	*.0032	.0016	*.0008	.0038	*.0460
11	.0002	.1877	.0010	.1938	.0000	.2418
12	.0030	.0549	.0000	*.0339	.0008	*.0105
13	.0001	*.0095	.0000	*.0014	.0004	*.0494
14	.0000	.6155	.0000	.5211	.0001 .0027	.3369
15	.0019	*.0406	*.0677	*.0232	*.1544	.1566

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TABLE LVII

Topic: Viruses

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0041	.5810	.0069	.5805	.0003	.2884
2	.0008	.1784	*.0831	.2472	.0447	.0916
3	.0004	.1008	.0056	.0603	.0140 .0000	.0628
4	.0000	.3662	.0127	.4097	.0000	.9190
5	.0000	.5513	.0026	.4897	.0000	.5480
6	.0000	.2217	.0026	.7227	.0000	.3849
7	.0000	.6830	.0086	.1031	.0000	.9825
8	.0032	.3070	.0029	.4511	.0111	.1160
9	.0060	*.0003	*.2055	*.0013	.0030 .0191	*.0001
10	*.2174	.6062	*.1451	.7866	.0947	.7075
11	.0029	*.0300	.0208	*.0330	*.0629	.1513
12	.0159	.0503	.0245	.6735	.0195 *.1053	*.0355
13	.0000	.3225	.0000	.1873	.0000	.2880
14	.0013	.6888	.0028	.8763	.0000 .0107	.8076
15	.0002	.4635	.0003	.1904	.0000	.1781
16	.0168	*.0000	*.6589	.0524	.0036	*.0000
17	.0343	*.0803	.2944 *.0968	.5617	.0008 .0360	.0784
18	.0055	.6945	.0022	.7186	.0001	.3530
19	.0000	.1952	.0002	.3029	.0000	.2316
20	.0321	.5232	.0060	.7901	.0175	.4625

APPENDIX D

TABLE LVIII

Topic: Microbial activities in nature

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0002	*.0008	.0000	*.0001	.0000	*.0004
2	.0000	*.0003	.0000	*.0030	.0030	*.0006
3	.0000	*.0049	.0000	*.0115	.0000	*.0021
4	.0005	.8697	.0000	.5725	.0052	.9498
5	.0015	.0678	.0001	.1038	.0466	.0513
6	.0112	.1640	.0002	.3039	.0141	.0569
7	.0002	*.0457	.0001	.1021	.0086	.0564
8	.0001	*.0360	.0000	*.0162	.0007	.1263
9	.0000	*.0048	.0000	*.0074	.0017	.1107
10	.	.4076	.	.5748		.9513
11	.	*.0370		.0700		*.0340

APPENDIX D

TABLE LIX

Topic: Host defenses and treatment against disease

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0027	.2227	.0030	.0689	.0030	.1213
2	.0357	.6137	*.1136	.7602	.0070 .1276	.6129
3	.0001	.6859	.0000	.4923	.0467 .0267	.6129
4	.0001	.4315	.0026	.9341	.0078 .0030	.8719
5	.0000	.1616	.0001	.1155	.0060 *.1951	.5493
6	.0001	.1605	.0010	*.0466	.0000	*.0379
7	.0012	.1291	.0077	*.0319	.0000	*.0318
8	.0001	.5138	.0001	.4202	.0001	.4747
9	.0199	.3311	.0016	.2376	.0194 .0050	.1334

APPENDIX D

TABLE LX

Topic: Microbial diseases according to organs/systems

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0259	.5601	.0015	.2994	.0003	.2930
2	.0253	.2996	.0010	.1270	.0001	.1408
3	.0346	.4968	.0034	.4849	.0010	.5948
4	*.0795	.8602	*.1961	.8597	.0014	.6234
5	*.0783	.9180	*.1601	.9703	.0011	.7913
6	*.1145	.8767	*.1168	.8974	.0011	.7921
7	.0246	.1334	*.0643	.2394	*.1068	.1622
			.0062		.0409	
8	.0043	.1487	.0190	.5409	.0287	.0687
			.0023		.0078	

APPENDIX D

TABLE LXI

Topic: Microbial diseases according to microbial groups

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0237	*.0300	.0004	.3188	.0003	*.0069
2	.0237	*.0111	.0004	.3778	.0003	*.0032
3	*.1313	.0597	.0074	.1387	.0014	*.0120
4	.0278	*.0091	.0005	.0744	.0001	*.0035
5	.0181	*.0366	.0011	.4272	.0001	*.0157
6	.0029	*.0105	.0002	*.0451	.0000	*.0016
7	.0050	.1787	.0003	.2840	.0000	.0819
8	.0007	.4195	.0000	.2743	.0000	.2049
9	.0001	.3887	.0001	.3513	.0011	.1313

APPENDIX D

TABLE LXII

Topic: Laboratory activities

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
1	.0001	*.0398	.0078	*.0277	.0028	*.0325
2	.0093	.2126	.0270	.0634	*.0528	.2176
3	.0000	.3339	.0059	.8509	.0000	.3848
4	.0000	.3077	.0003	.1968	.0000	.4760
5	.0014	.3281	.0011	.4035	.0097	.6410
6	.0177	*.0064	.0189	*.0027	.0005	*.0060
7	.0006	.2723	.0023	.2905	*.0611	.4616
8	.0002	.7648	.0258	.5927	.0258	.4818
9	.0027	*.0071	.0078 .0022	.0622	.0078 .0107	*.0030
10	.0000	.4625	.0000	.2085	.0013	.3026
11	.0000	*.0001	.0000	*.0141	.0003 .0008	*.0000
12	.0001	*.0035	.0001	.1818	.0015	*.0007
13	.0002	*.0101	.0001	*.0169	.0001	*.0037
14	.0000	.0849	.0009	.0576	.0001	*.0479
15	.0003	.0552	.0020	.0763	.0015	*.0141
16	.0003	.0509	.0011	*.0288	.0010	.0725
17	.0000	.1289	.0001	.0834	.0000	*.0483
18	.0066	.4252	.0167	.8257	.0168	.4389
19	.0000	*.0456	.0001	.9758	.0001	.0846
20	.0000	.5264	.0002	.4494	.0000	.2085

APPENDIX D

TABLE LXII
(continued)

Topic: Laboratory activities

Item #	Non-Grouped Responses (1 2 3 4 5)		Grouped Responses (1-2, 3, 4-5)		Grouped Responses (1-2, 3-4, 5)	
	Test Retest	Homogeneity	Test Retest	Homogeneity	Test Retest	Homogeneity
21	.0008	.4542	.0002	.2957	.0019	.2411
22	*.1084	.2522	.0053	.1414	.0152	.1974
23	.0277	*.0003	*.2573	*.0105	.0042	*.0000
24	.0001	*.0174	.0000	*.0223	.0000	*.0109
25	.0007	.9538	.0486	.8983	*.1020	.8920
26	.0000	*.0000	.0000	*.0011	.0358 .0000	*.0000
27	.0026	*.0002	.0026	*.0032	.0001	*.0001
28	.0003	*.0001	.0009	*.0028	.0002	*.0000
29	.0436	.3742	.0059	.3364	.0183	.1454
30	.0002	*.0222	.0000	.2944	.0001	*.0157
31	.0000	*.0006	.0000	.1530	.0000	*.0001
32	.0007	*.0000	.0001	*.0025	.0041	*.0000
33	.0104	.7388	.0045	.5960	.0102	.4256
34	.0047	.8248	.0057	.8011	.0002	.5905
35	.0029	.5372	.0002	.2128	.0003	.6812
36	.0010	.4060	.0003	.8333	.0051	.2080

APPENDIX E

APPENDIX E

This table summarizes the number of items in each topic, indicates how many of these items are reliable or unreliable according to the test-retest results, and indicates how many items in each topic were given the same depth of coverage and also how many were given different depths of coverage by the two populations of teachers.

TABLE LXIII

SUMMARY TABLE OF STATISTICAL ANAYSIS

TOPIC	# ITEMS	# RELIABLE	# UNRELIABLE	# AGREE	# DISAGREE
1	11	10	1	4	6
2	8	8	0	5	3
3	16	15	1	10	5
4	5	4	1	1	3
5	13	13	0	10	3
6	18	18	0	2	16
7	9	9	0	8	1
8	15	15	0	3	12
9	20	19	1	16	3
10	11	11	0	4	7
11	9	9	0	9	0
12	8	5	3	5	0
13	9	8	1	3	5
14	36	35	1	20	15
totals	188	179	9	100	79

APPENDIX F

APPENDIX F

Summary Tables of Percentage Frequencies

These tables summarize the depth of coverage to which the two populations of teachers assigned each item on the survey questionnaire.

Numbers in the first column are used to indicate the different items in a particular topic. The items are numbered according to their order of occurrence on the survey questionnaire.

The remaining columns are used to summarize the depth of coverage to which both populations of teachers assigned the various items. The letter J in a column indicates junior/community college responses and the letter C in a column indicates senior college responses. Placement of the letter indicates that 50% or more of that population of teachers assigned the corresponding item to the amount of coverage indicated at the top of the column.

The letter J is placed before the letter S when percentage frequencies for the individual items indicate greater depth of coverage for that item by junior/community college teachers than was assigned by senior college teachers. The letter S is placed before the letter J when greater depth of coverage was assigned that item by senior college teachers.

The letter X placed before the item's number indicates that that item is not reliable as computed from information derived from the test-retest survey where five categories of answers are used. An asterisk (*) placed after an item's number indicates that the two populations of teachers answered that particular item significantly different. A dollar sign ($) placed after an item's number identifies that item as a common element, which indicates that 50% or more of the senior college teachers assigned this item to moderate coverage or more.

TABLE LXIV

Topic: HISTORY OF MICROBIOLOGY

Item #			VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1		$			J,S		
2		$			S	J	
3	*					S	J
4	*	$			S	J	
5		$		J,S			
6		$		S	J		
X 7	*				S		J
8	*					S	J
9	*	$			S		J
10	*	$			S		J
11	*	$			S	J	

TABLE LXV

Topic: MICROSCOPY

ITEM #		VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	$		J,S			
2	* $		J,S			
3	* $		S		J	
4					J,S	
5	*				J,S	
6					J,S	
7					J,S	
8					J,S	

TABLE LXVI

Topic: EUKARYOTE MICROBES

ITEM #			VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1						S	J
2	X			J,S			
3		$		S	J		
4		$			J,S		
5	*	$			J,S		
6		$			J,S		
7	*					J,S	
8		$			J,S		
9		$			S	J	
10						J,S	
11	*	$			S	J	
12						J,S	
13	*					S	J
14	*					S	J
15						J,S	
16						J,S	

TABLE LXVII

Topic: TAXONOMY OF BACTERIA

ITEM #		VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	* $			J,S		
2	*				J,S	
3	* $			S	J	
4	$ *				S	J
5	$			J,S		

TABLE LXVIII

Topic: BACTERIAL ANATOMY AND STAINS

ITEM #			VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	*	$		J,S			
2		$		J,S			
3		$		J,S			
4		$			J,S		
5	*	$			J,S		
6		$		J,S			
7		$		J	S		
8		$			S	J	
9		$			J,S		
10						J,S	
11						J,S	
12	*					S	J
13		$			J,S		

TABLE LXIX

Topic: CHEMISTRY

ITEM #			VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	*	$		S		J	
2	*	$		S		J	
3	*	$			S		J
4	*	$			S	S	J
5	*	$			S	J	
6	*	$			S		J
7	*	$		S	J		
8		$		J,S			
9		$		J,S			
10	*	$			S		J
11	*	$			S		J
12	*	$			S	J	
13	*	$		S	J		
14	*	$		S	J		
15	*	$			S		J
16	*	$			S	J	
17	*	$			S		J
18	*	$			S		J

TABLE LXX

Topic: CULTIVATION OF MICROBES

ITEM #		VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	$		S	J		
2	$			J,S		
3	$		J,S			
4	$		J	S		
5	$	J	S			
6	$		J,S			
7	* $			S	J	
8	$		J,S			
9	$		J,S			

TABLE LXXI

Topic: MICROBIAL GENETICS

ITEM #		VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	* $		J,S			
2	* $		S	J		
3	* $			S	J	
4	* $			S		J
5	* $		J,S			
6	* $			S		J
7	* $		S		J	
8	* $		S		J	
9	* $		S		J	
10	* $			S	J	
11	$			S	J	
12	$		S	J		
13	* $		S	J		
14	$		J,S			
15	* $		S	J		

TABLE LXXII

Topic: VIRUSES

ITEM #			VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1		$			S	J	
2		$		J	S		
3		$			J,S		
4		$			J,S		
5		$			J,S		
6		$			J,S		
7		$			J,S		
8		$		S	J		
9	*	$			S	J	
X 10					J,S		
11	*	$		J	S		
12		$			J,S		
13		$		J	S		
14		$			J,S		
15		$			J,S		
16	*					S	J
17						S	J
18						J,S	
19						J,S	
20		$			J,S	J	

TABLE LXXIII

Topic: MICROBIAL ACTIVITIES IN NATURE

ITEM #		VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	* $			S	J	
2	*				S	J
3	* $			S	J	
4	$			J,S		
5	$			S	J	
6	$			J,S		
7	* $			S	J	
8	* $			S	J	
9	* $			S	J	
10					J,S	
11	*				S	J

TABLE LXXIV

Topic: HOST DEFENSES AND TREATMENT AGAINST DISEASE

ITEM #		VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	$		J	S		
2	$		J,S			
3	$		J,S			
4	$		J,S			
5	$		J,S			
6	$		J	S		
7	$		J	S		
8	$		J,S			
9	$		J	S		

TABLE LXXV

Topic: MICROBIAL DISEASES ACCORDING TO ORGANS/SYSTEMS

ITEM #	VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	$		J,S		
2			J	S	
3	$		J,S		
X 4			J,S		
X 5			J,S		
X 6			J,S		
7				S	J
8				S	J

TABLE LXXVI

Topic: MICROBIAL DISEASES ACCORDING TO MICROBIAL GROUPS

ITEM #		VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	* $			J,S		
2	* $			J,S		
X 3				J,S		
4	* $			J,S		
5	* $			J,S		
6	* $			S	J	
7	$			J,S		
8				J	S	
9					S	J

TABLE LXXVII

Topic: LABORATORY ACTIVITIES

ITEM #			VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
1	*	$		J	S		
2		$		J,S			
3		$		J,S			
4		$			J,S		
5		$			J,S		
6	*	$			S	J	
7		$		J	S		
8		$		J,S			
9	*	$		J	S		
10		$		J	S		
11	*	$			S	J	
12	*	$			J,S		
13	*	$			S	J	
14		$		J	S		
15		$		J	S		
16		$		J	S		
17		$			S	J	
18		$		J	S		
19	*				J	J,S	
20						J,S	

TABLE LXXVII
(CONTINUED)

Topic: LABORATORY

ITEM #			VERY DETAILED COVERAGE	DETAILED OR MORE COVERAGE	MODERATE OR MORE COVERAGE	BRIEF OR LESS COVERAGE	NO COVERAGE
21		$			J,S	J	
X 22					J,S		
23	*					S	J
24	*	$			J,S		
25		$		J,S			
26	*	$			S		J
27	*	$			S		J
28	*	$			S		J
29		$		S	J		
30	*	$		S	J		
31	*	$			S		J
32	*					S	J
33		$			J,S		
34		$			J,S		
35		$			J,S		
36						S	J

APPENDIX G

APPENDIX G

SUMMARY TABLES OF PERCENTAGE FREQUENCIES

The following tables summarize the depth of coverage to which the two populations of teachers assigned each item on the survey questionnaire.

Numbers in the first column are used to indicate the different items in a particular topic. The items are numbered according to their order of occurrence on the survey questionnaire.

The remaining columns are used to summarize the depth of coverage to which both populations of teachers assigned the various items. The letter J in a column indicates junior/community college responses and the letter C in a column indicates senior college responses. Placement of the letter indicates that 50% or more of that population of teachers assigned the corresponding item to the amount of coverage indicated at the top of the column.

The letter J is placed before the letter S when percentage frequencies for the individual items indicate greater depth of coverage for that item by junior/community college teachers than was assigned by senior college teachers. The letter S is placed before the letter J when greater depth of coverage was assigned that item by senior college teachers.

The letter X placed before the item's number indicates that that item is not reliable as computed from information derived from the test-retest survey where five categories of answers are used. An asterisk (*) placed after an item's number indicates that the two populations of teachers answered that particular item significantly different. A dollar sign ($) paced after an item's number idenitifies that item as a common element, which indicates that 50% or more of the senior college teachers assigned that item to moderate coverage or more.

TABLE LXXVIII

Topic: HISTORY OF MICROBIOLOGY

	ITEM #		DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
	1	$		J,S	
	2	$		S	J
	3	*			S,J
	4	* $		S	J
	5	$	J,S		
	6	$	S	J	
X	7	*		S	J
	8	*			S,J
	9	* $		S	J
	10	* $		S	J
	11	* $		S	J

TABLE LXXIX

Topic: MICROSCOPY

ITEM #	DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1 $	J,S		
2 * $	J,S		
3 * $	S		J
4			J,S
5 *			J,S
6			J,S
7			J,S
8			J,S

TABLE LXXX

Topic: EUKARYOTE MICROBES

ITEM #		DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1				S,J
X 2		J,S		
3	$	S	J	
4	$		J,S	
5	* $		J,S	
6	$		J,S	
7	*			J,S
8	$		J,S	
9	$		S	J
10				J,S
11	* $		S	J
12				J,S
13	*			S,J
14	*			S,J
15				J,S
16				J,S

TABLE LXXXI

Topic: TAXONOMY OF BACTERIA

ITEM #		DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1	* $		J,S	
2	*			J,S
3	* $		S	J
X 4	*			S,J
5	$		J,S	

TABLE LXXXII

Topic: BACTERIAL ANATOMY AND STAINS

ITEM #	DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1 * $	J,S		
2 $	J,S		
3 $	J,S		
4 $		J,S	
5 * $		J,S	
6 $	J,S		
7 $	J	S	
8 $		S	J
9 $		J,S	
10			J,S
11			J,S
12 *			S,J
13 $		J,S	

TABLE LXXXIII

Topic: CHEMISTRY

ITEM #	DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1 * $	S		J
2 * $	S		J
3 * $		S	J
4 * $		S	S,J
5 * $		S	J
6 * $		S	J
7 * $	S	J	
8 $	J,S		
9 $	J,S		
10 * $		S	J
11 * $		S	J
12 * $		S	J
13 * $	S	J	
14 * $	S	J	
15 * $		S	J
16 * $		S	J
17 * $		S	J
18 * $		S	J

TABLE LXXXIV

Topic: CULTIVATION OF MICROBES

ITEM #		DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1	$	S	J	
2	$		J,S	
3	$	J,S		
4	$	J	S	
5	$	J,S		
6	$	J,S		
7	* $		S	J
8	$	J,S		
9	$	J,S		

TABLE LXXXV

Topic: MICROBIAL GENETICS

ITEM #		DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1	* $	J,S		
2	* $	S	J	
3	* $		S	J
4	* $		S	J
5	* $	J,S		
6	* $		S	J
7	* $	S		J
8	* $	S		J
9	* $	S		J
10	* $		S	J
11	$		S	J
12	$	S	J	
13	* $	S	J	
14	$	J,S		
15	* $	S	J	

TABLE LXXXVI

Topic: VIRUSES

ITEM #			DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1		$		S	J
2		$	J	S	
3		$		J,S	
4		$		J,S	
5		$		J,S	
6		$		J,S	
7		$		J,S	
8		$	S	J	
9	*	$		S	J
X 10				J,S	
11	*	$	J	S	
12		$		J,S	
13		$	J	S	
14		$		J,S	
15		$		J,S	
16	*				S,J
17					S,J
18					J,S
19					J,S
20		$		J,S	J

TABLE LXXXVII

Topic: MICROBIAL ACTIVITIES IN NATURE

ITEM #	DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1 * $		S	J
2 *			S,J
3 * $		S	J
4 $		J,S	
5 $		S	J
6 $		J,S	
7 * $		S	J
8 * $		S	J
9 * $		S	J
10			J,S
11 *			S,J

TABLE LXXXVIII

Topic: HOST DEFENSES AND TREATMENT AGAINST DISEASE

ITEM #		DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1	$	J	S	
2	$	J,S		
3	$	J,S		
4	$	J,S		
5	$	J,S		
6	$	J	S	
7	$	J	S	
8	$	J,S		
9	$	J	S	

TABLE LXXXIX

Topic: MICROBIAL DISEASES ACCORDING TO ORGANS/SYSTEMS

ITEM #		DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1	$		J,S	
2			J	S
3	$		J,S	
X 4			J,S	
X 5			J,S	
X 6			J,S	
7				S,J
8				S,J

TABLE XC

Topic: MICROBIAL DISEASES ACCORDING TO MICROBIAL GROUPS

ITEM #		DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1	* $		J,S	
2	* $		J,S	
X 3			J,S	
4	* $		J,S	
5	* $		J,S	
6	* $		S	J
7	$		J,S	
8			J	S
9				S,J

TABLE XCI

Topic: LABORATORY ACTIVITIES

ITEM #		DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
1	* $	J	S	
2	$	J,S		
3	$	J,S		
4	$		J,S	
5	$		J,S	
6	* $		S	J
7	$	J	S	
8	$	J,S		
9	* $	J	S	
10	$	J	S	
11	* $		S	J
12	* $		J,S	
13	* $		S	J
14	$	J	S	
15	$	J	S	
16	$	J	S	
17	$		S	J
18	$	J	S	
19	*		J	J,S
20				J,S

TABLE XCI
(continued)

Topic: LABORATORY

ITEM #		DETAILED COVERAGE OR MORE	MODERATE COVERAGE OR MORE	BRIEF COVERAGE OR LESS
21	$		J,S	J
X 22			J,S	
23	*			S,J
24	* $		J,S	
25	$	J,S		
26	* $		S	J
27	* $		S	J
28	* $		S	J
29	$	S		
30	* $	S	J	
31	* $		S	J
32	*			S,J
33	$		J,S	
34	$		J,S	
35	$		J,S	
36				S,J

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