AN ABSTRACT OF THE THESIS OF

Thomas Edward Thompson for the degree Doctor of Education
(Name) (Degree)

in Science Education presented on August 8, 1974
(Major department) (Date)

TITLE: A SURVEY OF THE STATUS AND THE NEEDS OPINION OF SCIENCE EDUCATION IN OREGON DURING THE 1973-74 SCHOOL YEAR, GRADES K-12

Redacted for privacy

Abstract approved: ______________________
Dr. Stanley E. Williamson

The major problem of the study was to obtain information about the status of science education and the opinions of five different populations concerning what should be taking place in science education in Oregon for grades K-12 during the 1973-74 school year.

The design of the study included a stratified random sample plan where schools were selected based on the area of the state and size of individual schools. The five populations from which eight samples were obtained were: 1) 10,402 elementary school teachers representing 902 elementary public schools; 2) 1,310 secondary school science teachers representing 348 secondary public schools; 3) 113,794 secondary school students representing 225 secondary public schools; 4) 680 PTA officers representing 302 elementary and 38 secondary schools; and 5) 485 OSU scientists. The eight

sample sizes were; elementary teachers - 261 and 255; secondary science teachers - 188, 185 and 208; secondary students - 287; PTA officers - 225; and OSU scientists - 204. Two different samples were selected from elementary teachers to obtain information about the status and needs opinion of elementary school science education. Three different samples were selected from secondary school science teachers to obtain information about the status and needs opinion of secondary school science education. One sample each was selected from secondary school students, PTA officers and OSU scientists about the needs opinion of science education in Oregon. Complete randomization occurred.

Analysis of the data was conducted using standard computer programs. Descriptive statistics were used to measure frequency distribution and percentages. Multiple regression analysis, analysis of variance and chi-square were used to analyze individual items within and between the various questionnaires.

Among the significant findings were; 1) S-APA was the most commonly adopted elementary school science program, but ESS and SCIS were shown to be evaluated more favorably by elementary teachers on a number of independent variables; 2) poor facilities, lack of equipment and poor academic training were no longer considered to be barriers to effective teaching; 3) seventy-one percent of the secondary science teachers had master's degrees; 4) little formal articulation existed between the elementary school and secondary school science program; 5) all five populations ranked "learning how to learn, how to attack new problems, how to acquire new knowledge" as the most important of the NSTA goals of science education; 6) environmental quality was ranked as the most important science-related concern by four of the five populations, family living was ranked most important by the PTA officers; 7) the greater the science background of an individual, the less likely they perceived a conflict between science and religion in their explanations of the origin of man; 8) most samples agreed that students should have some input as to what the contents of a science course should be; and 9) most samples agreed that science should be integrated with other subject areas.

Conclusions were made in the areas of philosophy, objectives, curriculum, methodology, facilities and equipment, teacher education, evaluation and general improvement in science education in Oregon public schools. Thirteen recommendations were made to improve the quality of science teaching.

A Survey of the Status and the Needs Opinion of Science Education in Oregon During the 1973-74 School Year, Grades K-12

by

Thomas Edward Thompson

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirements for the
degree of

Doctor of Education

Completed August 1974

Commencement June 1975

APPROVED:

Redacted for privacy

Professor of Science Education
in charge of major

Redacted for privacy

Chairman of Department of
Science Education

Redacted for privacy

Dean of Graduate School

Date thesis is presented August 8, 1974

Typed by Suelynn Williams for Thomas Edward Thompson

ACKNOWLEDGEMENTS

Sincere appreciation is extended to the many people who contributed to this study by giving freely of their time, effort and encouragement. The researcher wishes to express his appreciation to the elementary teachers, science teachers, students, PTA Officers and Oregon State University scientists for their cooperation; the members of the Oregon Mathematics Education Council for their financial assistance; and the Oregon State Department of Education for their advice and cooperation.

Special thanks is extended to the following persons:

To Dean Stanley Williamson who allowed the researcher to grow professionally through a wide variety of experiences, who provided the inspiration for the study and who offered continual encouragement throughout the entire doctoral program;

To Dr. Karl J. Nice, who has given inspiration, friendship and provided the researcher with a model of good teaching;

To Dr. Thomas P. Evans, who has provided constructive criticism and guidance in the preparation of the study;

To Ray Thiess, who through his professional attitude has provided the researcher with enthusiasm and a positive attitude toward the future;

To Dr. Norbert Hartmann for his assistance with the design of the questionnaires and computer analysis of the data;

To Dr. Daniel Jones, Dr. Herbert Frolander, and Dr. James Armitage for serving as members of the doctoral committee;

To my wife, Mary Ann, who has given freely of her love, support, and understanding, and to my son, Mark, who has given "a whole lot and a little bit of love";

To my parents, Rula and George Thompson, whose love and sacrifice will never be forgotten.

TABLE OF CONTENTS

TABLE OF CONTENTS (contd.)

TABLE OF CONTENTS (contd.)

TABLE OF CONTENTS (contd.)

TABLE OF CONTENTS (contd.)

TABLE OF CONTENTS (contd.)

TABLE OF CONTENTS (contd.)

TABLE OF CONTENTS (contd.)

TABLE OF CONTENTS (contd.)

TABLE OF CONTENTS (contd.)

TABLE OF CONTENTS (contd.)

TABLE OF CONTENTS (contd.)

LIST OF TABLES

LIST OF TABLES (contd.)

LIST OF TABLES (contd.)

LIST OF TABLES (contd.)

LIST OF TABLES (contd.)

LIST OF TABLES (contd.)

LIST OF TABLES (contd.)

LIST OF TABLES (contd.)

LIST OF TABLES (contd.)

LIST OF TABLES (contd.)

LIST OF TABLES (contd.)

LIST OF TABLES (contd.)

A SURVEY OF THE STATUS AND THE NEEDS OPINION OF SCIENCE EDUCATION IN OREGON DURING THE 1973-74 SCHOOL YEAR, GRADES K-12

CHAPTER I

INTRODUCTION

Educational reforms are frequently made on the basis of availability of financial assistance rather than basic research. When monies are abundant, the tendency is to initiate change just for the sake of change itself. Sometimes there is thorough research before attempting change. However, too frequently the reverse is true. That is, little research and planning are conducted prior to the spending of large sums of money. In 1960, Obourn commented on the crisis in science education research:

> Today the climate for science is the most favorable that it has ever been . . . There are millions of dollars being spent for improvement and yet, for the most part, these programs are not based on solid research. I refer especially to the programs of N.S.F. and N.D.E.A. These programs to a degree are being carried forward without the exact findings of research. They are planned and carried out on the basis of hunches and assumptions, some of which will not stand up under careful scrutiny. (Obourn, 1960, p. 19)

In the same article, Obourn went on to elaborate about the position that science educators assumed in regards to research:

> The N.D.E.A. makes provision for acquiring new equipment for science teaching and will spend

> many millions of dollars over the next four years to provide for what we all know to be a serious bottleneck to the achievements of goals. And yet when we were faced with the problem of documenting the need for new equipment in Congressional hearings there was practically no research to point the need nor to serve as a bench mark from which improvement could be measured. (Obourn, 1960, p. 20)

When research is not involved as a prerequisite for change, the result is likely to be ineffectual. An obvious example was the attempt to improve science instruction in the 1960's by providing funds to recycle secondary science and mathematics teachers through summer and academic year institutes. Millions of dollars were readily available for up-dating the cognitive repertoire of thousands of teachers. Almost any reputable institution of higher learning could receive vast sums of money for educational reform in science and mathematics education. In fact nearly 300 colleges and universities were conducting summer and academic year institutes during the period 1957-1972. And yet, how much research went into the decision to invest wholesale funds to retrain science and mathematics teachers?

In 1960, Carleton and Renner discussed a plan for quality in science education. The questions were appropriate then, and certainly are appropriate today. They concluded their article by saying:

> As a final guideline, think big, think boldly, think ubiquitously, and act accordingly. In the future as we look back on an era of experimentation in science education, the competent educator will need to regret only those educational experiments which he did not himself try. (Carleton & Renner, 1960, p. 68)

The implication being that with all the money available to science education, experiment with many ideas and hope that some prove to be successful. Nothing is mentioned or inferred that some type of survey in the science education community should be conducted to receive some input from students, teachers or laymen. The federal government, scientists and science educators automatically assumed that the material, the methodology, the facilities and the teacher all needed to be changed. Time is proving that all the changes were not as beneficial as they once were hoped to be.

Today, monies are not readily available for educational reform in science education. Consequently, the tendency is to cause science educators to examine current practices and determine if indeed they have been doing the best possible job of educating the nation's children. It is hoped that a survey of science education in Oregon will provide the information necessary to provide for effective planning and implementation of school science programs.

The Problem

The purpose of this study will be to make an assessment of science education, grades K-12 in the state of Oregon. Before any reform is attempted, it is essential to determine what is currently taking place in science education in public schools throughout the entire state. Following a knowledge of the status, one must also be concerned with what should be taking place in public schools. Hopefully, science educators will then be armed with the information necessary to make intelligent decisions concerning reform based on research data rather than on some subjective opinion based primarily on the easy availability of monies.

Specifically then, the questions this study will attempt to answer are: how are decisions made for selecting, implementing and evaluating local science curricula? What kinds of facilities and materials are currently in use? What methodological procedures are being employed in classrooms? Who determines the subject matter? What materials are used? How much time is spent in laboratory situations? What do students feel should be taking place in the schools? What is the opinion of the layman? Are the opinions of the students and the laymen compatible with the opinion of science teachers? These and many more, are just some of the questions for which this study will attempt to provide some information.

Assumptions

In order to conduct this survey, certain assumptions must be made:

1. Teachers, students and laymen will give sincere and accurate responses when confronted with a survey questionnaire.
2. The samples selected for each questionnaire are random samples representing the population of Oregon.

3. The questions selected for the questionnaires will elicit an assessment of the needs for science education in Oregon.

4. The variables used for stratifying the random sample are appropriate ones to provide for accurate randomization.

5. In considering any biases for the lay group, the PTA bias is assumed to be the most positive in that it is a group concerned with providing good schools for children.

6. It is assumed that those persons who did not return the questionnaires would have had similar responses as those who did return the questionnaires.

Definitions of Terms

Elementary - Refers to grades K-6.

Secondary - Refers to grades 7-12.

Need - In a scientific sense, it refers to a deficit or absence of something that is necessary to the maintenance or optimal functioning of a system.

Assessment - The act of analyzing critically and judging definitively the nature, significance, status or merit of.

Needs opinion - Those opinions expressed by selected persons concerning what should be taking place in science education.

O.S.U. Scientist - One who is a specialist in a science-related field (i.e. biology, physics, chemistry), holding a minimum of a Ph.D. with the ranking of Assistant Professor or higher.

Need for the Survey

Evolutionary theory states that an organism which can readily adapt to any changes in environment is more likely to survive over long periods of time. Science education in the state of Oregon is currently in the position of survival. Fewer elementary teachers and secondary science teachers are in demand today compared with the situation five years ago. The rate of population growth has declined. Universities are no longer "mass producing" teachers to meet the demands of society. Instead their efforts have turned toward an emphasis on quality rather than quantity. Enrollment in science classes in our secondary schools has tapered off (Oregon Annual Fall Report). Seven years ago approximately 6, 000 students were enrolled in physics as compared with about 4, 500 last year (1972). During the same period, chemistry enrollment experienced a decrease from approximately 12, 000 to 9, 000 students. This represents a 25 percent drop in enrollment in chemistry and physics assuming no growth in student population. However, such was not the case for the number of students increased approximately six percent during the same period of time (1965-72).

Assuming that the decline in demand for teachers continues and assuming that the drop in the number of students electing to take physics and chemistry continues, then the question of the survival of science education as it now exists is a viable one. Science educators have at least three choices in determining what their influence will be: 1) they can continue a curriculum similar to that followed in the past; 2) they can make a change for the sake of change itself based on some intuitive hunch that their fate will improve; or, 3) they can effect a change based on research evidence.

Alternative one is analogous to the ostrich who buries his head in the sand and pretends that problems don't exist. Potentially it could be a rather precarious position to assume. Alternative two is weak because it implies input from only one person or group. This author contends that the third alternative is the most logical choice to make because any decision involving the establishment of new goals or reform should be based on careful research evidence. The most appropriate type of research initially would be the survey. Travers claims:

> More justifiable are surveys of opinion of various groups designed to provide a basis for establishing objectives or goals..... The selection of objectives is generally considered to be best undertaken as a group decision rather than as an individual decision, and hence surveys represent appropriate techniques for this purpose. (Travers, 1963, p. 234)

The last extensive science education survey to be conducted in Oregon was completed in 1960. The population consisted of all secondary teachers of science. Emphasis was placed on determining information about teacher preparation, facilities, methodology and course content. There was no concern for receiving input from other sources besides science teachers. Neither was there concern for opinions of what should be taking place in science education.

Limitations

1. The survey is limited by the extent of cooperation by individual school districts.

2. The survey is limited by the accuracy and sincerity of the responses on the questionnaires.

3. The survey limits generalizations to the state of Oregon.

4. The survey limits generalizations of students to those in senior high schools.

Delimitations

1. This survey does not intend to make individual teacher, school or district comparisons.

The Instruments

The survey consisted of two different sets of questionnaires. One set attempted to assess the current status of science education in grades K-12. The other attempted to collect the needs opinions of science education perceived by teachers, students, a lay group, and scientists for grades K-16. Therefore a total assessment could be accomplished with the input of two kinds of information, i.e. "what is" and "what should be".

The following categories were selected as being most pertinent in determining the criteria for question selection:

1. Personal data
2. Academic Preparation
3. Philosophy
4. Facilities and equipment
5. Content and organization of courses

6. Methodology
7. In-service professional growth
8. Scientific literacy
9. Evaluation
10. Crucial issues

The questionnaires primarily consisted of checklist items that could be answered quickly and concisely. However, some items required short answers requesting an elaboration of a particular response or a type of listing of activities that were once performed. All eight questionnaires were field tested prior to administration of the finalized questionnaires. During the field test, subjects were permitted to make comments and suggestions either orally or by written responses.

Procedures

The research samples were identified by a matrix established by Science Research Associates (SRA) and used by Oregon State Department of Education using area of state and school size as the two criteria for determining stratification. Area of state consisted of eastern and western Oregon and metropolitan Portland. School size was determined by ADM (elementary: less than 150, 150-349, 350-499 and 500 and over; secondary: less than 150, 150-499, 500-999 and 1000 and over).

Eight different samples were identified:

1. Elementary (K-6) teachers for the status assessment.

2. Elementary (K-6) teachers for the needs opinion.
3. Secondary (7-12) science teachers for the status assessment.
4. Secondary (7-12) science teachers for the status assessment (part 2).
5. Secondary (7-12) science teachers for the needs opinion.
6. Secondary (9-12) students for the needs opinion.
7. Parent-Teacher Association (PTA) groups for the needs opinion.
8. Oregon State University (OSU) scientists for the needs opinion.

The PTA was selected as a lay group for three reasons. First, to attempt to identify a truly random group of laymen was prohibitive from both a financial standpoint as well as a timeline for completing the survey. Secondly, the matrix employed by the State Department of Education could be used, thus eliminating the necessity for developing a totally new matrix. Finally, the PTA was assumed to be the least biased group associated with school districts. Other groups considered were: non-certified staff, administrators and school board members.

The Data and Statistical Instruments

The data consisted of eight different questionnaires obtained from five different populations. All secondary science teachers, all local PTA executive groups and all OSU scientists were contacted. The two-way stratified random sample was used to obtain samples of elementary teachers and secondary students. All the data was tabulated using a Control Data System 3300 computer. Statistical techniques used to analyze the data were: frequency distributions, percentages, analysis of variance, multiple regression and chi-square.

Organization of the Remainder of the Study

Chapter II contains a review of pertinent surveys in science education grades K-12. The surveys are organized into four sections; national, regional, state and Oregon surveys. Each section includes studies both at the elementary and secondary level. No survey attempted to include information at both elementary and secondary levels of instruction.

Chapter III describes the plan for randomization and discusses the procedure used in developing and distributing the questionnaires throughout Oregon.

Chapter IV contains the results for each set of questionnaires. In addition comparisons are discussed between samples for questions which were not mutually exclusive for the eight different sets of questionnaires.

Chapter V contains a summary, conclusions, and recommendations for further research.

Following Chapter V, a series of appendices including supplemental information about the questionnaires and individual responses to selected items is included. The responses to particular questions found in the Appendices are direct quotes taken from individual questionnaires.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter is devoted to a review of the literature which is pertinent to the present study. Many surveys have been conducted at the national, regional, state, and local levels. Because of the broad spectrum of information sought in this survey, it is inappropriate to include all the studies. For example, many surveys have been done at the state level focusing on a specific set of teachers, i.e. physics, biology, chemistry, and earth science. Because the results were limited to one group of teachers, the researcher decided to exclude them from the review.

The review is organized into four parts. The first focuses on national studies which have had impact on the science education community. The second is localized to regional areas. The third contains information restricted to specific states. The fourth part is concerned with surveys which are unique to the state of Oregon.

National Surveys

Elementary

In 1962, the U. S. Office of Education conducted a survey of elementary science education and was reported by Blackwood (1965).

The sample was selected by using a stratified random sample. The administrative district unit was one criterion and the other was school size. A variety of items were reported.

Ninety-seven percent of the schools considered the following purposes for teaching science as being very important or of some importance:

1. Help children develop curiosity.
2. Help children learn to think critically.
3. Teach knowledge.
4. Help children learn concepts and ideas for interpreting their environment.
5. Develop appreciations and attitudes about the environment.
6. Help children develop problem-solving skills.
7. Develop responsibility for the proper use of science knowledge for the betterment of men.

Major findings concerning administrative provisions of time and classroom organization were as follows:

1. Approximately five percent reported no science at all in kindergarten and first grade.
2. The percentage of schools teaching science five periods per week increases in the upper grades. The mean number of periods per week increases from 3.2 in the kindergarten to 4.1 in the seventh and eighth grades.
3. Of all the schools, about 15 percent are departmentalized.
4. The percentage of schools departmentalized for science teaching increases from the lower grades up to the seventh grade in each school enrollment group.

The following were included in relation to the characteristics of the personnel teaching science:

1. Science is taught most frequently, by far, by the classroom teacher with no help from a science specialist.
2. The percentage of schools in which science is taught by a classroom teacher decreases progressively from first grade (86 percent)

to eighth grade (73 percent).

3. The smaller school groups report a smaller percentage of science specialists available to help classroom teachers.
4. In grades four to eight, classroom teachers with special competence in science trade classes with other teachers in every school enrollment group. In grades one to three this practice is negligible. From one percent of the schools in the fourth grade to 4.6 percent in the seventh grades use teachers in this way.
5. In general, science taught as a separate subject and science taught as a separate subject and incidental emerge as the two patterns that are most common in the upper grades with the percentage of schools teaching science integrated with other subjects being highest in the early grades and lowest in the upper grades.
6. Thirty-six percent of all the schools teach science and social studies together.
7. Approximately 25 percent of the elementary schools have a policy that science should be taught separately, and 16 percent have no policy.

Findings by Blackman concerning the availability and use of consultant help were as follows:

1. Providing consultant help for elementary teachers is considered one important way of improving science teaching. Of all the schools, 42 percent have consultant help in science. The availability of consultants is greatest in the large schools and smallest in the small schools.
2. Approximately 15 percent of all the schools have an elementary science consultant. High school science teachers are available for science consultant help in 27 percent of all the schools.

The following were included among major findings by Blackman related to science facilities and equipment.

1. Eight percent of all schools indicated that the availability of equipment and supplies was very plentiful; 46 percent generally adequate, and 46 percent responded in the combined categories far from adequate and completely lacking.
2. The most common science equipment found in the elementary schools were compasses, magnets, mineral and rock collections, reading glasses, and thermometers.

Thirteen barriers to effective science teaching were reported by Blackman in rank order of importance:

1. lack of consultant service
2. lack of supplies
3. inadequate room facilities
4. insufficient funds
5. do not have knowledge
6. lack in-service opportunities
7. inability to improvise
8. do not know methods
9. not enough time
10. lack of community support
11. teachers lack interest
12. what to teach not determined
13. other areas more important

Moorehead (1965) conducted a study in 1964 of the status of elementary school science and how it was taught. His study was designed to investigate the teacher education programs in elementary school science in selected colleges and universities representing the fifty states and the District of Columbia. One of the primary purposes of the study was to determine whether or not experiences in science were developing the rational powers of students. No definite trends in science programs were established, but the lecture-laboratory, lecture-demonstration, and discussion methods were found to be commonly used in science courses taken by prospective elementary school teachers. Gaining knowledge of content was the most outstanding objective in the teacher education survey.

Moorehead made the following conclusions:

1. The teacher education program in elementary school science

should consist of courses in biological, physical, and earth sciences which emphasize the discovery method.

2. The twenty-eight schools using the conventional materials in elementary school science showed a definite need for in-service programs, consultants, and a coordinated program in science which is integrated with the secondary science program.
3. The two schools using the newer developments in elementary school science demonstrated that teachers can learn to use these materials through in-service programs, qualified consultants, and seminars.

Secondary

The national surveys in secondary science education were not of the same magnitude that Blackman conducted in elementary science education. According to Obourn (1963) the first status survey in secondary science education was carried out by Johnson in 1950. The purpose of his study was to determine class sizes, enrollment figures, grade levels of students and the amount of time spent on teaching science. Significant findings which relate to this study were:

1. Of the 715 schools responding, there were 827 full-time science teachers. Sixty-three percent were men. There were 1,011 part-time science teachers who taught mathematics or some other course in addition to science.
2. The problem areas reported by science teachers were related to physical facilities and equipment shortages.

In the early 1960's, a joint survey was conducted by the National Association of State Directors of Teacher Education and Certification, and the American Association for the Advancement of Science (1963). The purpose of this study was to determine the educational and professional backgrounds of secondary science teachers in the United

were:

1. in-service science activities

States during the 1960-61 school year. Some pertinent findings were:

1. Of the entire sample, 69 percent were male. Half were less than 35 years of age.
2. Nearly all had a bachelor's degree and 39 percent held master's degrees.
3. Twenty-six percent of the teachers had completed at least one National Science Foundation Summer Institute.
4. More than half of the teachers were full time science teachers.

Regional Surveys

In the early 1970's, six regional surveys were conducted which essentially sampled the entire United States. Three were focused on the elementary schools and the other three were focused on the secondary schools.

Elementary

Webb (1972) attempted to determine what procedures, practices, policies and conditions related to science teaching in the public elementary schools of the Plains, Rocky Mountain and Southeast regions of the United States that existed in the 1970-71 school year. Sub-problems of the study investigated relationships between teacher characteristics and science teaching practices and teacher satisfaction with teaching elementary school science.

Webb found that the best predictors of science teaching practices were:

1. in-service science activities

2. semester hour credits in methods of teaching science
3. undergraduate and graduate semester hour credits in science content
4. the availability of supplies

The best predictors of teachers' satisfaction with teaching elementary school science were:

1. Training in science content
2. The availability of supplies

The factors that represented the greatest deterrents to effective science teaching were:

1. Inadequate room facilities
2. Lack of equipment and supplies
3. Insufficient funds for purchasing supplies

Webb found that teachers were better prepared in biology than in any other science and teacher participation in in-service activities was becoming more widespread.

In addition, Webb's findings relating to science instruction showed that:

1. Science is predominately taught by a regular classroom teacher without consultant help.
2. That science is most often taught in regular classrooms without special facilities or equipment.
3. That the textbooks served as the predominate instructional material.

A second regional survey in elementary science was conducted by Nelson (1973) in 1970-71. She attempted to determine if there were combinations of variables in the New England Region, the Mid-east Region, and the Southwest Region of the United States, that were predictive of science-teaching practices and/or teacher satisfaction with teaching science.

Among Nelson's findings which are pertinent to this study were that:

1. The predominate form of science curriculum materials used were single textbooks or locally prepared materials.
2. Science course improvement projects were used by 17 to 30 percent of the teachers in the three regions of her study.
3. The most frequently used learning activity for teaching science was lecture-discussion as indicated by over 50 percent of the respondents.
4. About 50 percent of all the respondents indicated that science was taught as a separate subject and 42 percent reported teaching as a regular classroom teacher with no help from an elementary science consultant.

The third survey was conducted by Maben (1971) in 1970-71 and focused on the Central States of Illinois, Indiana, Michigan, Ohio and Wisconsin and the Far West States comprising Alaska, California, Hawaii, Nevada, Oregon, and Washington. He focused on the problem of obtaining information about the science teaching practices, procedures, policies, and conditions prevailing in the two regions of his survey.

Among the major findings which are pertinent to this study were:

1. The level of undergraduate, graduate and science course improvement project preparation was low in both the Great Lakes and Far West regions of the United States. This was especially true in science teaching methods, earth science and science course improvement projects.
2. Participation in elementary science courses and elementary science workshops was highest in the Far West region.
3. Oregon teacher respondents reported the highest level of participation in workshops or institutes on science course improvement

projects.

4. Lack of science knowledge and lack of science methods were barriers to effective science teaching.
5. At least two-thirds of the schools taught science three or more periods per week to the selected science classes.
6. The use of science course improvement materials in both regions was low.
7. A single science textbook series was the most commonly used curriculum material in both regions.
8. Lecture discussion was the most commonly used learning activity in the selected science courses.
9. About half of the teacher respondents in both regions indicated that science was taught as a separate subject.

Secondary

Buckeridge (1973) designed a regional study to determine information related to science teaching in public secondary schools of New England, Mideast, and Southwest States of the U. S. and the District of Columbia. A number of hypotheses were studied, some of which involved identifying possible significant relationships between science teachers' attendance at National Science Foundation sponsored teacher-training institutes and selected learning activities. Buckeridge found that significant relationships were identified:

1. between attendance at Summer and In-service Institutes as well as with Academic Year Institutes with the science teacher's choice of using one or more of the Science Course Improvement Project programs,
2. between Institute attendance and the teacher's attitude regarding administrative and organizational factors important to good science teaching conditions,
3. between Institute attendance at NSF Institutes and the science teacher's satisfaction with the teaching of science as a career.

In addition, Buckeridge found that there appears to be a decreased emphasis on Science Teaching Methods courses as requirements in Science Teacher Education programs.

A second regional study was conducted by Baker (1973) in the public secondary schools of the Plains, Rocky Mountains and Southeast regions of the U. S. in the 1970-71 school year. The purpose of the study was to obtain information relevant to the practices, procedures, policies, and conditions related to the teaching of secondary school science.

Baker's findings which were pertinent to this study were:

1. Period scheduling was most common, and less than eight percent of the secondary schools used modular scheduling.
2. The majority of schools had class periods within the range of 40-59 minutes, with the 55-59 minute range being the most common.
3. The three most common special science facilities available to more than 16 percent of the science teachers were: science darkrooms, nature trails and closed circuit televisions.
4. The percentages of schools which offered Science Course Improvement Projects in grades seven through ten were as follows: IPS-35.4 percent; ESCP-22.5 percent; and ISCS-6.9 percent.
5. The percentages of schools which offered Science Course Improvement Projects in grades ten through twelve were as follows: BSCS Projects Green-23.5 percent, Yellow-13.8 percent, and Blue-9.5 percent; CHEM Study-20.7 percent; CBA Chemistry-8.6 percent; PSSC Physics-16.0 percent; HPP Physics-8.1 percent; IPS-16.5 percent; and ESCP-7.0 percent.
6. Learning activities most commonly used by the science teachers were: lecture-discussion instruction, group laboratory instruction, and individual laboratory instruction.

Chin (1971) conducted a survey of science teaching in the public secondary schools of the Great Lakes and Far West regions of the U.S. in the 1970-71 school year. The purpose of his study was to obtain information about practices, procedures, policies, and conditions effecting science education. Chin's findings which are pertinent to this study were:

1. Approximately 90 percent of the schools were organized into regular class periods.
2. The percentages of schools which offered Science Course Improvement Projects in grades ten through twelve were as follows: BSCS Blue-14.8 percent, BSCS Green-19.3 percent, and BSCS Yellow-21.4 percent; CHEM Study-28.6 percent; PSSC Physics-27.6 percent; and HPP Physics-9.4 percent.
3. Over 87 percent of all science teachers were male, and 62 percent were under 40 years of age.
4. The Master's degree was held by 63 percent of the teachers.
5. The three most commonly used learning activities were: lecture-discussion, individual laboratory activity, and group laboratory activity.
6. According to the science teachers, the three most important factors for obtaining and maintaining high quality science programs were: science facilities, administrative support and cooperative staff.
7. Over 94 percent of science teachers reported that they were very satisfied or satisfied with teaching science.

In summary, the most extensive national or regional surveys in science education besides the Blackman study were conducted by Webb, Nelson, Maben, Buckeridge, Baker, and Chin, all from The Ohio State University. The project was essentially a cooperative effort in order to obtain the first complete set of data in science education for grades K-12. Prior to this time a number of surveys had been conducted at either the elementary or the secondary levels of instruction, but no K-12 surveys had been conducted. With the exception of Blackwood's study, most studies focused on the background preparation of elementary and secondary teachers.

State Surveys

Most state surveys that have been conducted either focused on the elementary, junior high or senior high school. Very few have been conducted on the scope of grades K-12. The researcher has attempted to synthesize a representative sampling of state surveys which will give the reader a general idea of what kinds of information have been gathered at the state level.

Elementary

In 1955, Auletto (1955) conducted a survey of science teaching in grades one through six in Delaware. He gathered information from both administrators and elementary classroom teachers. Among his findings were:

1. About 56 percent of the respondents felt that they were teaching science inadequately. A lack of experience in science and an insufficient amount of time were the reasons given for the inadequacy.
2. The most urgently needed pieces of science equipment were: microscopes, classroom radios, film strip projectors, magnets, television sets, commercially prepared biological slides, and balance scales.
3. Objectives receiving the greatest endorsement included those which would a) "help the child to interpret the phenomena of the world about him", b) "help the child to appreciate and love nature", and c) "help the child to appreciate and use the scientific method in solving life problems".
4. About 41 percent of the teachers integrated science with other subjects. About 32 percent of the teachers taught science separately and integrated it with other subjects. About 15 percent of the respondents followed an incidental approach to science teaching.

5. Paper and pencil techniques of evaluation were favored by the teachers.
6. The teachers reported that they had been inadequately trained for teaching science in the elementary school.

In 1956, Challand (1956) conducted a survey of elementary school science instruction in Illinois. She attempted to determine practices and conditions of science teaching in elementary schools in Illinois and then compare the graduates of the National College, Evanston, Illinois with the state figures. Her findings which are pertinent to this study were:

1. The average number of field trips taken by pupils in the Illinois classrooms per year was 1.53.
2. Less than one third of the teachers provided cooperative participation in group situations in establishing goals, methods of attaining goals and methods of appraising those goals.
3. Seventy-one percent of the teachers' background in science was in the biological sciences and twenty-nine percent was in the physical sciences.
4. Eleven percent of the Illinois teachers and thirty percent of the National College teachers have had a professional course in science methods and materials.

Moser (1964) conducted a survey in 1964 of the post-secondary science training of New York State elementary school teachers. The purpose of Moser's study was twofold:

1) to determine the nature of the science training of a representative group of elementary school teachers, and

2) to discover what science training courses were believed to be needed by them.

Among the main findings of Moser were:

1. Twenty-two percent of the elementary school teachers had no science training.
2. An average of ten semester hours of science training courses were taken by the elementary teachers.
3. The most common course title was methods of teaching science, which was taken by 55 percent of the teachers.
4. General biology was the course in which the greatest number of semester hours were taken by the teachers.

In 1963, Ricker (1963) conducted a study in the state of Maryland to investigate the selection and utilization of science equipment in the elementary school. Among his findings which are pertinent to this study were:

1. The regular elementary classroom teachers were primarily responsible for teaching science.
2. Integrated subject and separate subject approaches in teaching science were used by 36 and 45 percent of the teachers respectively.
3. The teachers had more training in the biological sciences.
4. Almost 50 percent of the teachers have not participated in teachers' meetings within their school on elementary sciences, and 66 percent have not attended district in-service programs on science during the year.
5. One-third of the teachers considered a lack of science equipment as one of the most serious obstacles in their teaching.

Another important study was conducted by Snoble (1967) in 1966 in the Iowa public schools. His study was done in conjunction with a similar study conducted in 1963. The purpose of his investigation was to measure any changes that had occurred between 1963 and 1966 in: course content, emphasis, curriculum patterns, local planned curricula, classroom methods, facilities and materials of instruction, administration of science programs, and teacher background and experience.

Among Snoble's findings from the investigation were:

1. Approximately 75 percent of the teacher respondents reported no departmentalization for science in their school.
2. The average time devoted to science instruction varied from one hour or less per week to two or more hours per week.
3. The most frequently used teaching aid reported by teacher respondents in both surveys was the bulletin board.
4. More than 80 percent of the schools did not have science consultants available either year studied.
5. More than 50 percent of the schools had not conducted science in-service workshops or science courses.

Secondary

As previously indicated during the introduction to this chapter, many surveys have been conducted at the state level in regard to specific teachers in specific subject areas. Because of the relative high degree of specificity of those surveys, they have been excluded from this review of the literautre.

In 1958, Voss (1958) reported the status of science education in Iowa high schools. The purpose of his study was to discover and to describe trends in science education. Among his findings which are pertinent to this study were the following:

1. Few schools were engaged in curriculum planning, particularly in schools under 500 in enrollment.
2. There was a trend away from fixed laboratory periods.
3. About 50 percent of the schools reported having a science club.
4. Problems in science teaching as cited most frequently by science teachers were meeting individual differences, lack of equipment, lack of facilities, and lack of time for improving experiments and demonstrations.
5. About 40 percent of the science teachers were making four or more preparations.

Bowles (1964) reported a study in grades seven, eight and nine in Michigan public schools. The purpose of his study was to determine the status of science programs and to develop recommendations which would contribute to further improvement of science education. Included in his findings were:

1. Approximately 53 percent of all teachers had a petty cash fund for local purchases of incidental supplies.
2. Most of the major obstacles to more effective instruction which were given by teachers related to lack of laboratory facilities and equipment, teaching load, and lack of program coordination, communication, and consultant service.

In 1966, Crawley, Jr. (1967) conducted a survey on the status of science education in Iowa high schools. The purpose of his study was to determine the status of science education in the 1966-67 school year and to relate those findings to a similar study of the 1957-58 school year in order to determine the changes which occurred during that period.

Among Crawley, Jr.'s findings which are pertinent to this study are the following:

1. More schools offered more science courses in 1967 than in 1958.
2. The most common type of science facility observed in 1967 was the combination lecture-demonstration-laboratory room.
3. The most common activity observed in science classes in 1958 and in 1967 was a question and answer recitation conducted by the teacher.

McCurdy (1967) reported a survey of secondary science education in Missouri public schools in 1967. He undertook the problem of determining the status of: 1) the present course offerings; 2) the procedures for changing the curriculum and the extent to which the "new curricula" in science have entered the school programs; 3) the academic and professional preparation of teachers; 4) the instructional methods and media used by science teachers; and 5) the laboratory facilities utilized in teaching science.

Included in his major findings were:

1. Approximately 35 percent of the respondents considered their science teaching equipment to be marginal or inadequate.
2. Over 55 percent of the respondents reported attendance to at least one NSF summer institute. Thirteen percent revealed having attended an academic year institute and seven percent had been involved in a research participation program.
3. Slightly more than 50 percent of all responding science teachers had earned an advanced degree.
4. Over 90 percent of all the respondents had membership in the Missouri State Teachers Association, and nearly two-thirds had been affiliated with the National Education Association.
5. Approximately 30 percent of the teachers belonged to the National Science Teachers Association.
6. Methods employed by the science teachers tended to be teacher-centered.

The status of secondary science education was conducted in New Mexico in 1964-65 by Zweig (1967). His purpose was to survey the status of secondary science education for the purpose of establishing bench marks against which future changes could be measured.

Zweig's findings which are pertinent to this study were:

1. Science teachers in New Mexico did a minimal amount of reading in scientific and science education journals and did not belong to or attend meetings of science or science teacher organizations.
2. Facilities and equipment were generally inadequate for an enriched laboratory oriented course.
3. Teacher-centered activities dominated and occupied the major part of instructional time.

In 1970, Stewart (1970) reported a survey of the status of science curricula, programs and student activities in Texas secondary schools. Among Stewart's findings were:

1. Approximately 70 percent of the science teachers have participated in one or more science workshops, institutes, or in-service programs.
2. The professional reading of the science teachers indicated a preference for Scientific American, Science News, and Science Digest, as the most important journals containing information relevant to the entire science curriculum.
3. Approximately 50 percent of the science teachers responding considered the science facilities in their respective schools adequate enough for instructional needs.
4. The teaching method used by the majority of the science teachers was the lecture method.
5. Laboratory activities, such as open-ended experiments or research which provided a more up-to-date inquiry-oriented science program, were used regularly by fewer than 50 percent of the science teachers.

Two important recommendations made by Stewart were:

1. There should be greater emphasis on earth science preparation in the undergraduate teacher education program.
2. Science instruction in Texas could be greatly benefitted if school administrators would provide a more flexible scheduling of classes in order to allow the time required for open-ended experiments and research projects.

In summary, the majority of the surveys in elementary school science were primarily concerned with the academic preparation of teachers to teach elementary school science. The common findings were that elementary teachers were poorly trained in the sciences as well as in science methods. In addition, poor facilities and lack of equipment were primary concerns as barriers to effective teaching.

Secondary science surveys showed that prior to 1970, poor academic training in the sciences was a primary concern of secondary science teachers. However, current information shows that more than 50 percent of all secondary science teachers have a master's degree. Lecture-discussion was and continues to be the type of classroom instruction most prevalent in the secondary school science programs.

Oregon surveys

Four surveys have been conducted in science education in Oregon public schools during the last thirty years. The first two were concerned with elementary school science while the last two focused on secondary school science.

Elementary

Quaintance, Wells, and Dodds (1945), members of the State System of Higher Education reported in 1945 a study of the problems of teacher education for elementary school science. They reported that the elementary teachers as a group lacked the subject matter preparation in the sciences. The teachers stressed the fact that they believed most of their difficulties would not have arisen if they had been sufficiently trained in the biological and the physical sciences.

In 1950-51, Bolen (1953) conducted a statewide survey examining science teaching facilities and practices in Oregon public elementary schools. He was concerned with ascertaining and evaluating the extent to which elementary teachers were trained for teaching science. In addition he attempted to determine what the teachers believed to be their major problems in elementary science teaching.

Bolen used a composite questionnaire which he mailed to all 6,966 elementary teachers in Oregon. He obtained an approximate return of 40 percent. Among Bolen's findings were the following:

1. Ninety-two percent of the respondents were female and eight percent were male.
2. Slightly over 50 percent of the elementary teachers did not like science because of their weak college preparation in the basic sciences.
3. The science-related journal most subscribed to by elementary teachers was _National Geographic_.
4. Ninety-seven percent of the teachers reported planning their own programs for science teaching and three percent received help or suggestions from the supervisor or administrator.
5. The time designated for science teaching ranged from a 10 to 15 minute period three times a week to a 50 or 55 minute period three days per week.
6. Thirty-three percent of the respondents reported _not_ having a single facility in their room as suggested by the questionnaire.
7. The most frequent number of field trips taken by all respondents was two per year.
8. The respondents reported the use of a variety of procedures or methods for science teaching. Collections of materials and exhibits prepared by students were the most frequently mentioned methods.
9. Some of the major problems of science teaching were reported to be: too many pupils in class, improper time allotment for science, inadequate equipment and facilities, and lack of college training.

Secondary

The first secondary school science survey was conducted by Thaw (1958) in 1956-57. The purpose of his study was to survey the extent of preparation and the work week of teachers of science in Oregon and to compare that data with available studies on the national level. Thaw used two questionnaires to obtain his data. One was sent to the building principal requesting enrollment figures and the second was sent to each science teacher in the principal's building.

Included in Thaw's findings which are pertinent to this study were the following:

1. Thirty-eight percent of the secondary science teachers had obtained the master's degree.
2. The majority of Oregon's science teachers had ten or fewer years of teaching experience.
3. Enrollment figures for science classes were as follows: biology - 16,168 pupils, chemistry - 5,421 pupils, and physics - 3,334 pupils.

The most recent survey in secondary science education in Oregon was conducted by Cummins (1960) in 1958-59. The purpose of his study was to survey the status of secondary school science teachers and science teaching in the state of Oregon. A questionnaire was mailed to every public secondary school science teacher in grades nine through twelve in Oregon.

In developing the Secondary School Science Questionnaires I and II to be in this study, the researcher used some of the same questions which Cummins used in his study. Therefore, longitudinal comparisons will be made and specific reference can be made to Cummins' results in Part A Sections II and III of Chapter IV of this study.

In summary, the four Oregon surveys substantiate the national and regional findings of other studies. Elementary teachers were primarily concerned with their poor academic preparation, lack of facilities and equipment and too little time to teach elementary school science.

Secondary science teachers shared the same basic concerns as the elementary teachers. The secondary science teachers were concerned about their general lack of knowledge in the sciences, poor facilities and lack of equipment, and the lack of funds for basic supplies. In addition, the lecture-discussion method of instruction continues to be the most commonly used type of classroom instruction.

CHAPTER III

PROCEDURE

The Populations

The populations in this survey consisted of five groups from Oregon: 1) 10,402 elementary teachers representing 902 elementary public schools; 2) 1,310 secondary science teachers representing 348 public secondary schools; 3) 113,794 secondary students representing 225 secondary public schools; 4) 680 PTA office holders representing 302 elementary and 38 secondary schools; and 5) 485 OSU scientists.

Randomization

To insure complete randomization, a stratified random sample, was employed in order to select an accurate representation of elementary and secondary teachers and secondary students from Oregon. The plan for stratification had been used previously by the Oregon State Department of Education, and was developed for them by Science Research Associates.

All elementary and secondary public schools were classified by geographic region (eastern Oregon, western Oregon and the Portland metropolitan area). Eastern Oregon represents approximately two-thirds of the state by area, east of the Cascade Mountains and maintains approximately 10 percent of the total population. Western Oregon represents approximately one-third of the state by area, west of the Cascade Mountains and maintains approximately 40 percent of the total population. The Portland metropolitan area maintaining the remainder of the population, namely, 50 percent.

In addition, the elementary schools were grouped into four strata; less than 150, 150-349, 350-499, and 500 ADM and over. (See Table 1)

Table 1. Strata for elementary schools.

Stratum	School Size
E-1	500 ADM and over
E-2	499-350
E-3	349-150
E-4	less than 150

The secondary schools were also grouped into four strata: less than 150 ADM, 150-499, 500-999, and 1000 ADM and over.

Table 2. Strata for secondary schools.

Stratum	School Size
S-1	1000 ADM and over
S-2	999-500
S-3	499-150
S-4	less than 150

The Matrix

In Table 3, a matrix was constructed with stratum on one side and geographic region across the top in order to obtain a representative random sample of teachers and students. The total number of schools and participants were then placed in their appropriate cells.

Both elementary and secondary schools were selected in a similar manner. All schools were listed by county according to area of state and to stratum. Appendix A is a sample page of one of 66 pages of school listings. All random selections were based on the 1972 enrollment figures (the 1973 enrollment figures were not yet available at that point in time).

Individual schools were selected in the following manner. After determining the relative proportions for each cell in the matrix, a table of random numbers was used to select those schools for that part of the state and size of school.

Once the schools were selected a similar procedure was used to select the total number of teachers for each cell in the matrix. Minor adjustments were then made in order that every school selected in a particular stratum would have the same number of teachers. Thus one might find that five teachers would be selected from every randomly selected school in stratum one, three teachers from stratum two, two teachers from stratum three, and one teacher from stratum four.

Table 3. Oregon statewide school sampling plan for elementary and secondary schools.

Stratum	Geographic Area												Total			
	East				West				Metro							
	Total	Sought	Received	Percentage	Total	Sought	Received	Percentage	Total	Sought	Received	Percentage	Total	Sought	Received	Percentage
1 Schools Participants																
2 Schools Participants																
3 Schools Participants																
4 Schools Participants																
Total Schools Participants																

The Sample

Table 4 shows the sample sizes needed to represent the populations at the 0.05 level for permissible error.

Table 4. Appropriate sizes of simple random samples for a permissible error of 0.05 when the true proportion in the population is 0.50 and the confidence level is 90 percent.

Population	Population Size	Sample Size
Elementary Teachers	10,402	263
Secondary Teachers	1,310	221
Secondary Students	113,794	270
PTA Officers	680	193
OSU Scientists	485	174

Selection of the Sample

The total samples for each of the 12 cells in each of the matrices were determined by simple proportions. For example, assume that the sample size was desired for all schools size 500-999 ADM in western Oregon. If the sample size was 240 representing a population of 10,000, and the population of the particular cell in question was 2,000, then the sample size for that cell would be two-tenths of 240, or 48.

In order to increase the probability of obtaining the necessary sample size to represent the desired population, at least twice the number of questionnaires were mailed. Therefore, if 50 percent of the questionnaires were returned, the sample would sufficiently represent the particular population.

Table 5 contains the sample sizes for each individual cell representing the elementary teachers in Oregon. Because there were two different questionnaires mailed to the elementary teachers and because the sample sizes were doubled in order to insure an adequate representation, the total required sample size was 1052, (263 x 4). The reason for the discrepancy between 1052 and 1067 which is found in Table 5, is due to some minor adjustments for ease of mailing. The researcher wanted to leave open the possibility of making comparisons between schools of different sizes. Therefore it was necessary to include a few additional schools in particular cells. Even though the possibility did exist, the researcher decided to omit those kinds of comparisons due to financial limitations.

Of the total of 1,067 questionnaires which were mailed, 516 were returned. This represented a 48 percent reply. Examination of the two individual questionnaires showed that 534 questionnaires requesting the status of elementary school science were mailed. Of that total, 261 were returned which represented a 49 percent return. Two hundred sixty-three were needed to represent the population at the 0.05 level of permissible error. The researcher felt that 261/263, or a 99 percent return was more than an acceptable return.

Table 5. Matrix for the random selection of elementary teachers.

Stratum		Geographic Area												Total			
		East				West				Metro							
		Total	Sought	Received	Percentage	Total	Sought	Received	Percentage	Total	Sought	Received	Percentage	Total	Sought	Received	Percentage
E-1	Schools	7	3			24	11			81	38			112	52		
	Teachers	163	15	3	20	520	55	24	44	1819	190	86	45	2502	260	113	43
E-2	Schools	25	12			104	48			78	36			206	96		
	Teachers	420	48	33	69	1745	192	100	52	1297	144	67	47	3462	384	200	52
E-3	Schools	66	30			186	86			78	37			331	153		
	Teachers	655	60	34	57	1966	172	92	53	813	74	34	46	3434	306	160	52
E-4	Schools	95	45			137	62			20	10			253	117		
	Teachers	344	45	13	29	579	62	25	40	81	10	5	50	1004	117	43	37
Total	Schools	193	90			449	208			260	121			902	419		
	Teachers	1582	168	83	49	4810	481	241	50	4010	418	192	46	10402	1067	516	48

The second questionnaire concerning the needs opinions of elementary teachers as to what should be taking place in science education, had nearly an equally acceptable return. Two hundred fifty-five were returned out of 533 which were mailed. This represented a 48 percent reply. Again, the researcher felt that 255/263, or a 97 percent return was more than an adequate reply.

Table 6 contains the sample sizes for each individual cell representing the secondary science teachers in Oregon. Because there were three different questionnaires mailed to the science teachers and because the sample sizes were doubled to insure an adequate representation, the total sample sizes of science teachers in Oregon was 1, 310. So the decision was made to send a questionnaire to every science teacher in the state. The use of the matrix insured the random distribution of the three separate questionnaires.

Three different questionnaires were distributed in order to increase the probability of return. The original questionnaire seeking status information was determined to be excessive in length, so it was split into two separate questionnaires. The third questionnaire sought to obtain needs opinions from science teachers concerning what should be happening in the science education community.

Of the total of 1, 310 questionnaires which were mailed, 581 were returned. This represents a 44 percent return. Individually it represents the following returns:

Table 6. Matrix for the random selection of secondary science teachers.

Stratum		Geographical Area												Total			
		East				West				Metro							
		Total	Sought	Received	Percentage	Total	Sought	Received	Percentage	Total	Sought	Received	Percentage	Total	Sought	Received	Percentage
S-1	Schools	3	3			22	22			35	35			60	60		
	Teachers	28	28	5	18	139	139	74	53	255	255	115	45	422	422	194	46
S-2	Schools	24	24			67	67			23	23			114	114		
	Teachers	93	93	49	53	283	283	114	40	107	107	33	26	483	483	196	41
S-3	Schools	30	30			75	75			18	18			123	123		
	Teachers	78	78	43	55	201	201	91	45	50	50	21	42	329	329	155	47
S-4	Schools	32	32			17	17			0	0			49	49		
	Teachers	53	53	26	49	23	23	10	43	0	0	0	0	76	76	36	47
Total	Schools	87	87			181	181			76	76			346	346		
	Teachers	252	252	123	49	646	646	289	45	412	412	169	41	1310	1310	581	44

Secondary School Science I
188 out of 437 were returned, or a 43 percent reply
Secondary School Science II
184 out of 437 were returned, or a 42 percent reply
Secondary School Science III
208 out of 436 were returned, or a 48 percent reply

It is the researcher's opinion that the discrepancy between III and I or II was due to the relative ease with which questionnaire III could be completed. There were more multiple choice items in comparison to questionnaires I and II.

Of the total of 581 questionnaires which were returned, the breakdown on the percentages were as follows:

Secondary School Science I
188 were returned
221 were needed
85 percent reply
Secondary School Science II
185 were returned
221 were needed
84 percent reply
Secondary School Science III
208 were returned
221 were needed
94 percent reply

Table 7 contains the sample sizes for each individual cell representing the secondary school students in Oregon. The total required sample size was 540 (270 x 2). The explanation for the slightly excessive number of questionnaires that were mailed can be found under the section - The Questionnaires found on page 47 of this chapter.

Of the total of 583 questionnaires which were mailed, 287 were

Table 7. Matrix for the random selection of secondary school students.

Stratum		Geographic Area												Total			
		East				West				Metro							
		Total	Sought	Received	Percentage	Total	Sought	Received	Percentage	Total	Sought	Received	Percentage	Total	Sought	Received	Percentage
S-1	Schools	3	3			18	18			31	31			52	52		
	Students	4,019	18	17	94	23,077	108	60	56	37,027	186	92	49	64,123	312	169	54
S-2	Schools	12	12			29	29			8	8			49	49		
	Students	7,552	36	15	42	16,938	87	51	59	5,515	24	12	50	30,005	147	78	53
S-3	Schools	20	20			51	51			7	7			78	78		
	Students	3,406	20	10	50	12,177	51	17	33	1,611	7	4	57	17,194	78	31	39
S-4	Schools	32	32			14	14			0	0			46	46		
	Students	1,721	32	5	16	751	14	0	0	0	0	0	0	2,472	46	9	20
Total	Schools	67	67			112	112			46	46			225	225		
	Students	16,698	106	48	45	52,943	260	131	50	44,153	217	108	50	113,794	583	287	49

returned. This represented a 49 percent return. Of the total of 287 which were returned, 270 were needed to represent the population at the 0.05 level. The percent return was in excess of 100 percent of the expected return.

Table 8 reveals the distribution of questionnaires returned by PTA officers. All local PTA organizations were contacted throughout the state. Therefore, there was no need to make any random selection as was done with previous populations. A total of 680 questionnaires were mailed to a total of 340 local PTA organizations, 302 of which were elementary schools and 38 of which were secondary schools. If the assumption is made that each local organization consisted of a minimum of two officers - president and vice-president, then the total population would be 680. Of the 680 questionnaires which were mailed, 225 were returned. This represented a 33 percent reply. Of the total of 225 which were returned, 222 were needed to represent the population at the 0.05 level. The return was in excess of 100 percent of the expected return.

The final questionnaire was mailed to the entire population, namely the OSU scientists. The criteria for selection of the OSU scientists was as follows:

1) must hold a Ph. D.
2) must have a minimum ranking of assistant professor
3) extension agents were excluded

A total of 485 questionnaires were distributed. Of that number

Table 8. Matrix for the distribution of PTA office holders.

Stratum		Geographic Area: East Total	East Sought	East Received	East Percentage	West Total	West Sought	West Received	West Percentage	Metro Total	Metro Sought	Metro Received	Metro Percentage	Total Total	Total Sought	Total Received	Total Percentage
	Ele. sch.	3	3			11	11			60	60			74	74		
1	Sec. sch.	0	0			4	4			13	13			17	17		
	Officers		6	2	33		40	12	30		146	44	30		182	58	32
	Ele. sch.	7	7			40	40			45	45			92	92		
2	Sec. sch.	2	2			6	6			5	5			13	13		
	Officers		18	6	33		92	30	33		100	38	38		210	74	35
	Ele. sch.	20	20			56	56			39	39			115	115		
3	Sec. sch.	2	2			3	3			2	2			7	7		
	Officers		44	15	34		118	31	26		82	29	35		244	75	31
	Ele. sch.	9	9			8	8			4	4			21	21		
4	Sec. sch.	1	1			0	0			0	0			1	1		
	Officers		20	11	55		16	4	25		8	3	37		44	18	41
Total	Ele. sch.	39	39			115	115			148	148			302	302	200	66
	Sec. sch.	5	5			13	13			20	20			38	38	25	66
	Officers		88	34	39		256	77	30		336	114	34		680	225	33

204 were returned. This represents a 42 percent reply. Of the total of 204 which were returned, 174 were needed to represent the population at the 0.05 level. The percent was in excess of 100 percent of the expected return.

In summary, all sample sizes were sufficient in size in order to represent their respective populations at the 0.05 level of significance for permissible error. The range of sample sizes in this survey was from 117 to 84 percent of the expected return. Therefore it can be assumed that the data found in Chapter IV does indeed represent the five populations used in this survey.

The Questionnaires

The researcher sought the advice from a number of different sources in composing the individual questionnaires. Input was obtained from Ray Thiess, Oregon State Department of Education Science Supervisor. His input centered primarily on the need for in-service education for both elementary and secondary teachers.

The Council of College and University Science Educators (CUCSE) was another source of input. CUCSE is a statewide group of science educators representing the major institutions of higher education in Oregon. Their primary concern was to receive input regarding the education of preservice teachers and what various groups felt should be taking place in science education in Oregon.

Another group which provided assistance were the graduate students and faculty in the Department of Science Education at Oregon State University. All eight questionnaires were distributed to them on two separate occasions for their suggestions. Their concern as indicated to the researcher was primarily focused on obtaining the most desirable information that might be used to up-grade the science education profession.

The last source of information was a survey conducted by Cummins (Cummins, 1960) in 1960 in Oregon. The researcher used some of the same questions which Cummins used in order that longitudinal comparisons could be made.

As previously stated in Chapter I, two different kinds of information were sought. The first was concerned with what was currently taking place in the public schools in Oregon. For this information the researcher used two different populations: elementary school teachers and secondary school science teachers. Appendix B contains a copy of the questionnaire mailed to elementary teachers seeking this information. Henceforth the researcher shall refer to items in this questionnaire as Elementary Teacher Questionnaire I (ETQ-I). A variety of items were included ranging from age and years of teaching experience to evaluation of students and the nature of the total science program.

Appendices D and E contain copies of the two questionnaires mailed to secondary science teachers. As previously stated, two different questionnaires were used because of the large volume of desired information. It was felt that by splitting the information into two smaller individual questionnaires a larger return could be expected. Some items were included in both questionnaires in order that comparisons could be made. Henceforth the researcher shall refer to the two questionnaires as Secondary School Science Questionnaire I (SSSQ-I) and Secondary School Science Questionnaire II (SSSQ-II). A variety of items were included ranging from age and years of experience to participation in professional organizations.

The second kind of information which was sought was concerned with the opinions as to what should be taking place in science education. For this information the researcher used five separate populations: elementary school teachers, secondary school science teachers, secondary school students, PTA officers, and OSU scientists.

Appendix C contains a copy of the questionnaire mailed to elementary school teachers. A variety of items were included ranging from age and years of teaching experience to how they perceived the degree of conflict between science and religion in their explanations of the origin of man. Henceforth the researcher will refer to this questionnaire as Elementary Teacher Questionnaire II (ETQ-II).

Appendix F contains a copy of the questionnaire mailed to secondary school science teachers to determine what their opinion was as to what should be taking place in science education. A wide variety of items were included ranging from their opinion about the preparation of science teachers to what should be the priority of science teaching goals as stated by the National Science Teachers Association (1971). Hereafter, the researcher will refer to this questionnaire as Secondary School Science Questionnaire III (SSSQ-III).

Appendix G contains a copy of the questionnaire mailed to secondary school students to determine what their opinion was as to what should be taking place in science education. A wide variety of items was included ranging from a rating of the student's overall performance in science classes to the degree to which students should have input in determining what the contents of a science course should be. After this the researcher will refer to this questionnaire as Student Questionnaire (SQ).

Appendix H contains a copy of the questionnaire mailed to PTA officers to determine what their opinion was as to what should be taking place in science education. A wide variety of items were included ranging from their opinion regarding the proper emphasis that schools were placing on science to their feeling concerning the integration of science with other subject areas. Now the researcher will refer to this questionnaire as PTA Questionnaire (PTAQ).

Appendix I contains a copy of the questionnaire mailed to OSU scientists to determine what their opinion was as to what should be taking place in science education. A wide variety of items was included ranging from the kind of academic training they felt would improve the quality of science teachers to ranking of a number of science related concerns such as population control and environmental quality. Henceforth the researcher will refer to this questionnaire as OSU Scientist Questionnaire (OSUSQ).

Identical items were included in ETQ-II, SSSQ-III, SQ, PTAQ, and OSUSQ in order to be able to make comparisons between all five populations.

Field Testing of Questionnaires

All eight questionnaires were field tested prior to their final revision with appropriate segments from their respective populations.

Both ETQ-I and ETQ-II were administered in approximately 25 elementary school teachers, grades K-6 in Kennedy Elementary School in Salem, Oregon. SSSQ-I, SSSQ-II and SSSQ-III were administered to the entire science staff of 15 teachers at Marshfield High School in Coos Bay, Oregon. SQ was administered to approximately 20 eleventh grade social studies students in the same high school. PTAQ was administered to five members of a local parent-teacher group from Roosevelt Elementary School in Corvallis, Oregon. OSUSQ was given to five science educators from Oregon State University.

Based on the input received from the field testing of all eight questionnaires, appropriate revisions were made and the questionnaires were printed as found in Appendices B-I.

Distribution of Questionnaires

All questionnaires were mailed out during the first week in October 1973. The deadline given for their completion was October 19, 1973. Any questionnaires that were not in the researcher's possession by November 1, 1973 were excluded from the survey.

With the exception of the OSUSQ which was distributed through the on-campus mailing facilities, all questionnaires were coded in such a way to determine where they were from. The return envelopes were marked so that each cell in the matrices had their own individual mark. Appendix J contains a return envelope along with the coding mark for each matrix cell.

Referring to Table 5, it is obvious that five elementary teacher questionnaires were mailed to each school in stratum one. Similarly, four questionnaires were mailed to each school in stratum two, two questionnaires were mailed to each school in stratum three, and one questionnaire was mailed to each school in stratum four. This procedure enabled complete randomization for both schools and teachers. To further increase the likelihood of an unbiased sample, instructions were given to the building principal for individual teacher selection.

He was instructed to alphabetically arrange all elementary teachers. From that list he was to select either one, two, four or five teachers depending on the particular stratum in question. The teachers selected were determined by the researcher with the aid of a table of random numbers. Appendix K contains those letters of instruction for both ETQ-I and ETQ-II: page 306 contains the instructions for those principals of schools in stratum one; page 305 contains the instructions for those principals of schools in stratum two; page 304 contains the instructions for those principals of schools in stratum three; and page 303 contains the instructions for those principals of schools in stratum four.

In Appendix L are letters of instruction for secondary principals and social studies teachers used in the selection process of secondary students. An attempt was made to select the least biased group of secondary students. Therefore the researcher chose to go to a social studies class rather to a science class. This insured a random distribution of both students interested in the sciences as well as those with the least interest.

Referring to Table 7, one can see that six student questionnaires were mailed to each school in stratum S-1. Similarly, three questionnaires were mailed to each school in stratum S-2 and one questionnaire was mailed to each school in strata S-3 and S-4.

The procedure for selecting social studies students involved a two step randomization process. First the principal selected a social studies teacher by alphabetically arranging all social studies teachers who taught students in grades 10-12. Then he was instructed to select the seventh (the number seven was taken from a table of random numbers) teacher and give him the questionnaires which would in turn be administered by the teacher. The social studies teacher was instructed to alphabetically list the students in his first social studies class that he would normally meet with on Tuesdays. From that list, he was instructed to select either one, three or five students, depending on the particular stratum in question, to complete the questionnaires.

The PTA Questionnaires were handled somewhat differently. A packet of two questionnaires, two return envelopes and a set of instructions were mailed to the president of every local PTA organization in the state. The instruction sheet (see Appendix M) directed the president to fill out one of the questionnaires and give the second to another officer in his organization. Both had separate return envelopes to insure privacy of answers. Table 8 shows the distribution of questionnaires for both elementary and secondary PTAQ organizations in the state.

The Secondary School Science Questionnaires I, II, and III were mailed directly to the science teachers in the state. See Table 6 for the complete statewide distribution of those questionnaires.

Appendix N contains a copy of the accompanying letter which was used to explain the nature of the survey to the participating OSU scientists. There was no need for marking those questionnaires because they were all faculty members on the campus in Corvallis, Oregon.

Data Coding

All the data was first transferred from the questionnaires to coding sheets. The coding sheets were essentially replicas of key punch cards. All the key punching was performed by trained key-punch operators at the Oregon State Department of Education in Salem, Oregon.

Each questionnaire required a minimum of two key punch cards and both SSQ-I and SSQ-II required three key punch cards. The total number of cards which were required to house the data was approximately 4,000.

Statistical Treatment of Data

All the data was fed into a CDC 3300 computer on the OSU campus. With the exception of the chi-square statistic, all treatment was conducted through a program called SIPS (Statistical Interactive Programming System). The advantage of using the SIPS program was that once the data was in the computer, the commands of TABULATE, PERCENTAGE, REGRESS, etc. could be given and the various statistical computations would be performed without the need of a new program.

The following kinds of statistical treatment were employed throughout the survey:

1. Frequency distribution - this procedure was used to obtain a simple tabulation or counting of a response to a particular item in the questionnaire.

2. Percentage - for each tabulation, the relative percentages were calculated.

3. Multiple regression - was used to determine if any relationship existed between individual items on a given set of questionnaires.

4. Analysis of variance - was used to test to determine if there were any significant differences between various commercially produced elementary science programs and particular items on their respective questionnaires.

5. Chi-square - was used to compare the distribution of responses between the different questionnaires.

Summary

Steps were taken to obtain a very high degree of randomization of elementary teachers, secondary science teachers, and secondary students. This was accomplished. Representation of different size schools from all regions of the state was also accomplished. The researcher recognizes the possibility biases do exist in two of the samples, the PTA group and the OSU scientists group.

The PTA group was selected in an attempt to obtain some input from a lay group. Almost any group chosen with the exception of a

Gallop or Harris type survey, would have had certain built in biases. The information obtained from the PTA groups was used recognizing its limitations.

The OSU scientists were selected in an attempt to obtain information from the academic science community. Again the researcher recognized the biases of this sample. However, the information obtained is useful as long as the reader is aware of the biases.

Overall, 4,125 questionnaires were mailed out to eight different samples representing five populations. Of that total, 1,813 were returned in usable form, or a 44 percent return. The researcher doubled the sample sizes in all cases, hoping for a 50 percent reply. Therefore the overall return was 88 percent.

CHAPTER IV

RESULTS OF THE STUDY

Introduction

This chapter is divided into two separate parts. Part A will provide a picture of the status of science education in Oregon Public Schools for grades K-12. Part B will provide information about what should be taking place in science education in Oregon Public Schools. Information is included from elementary and secondary teachers, students, PTA officers and OSU scientists.

Part A - The Status of Science Education

Section 1 - Elementary School Science

Section 1 includes data obtained from elementary teachers describing the status of elementary school science in Oregon. Frequency distribution and percentages are used as the statistical measure for describing the raw data. In addition, individual responses are included in the Appendices to explain the reason for a teacher's answer to a particular item. Multiple regression analysis was used to determine if relationships existed between particular items on the questionnaire. Analysis of variance was used to determine if there was any significant differences between some of the items which were non-continuous variables.

Of the total of 261 respondents 197 were female and 64 were male. Approximately 50 percent of the teachers were under 40 years of age. Table 9 gives a summary of the ages of the participants.

Table 9. Frequency distribution of elementary teacher's ages in ten year intervals - ETQ-I.

Age	Frequency	Percentage
20-30	81	31
31-40	52	20
41-50	55	21
51-60	58	22
61-70	15	6

The elementary teachers were asked, "Indicate your number of years of teaching experience at the elementary level counting this year." Table 10 reveals that approximately 50 percent of the teachers had less than nine years of teaching experience.

Table 10. Frequency distribution of elementary (K-8) teaching experience including the current year, 1973 - ETQ-I.

Years	Frequency	Percentage
one	1	< 1
2-3	34	13
4-9	92	35
10-15	47	18
16-25	56	22
> 25	31	12

Table 11 reveals that the majority of teachers indicated the self-contained classroom was still the predominate organization for instruction. The teacher was asked to indicate which phrase best described their elementary school. It first appears that a relatively large number of science classes are taught in a setting other than the self-contained classroom situation. Totaling the frequency of "departmentalized", "semi-departmentalized" and "team teaching" items one finds about 100 teachers could be in a situation where some other person was responsible for teaching science. However, the question, "Indicate the person primarily responsible for teaching science in your classroom." contradicts those figures because 90 percent of the teachers were responsible for teaching science themselves as they responded to that question.

Table 11. Frequency distribution of type of the school organization for elementary schools - more than one item could be checked - ETQ-I.

Organization	Frequency*
Self-contained classroom	179
Departmentalized	14
Semi-departmentalized	53
Nongraded	17
Team teaching	30
Other	8

*Some teachers checked more than one item, thus percentages were not used.

Those checking the "other" category generally made reference to a combination of two of the organizations such as self-contained and nongraded.

There is a fairly even distribution of teachers at all grade levels represented in the sample, with the exception of kindergarten, first, seventh and eighth grade teachers. Table 12 reveals the distribution of teachers at grade levels. The fact that kindergarten is not required by state law would account for the low number of kindergarten teachers responding.

Table 12. Frequency distribution of grade levels taught by elementary teachers - ETQ-I.

Grade levels taught	Frequency*
Kindergarten	6
First grade	34
Second grade	52
Third grade	46
Fourth grade	49
Fifth grade	60
Sixth grade	55
Seventh grade	21
Eighth grade	21
No reply	1

* Teachers could check more than one grade level, thus percentages were not used.

The teachers were asked to state the average minutes spent per week on science instruction. Table 13 was designed to provide frequency on 30 min/week intervals. The mode interval was 31-60 min/week. If the assumption is made that one period of science per day is equivalent to 30 minutes, then less than 20 percent of the teachers were teaching science on the average of 150 min/week. The results indicated that approximately 36 percent were teaching science less than 60 min/week.

Table 13. Frequency distribution of average time spent teaching science in minutes per week by elementary teachers - ETQ-I.

Time (min/wk)	Frequency	Percentage
0	10	4
1-30	20	8
31-60	63	24
61-90	50	19
91-120	38	15
121-150	24	9
151-180	13	5
> 181	22	8
No reply	21	8

The pattern for most Oregon elementary schools was to establish some group or committee to select a building science curriculum. When asked how their building science curriculum was selected, 215 teachers indicated that it was not done by a single person, but by some group or committee. Table 14 indicates the breakdown of the responses. The responses totaled 293 indicating that some teachers checked more than one item. The types of responses to "by some other committee" were as follows:

science committee and classroom teachers
elementary and secondary teachers
principal and curriculum coordinator
junior high and elementary committee
self, along with another teacher
don't know
county wide
teachers, principal and administration

Those checking "other" included such responses as "not sure", "administrators", and "district scope and sequence".

Table 14. Frequency distribution of selection of building science curriculum - ETQ-I.

Selection method	Frequency
By a building principal	17
By a curriculum specialist	19
By a single classroom teacher	14
By a science consultant	13
By the board of education	10
By the entire elementary staff	39
By a committee of elementary teachers from your school	45
By a committee of elementary teachers representing the entire school district	109
By some other committee (describe)	12
Other (describe)	10
No reply	5

When asked "Is there one person responsible for the administration of the science program in your building?", 42 percent of the teachers indicated that there was such a person (see Table 15). The positions of those 109 persons who were responsible for the administration of the science program can be found in Table 16. In 56 percent of the schools the classroom teacher was the person in charge.

Table 15. Frequency distribution of the responses to the question of whether there was one person responsible for the administration of the science program - ETQ-I.

Response	Frequency	Percentage
Yes	109	42
No	149	57
No reply	3	1

Table 16. Frequency distribution of the positions of the persons responsible for the administration of the building science program - ETQ-I.

Position	Frequency	Percentage based on 109 yes responses
Principal	23	21
Classroom teacher	62	56
Science consultant	12	11
District curriculum specialist	3	3
Other	9	9

When asked to "check the one statement that best described the relative effectiveness of that person's action in that role", the majority (78 percent) were described as being moderately to very effective. Only seven percent were described as being ineffective (see Table 17).

Classmeans were calculated to determine which position was most effective. The smaller the classmean value, the more effective the particular position. As reported in Table 18, the building principal and the librarian were the most effective persons administering

Table 17. Frequency distribution of the responses to the relative effectiveness of the person responsible for the administration of the science program - ETQ-I.

Effectiveness	Frequency	Percentage based on 109 yes responses
very effective	39	36
moderately effective	43	41
slightly effective	20	18
ineffective	8	7
no reply	1	1

the science program. However, due to the relatively small number of responses for the librarian, science consultant and curriculum specialist, the reader should be careful about drawing any conclusions involving those positions.

Table 18. Classmeans comparing effectiveness of the person administering the science program and the position of the individual - ETQ-I.

Position	*Classmeans
Principal	1.71
Classroom Teacher	1.98
Science Consultant or Supervisor	2.27
District Curriculum Specialist	2.00
Librarian	1.75

* Note classmean values were calculated based on the following rating scale:
1: Very Effective
2: Moderately Effective
3: Slightly Effective
4: Ineffective

To the question "What do you think that person could do to improve his effectiveness?", 50 percent of the teachers were not sure, 21 percent indicated that the person needed more time and eight percent said nothing could be done. The majority of the remainder of the responses were quite varied and applied to specific teaching situations. See Appendix O for the specific responses.

Most teachers believed that the philosophy of their science program was compatible with the written philosophy of the school. Table 19 shows that 80 percent thought the two philosophies were compatible. The nine percent who indicated that there was a discrepancy between the two philosophies had the following comments explaining why there was a discrepancy:

Frequency	Comments
6	no written philosophy for the school
2	district does not provide enough time
2	inadequate facilities
2	no written philosophy for the science program
2	equipment is poorly utilized
4	no reply

Table 19. Frequency distribution of the teacher's perception of the compatibility of the philosophy of the science program with the written philosophy of the school - ETQ-I.

Response	Frequency	Percentage
Yes	208	80
No	23	9
No reply	30	11

The question, "To what degree is the building principal knowledgeable of newer programs and approaches currently available in elementary school science?" was asked of the elementary teachers. Generally, most principals (87 percent) were rated as being knowledgeable, moderately knowledgeable or very knowledgeable. Only two percent were judged unknowledgeable. Table 20 reveals the distribution for the five choices for the question.

When asked to "Indicate whether science is taught as a separate course or if it is integrated with other subjects such as art, social

Table 20. Frequency distribution of the knowledgeability of principals for new programs and approaches in elementary school science - ETQ-I.

Knowledgeability of principal	Frequency	Percentage
Very knowledgeable	81	31
Moderately knowledgeable	72	28
Knowledgeable	72	28
Slightly knowledgeable	24	9
Unknowledgeable	5	2
No reply	7	3

studies, mathematics, etc.", 57 percent said that they were separate at times and integrated at other times. Thirty-two percent kept science as an isolated subject. Table 21 gives the breakdown on the individual responses. More information is needed in this area to establish any trends toward the integration of science with other subjects.

Table 21. Frequency distribution showing the degree of integration of science with other subjects - ETQ-I.

Degree of integration	Frequency	Percentage
Separate	83	32
Integrated	26	10
Separate at times and integrated at other times	149	57
Neither	0	0
No reply	3	1

The classroom teacher still remains as the person primarily responsible for teaching science, even though there is a movement away from the self-contained classroom type of school organization. Table 22 indicates that 90 percent of the teachers were responsible for teaching science themselves. The remainder of the science classes were taught either by a science teacher, science consultant, or by a fellow classroom teacher who traded off science for some other subject.

Table 22. Frequency distribution of the person primarily responsible for teaching science in the elementary teacher's classroom - ETQ-I.

Person primarily responsible for teaching science	Frequency	Percentage
Yourself	236	90
Science teacher	12	5
Science consultant	3	1
Self-contained classroom teacher who trades off some other subject with another teacher	7	3
Other	2	1
No reply	1	< 1

The most commonly adopted elementary science program in Oregon was Science - A Process Approach (S-APA). The researcher discovered in his travels throughout Oregon that many schools had extensive S-APA materials, but the teachers on the whole were not utilizing them. Table 23 reveals the number of schools which used the particular programs. The percentages were based on the sample size of 261 rather than on the total number of responses which was 346. This was used because many schools used a combination of two

Table 23. Frequency distribution of the type or types of science program being used in the teacher's building - ETQ-I.

Science program	Frequency	Percentage (Based on a sample of 261)
Science - A Process Approach (S-APA)	107	41
Elementary Science Study (ESS)	71	27
Science Curriculum Improvement Study (SCIS)	22	8
Textbook series (Publisher)*	82	31
Locally developed program	16	6
None	1	< 1
Other**	34	13
No reply	13	5

* Frequency of textbook publishers:

Frequency	Publisher
27	Holt Rinehart & Winston
14	Harper and Row
11	Silver Burdett
4	Harcourt Brace
3	Scott Foresman
2	Allyn Bacon
1	Brandewein
1	Laidlow
1	Merrill
17	No reply

** Responses for those who checked "other":

Frequency	Other
23	Experiences in Science (EIS)
7	Teachers' Units
2	Intermediate Science Curriculum Study (ISCS)
1	Research
1	Experimental Approach - McGraw-Hill

or more programs in addition to a classroom textbook. S-APA, textbooks and Elementary Science Study (ESS) were the three most frequently used science materials.

When asked to comment on the degree of satisfaction with their present science program, 59 percent of the teachers indicated they were satisfied to highly satisfied. Table 24 reveals the distribution of responses.

Table 24. Frequency distribution of responses to the degree of satisfaction that elementary teachers have with their present program.

Degree of satisfaction	Frequency	Percentage
highly satisfied	38	15
satisfied	115	44
indifferent	31	12
unsatisfied	57	22
highly unsatisfied	15	6
no reply	5	2

An analysis of variance was made to compare the three major science programs with the degree of teacher satisfaction. The results (see Table 25) show that there were highly significant differences at the 0.01 level between S-APA and ESS and between S-APA and SCIS, but none between ESS and SCIS. The results showed that elementary teachers were satisfied with ESS and SCIS, and unsatisfied with S-APA.

Table 25. Comparisons of the classmeans of the teacher's degree of satisfaction with their science program for the three science curricula - S-APA, ESS and SCIS.

Science Curriculum Improvement Projects	Teacher satisfaction	
	Frequency	*Mean
S-APA	90	2.92
ESS	60	2.23
SCIS	22	1.82

* Note - Mean values are based on the following scale:
1 = highly satisfied
2 = satisfied
3 = indifferent
4 = unsatisfied
5 = highly unsatisfied

The teachers were asked "How do you perceive the students in your class liking science?". Ninety-eight percent felt that science was enjoyable to some degree. Only one percent felt that their students disliked science. Table 26 gives the distribution of responses for the five categories. It appears that regardless which program was used, the students enjoyed science to some degree.

Table 26. Frequency distribution of the teacher's perception of the degree to which students enjoyed science - ETQ-I.

Degree of enjoyability	Frequency	Percentage
very enjoyable	76	29
moderately enjoyable	81	31
enjoyable	73	28
slightly enjoyable	26	10
dislike	2	1
no reply	3	1

When asked, "To what degree does the administration encourage and provide the opportunity for elementary teachers to attend professional meetings and workshops related to science education?", 74 percent of the respondents indicated their administration was encouraging to some or considerable degree. Table 27 indicates that 24 percent of the respondents received little or no encouragement to attend professional meetings or workshops in science education.

Table 27. Frequency distribution of the degree to which the teacher's administration encouraged teachers to attend professional meetings and workshops in science education - ETQ-I.

Degree of encouragement	Frequency	Percentage
Considerable	88	34
Some	104	40
Little	49	18
None	15	6
No reply	5	2

The experiences that teachers have received in their respective districts to improve the existing science program have been quite varied. The most popular approach as seen in Table 28, is that of in-service programs, generally at the district level. The second most popular technique is that of taking Division of Continuing Education Courses. Workshops, most of which were at the district level also, were third in popularity. University courses were least frequently used.

Table 28. Frequency distribution of the methods used by administrations to improve the existing district science programs - ETQ-I.

Type of experience	Frequency
University courses	39
In-service:	(151)
building	32
district-wide	74
local IED	10
university level	8
no reply	27
Division of Continuing Education	46
Workshop:	(42)
national conference	0
university level	3
district	27
building	7
no reply	5
Other	37
No reply	26

The responses to the question asking the teachers to "List and describe those science activities that students are engaged in that are related to career awareness", were relatively small considering the recent emphasis that the Oregon State Department of Education has given to career education. Only 60 percent of the teachers responded to the question. Of that total, only 17 teachers seemed to be in agreement with the accepted use of the phrase "career education". Table 29 indicates those types of activities that teachers felt were related to career awareness.

Table 29. Frequency distribution of the kinds of science-related activities that were related to career education - ETQ-I.

Career awareness activities	Frequency	Percentage
specific academic course	47	18
job information	29	11
none	17	7
variety of activities	17	7
life of scientist	12	5
processes of science	10	4
environmental studies	4	2
field trips	2	1
all are	1	< 1
films	1	< 1
making rockets	1	< 1
career fair	1	< 1
drug education	1	< 1
discussions	1	< 1
tree farm co-op	1	< 1
no reply	111	42

Sixty-five percent of the teachers questioned said that adequate or extensive classroom quantities of science materials were readily available to them in order to successfully conduct the science program. Thirty-four percent reported that they were limited in materials (see Table 30).

Table 30. Frequency distribution of the degree to which classroom quantities of science materials were readily available to teachers - ETQ-I.

Availability of science materials	Frequency	Percentage
extensive	46	18
adequate	123	47
limited	71	27
poor	19	7
no reply	12	1

The question was asked, "Do provisions exist for ordering and receiving small amounts of simple chemicals and expendable materials during the school year?". Seventy-seven percent stated that it did, 17 percent stated that it didn't, and six percent did not reply. Of those that stated that provisions did exist, 65 percent indicated that the procedure was easy and expedient, 23 percent indicated that it was not, and 11 percent did not reply.

The frequency with which natural materials were brought into the teacher's classroom and used in science study was quite varied. No particular pattern existed other than the teachers were equally divided as to the frequency as demonstrated in Table 31.

Table 31. Frequency distribution for how often environment materials were brought into the classroom and used for science study - ETQ-I.

Frequency with which environmental materials were brought into the classroom	Frequency	Percentage
at least once a week	69	26
about once every two weeks	70	27
about once a month	69	26
about once a semester	38	15
no reply	15	6

The variety of science-related field trips taken by elementary teachers was quite varied as seen by the length of the list in Appendix P. A total of 52 different field trips were listed along with their frequency distribution.

In relation to the above item, teachers were asked how often they took their students outdoors to study things in the natural environment. As revealed in Table 32, "about once a semester" was the modal value.

Table 32. Frequency distribution for how often the elementary teacher took students outdoors to study things in the natural environment - ETQ-I.

Frequency with which students were taken outdoors to study things in natural environment	Frequency	Percentage
at least once a week	11	4
about once every two weeks	29	11
about once a month	74	28
about once a semester	89	34
about once a year	37	14
never	12	5
no reply	9	3

The researcher was interested in determining how much incidental learning was a part of the regular science program. Therefore the question "List the kinds of incidental science items that are found in your classroom" was asked. The results were tabulated in such a way to focus on the numbers of incidental science, rather than the specific kind. Table 33 gives the number of teachers who listed zero to five or more different kinds of incidental science. It was encouraging to note that the modal item checked was five or more.

Table 33. Frequency distribution of the number of different kinds of incidental science items brought into the classroom for examination - ETQ-I.

Numbers of incidental science items that were brought into the classroom during the year	Frequency	Percentage
zero	2	1
one	11	4
two	21	8
three	43	16
four	52	20
five or more	106	41
no reply	26	10

Table 34 lists a variety of classroom activities that could be used in science teaching. The teachers were asked to check if they used the activity at least once every two weeks. Each percentage value is figured on the sample size of 261. The two types of class activity most commonly used were: discussion led by the teacher (87 percent) and visual aids (82 percent). In spite of the current increased use of laboratory activities for elementary school children, approximately 40 percent of the teachers did not make use of activities as a vehicle for learning.

When asked to indicate the type of science-related magazine they were reading, the elementary teachers chose National Geographic, Ranger Rick, and National Wildlife. The question asked for stating whether the teacher read the magazine thoroughly, about one article per issue or not at all. Science and Children, the

Table 34. Frequency distribution of the kind of classroom activity used by teachers at least once every two weeks-ETQ-I.

Class activity types	Frequency	Percentage
discussion led by teacher	228	87
discussion led by pupil	119	46
teacher lecture or explanation	179	69
teacher demonstration	183	70
laboratory activities	157	60
supervised individual study	149	57
supervised class project	164	63
supervised small group project	154	59
pupil recitation	104	40
library reading	151	58
preparation of reports	88	34
visual aids	215	82
other	11	4
no reply	12	5

professional journal for elementary school science was not read by 87 percent of the teachers.

Teachers were asked to rate their familiarity with selected-contemporary psychologists. Elementary teachers were most familiar with William Glasser (82 percent), B. F. Skinner (71 percent), and Jean Piaget (69 percent). These figures included those teachers who said they were either "familiar" or "slightly familiar" with the psychologist in question. See Table 36 for the individual distribution of responses. Considering that S-APA was the most commonly adopted program in the state, it was interesting to note that 87 percent of the teachers were unfamiliar with Robert Gagne. It would appear that during the implementation of S-APA the psycho-

Table 35. Frequency distribution of the kind of magazine and the degree of thoroughness that it is read by elementary classroom teachers - ETQ-I.

Magazine	Reads thoroughly		Reads about one article per issue		Do not read	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
a. <u>Science and Children</u>	6	2	27	10	228	87
b. <u>School Science & Math</u>	3	1	27	10	231	89
c. <u>Environmental Education</u>	6	2	17	7	237	91
d. <u>National Geographic</u>	89	34	119	46	53	20
e. <u>Ranger Rick</u>	42	16	81	31	138	53
f. <u>Scientific American</u>	5	2	20	8	236	90
g. <u>National Wildlife</u>	34	13	89	34	138	53
h. Other	36	14				

Table 36. Frequency distribution of the elementary teacher's degree of familiarity with selected contemporary psychologists.

Psychologists	Familiar		Slightly Familiar		Unfamiliar	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Jean Piaget	114	44	66	25	81	31
Jerome Bruner	56	21	58	22	147	56
C. T. Frank	0	0	18	7	243	93
Carl Rogers	40	15	69	26	152	58
William Glasser	163	62	53	20	45	17
Robert Gagne	5	2	28	11	228	87
B. F. Skinner	109	42	76	29	76	29
Abraham Maslow	40	15	69	26	152	58

logical foundation upon which it was based was not discussed with the elementary teacher.

Two questions concerning evaluation. One focused on how they personally evaluated children's performance in science and the other on how the total science program was evaluated. The first question was "Would you describe the evaluation of children in the area of science as being individualized or group evaluated?". Nearly half the teachers expressed that they used a combination of both group and individualized methods for evaluating their students. Table 37 reveals that 26 percent used strictly an individualized method while 20 percent used strictly a group approach.

Table 37. Frequency distribution of the type of evaluation process used to measure children's learning in science - ETQ-I.

Type of evaluation	Frequency	Percentage
Individualized	68	26
Group	51	20
A combination of above	129	49
None of the above	4	2
No reply	9	3

The second question was "Is any provision made for evaluating the total science program in your school or district?". Table 38 reveals that 31 percent indicated that such provisions existed. When asked to describe the procedure for making such an evaluation, the responses were quite varied. Some indicated that a science

Table 38. Frequency distribution of responses to the question - "Is any provision made for evaluating the total science program in your school or district?" - ETQ-I.

Response	Frequency	Percentage
Yes	80	31
No	152	58
No reply	29	11

committee from their school was responsible while others used such things as checklists or achievement tests. Appendix Q contains a list of those responses.

Statistical Treatment of the Data for ETQ-I

A number of variables were tested by using the statistical technique of multiple regression analysis. It was not the researcher's intent at the outset of the study to measure such relationships, however the nature of the data did lend itself for making comparisons. In calculating the regression model, the greatest correlation figures were between 0.20 and 0.30. Those figures by themselves were too small to indicate a high correlation in the model. However when the F statistic was calculated for the particular variables in question, some very significant relationships were determined. Statistically this phenomenon can be explained by stating that significant relationships can exist in a regression model even though low correlations are found. Low correlations result when there are other independent variables effecting the regression model, but are not present. Explained in terms of this study, the researcher did not collect all the data necessary in order to obtain high correlation figures, but did find some very significant relationships between particular items in the questionnaires.

At the end of each section in this chapter the reader will find an analysis of the relationships determined between individual variables as a result of the stepwise multiple regression analysis.

Multiple regression analysis of the dependent variable - teacher's satisfaction with the science program

A multiple regression model was calculated using the dependent variable of the teacher's degree of satisfaction with the present science curriculum with the following list of independent variables:

a. age of the teacher
b. the number of years of teaching experience
c. the degree with which the administration encouraged and provided the opportunity for the elementary teacher to attend professional meetings and workshops in science education
d. the degree that classroom quantities of science materials were readily available for the classroom teacher to teach science
e. the frequency with which students were taken outdoors to study things in the natural environment
f. the extent with which the teachers read selected science-related journals

The independent variables which were related at the 0.05 level of significance with the teacher's degree of satisfaction with the present science curriculum were d, e and c. The results showed that if an elementary teacher was highly satisfied with the present science curriculum, there was also the likelihood that classroom quantities of materials were available, that the children were taken outdoors to study things in the natural environment and that the administration was very encouraging about participation in professional meetings and workshops.

The regression model for the above analysis was:

$$Y = 53.607 + 21.858(d) + 40.507(e) + 20.135(c)$$

Multiple regression analysis of the dependent variable - teacher's perception of how the students enjoyed science

A multiple regression model was calculated using the dependent variable of the teacher's perception of how the students enjoyed science with the following list of independent variables:

a. the age of the teacher
b. the number of years of teaching experience
c. the amount of class time devoted to science instruction
d. the effectiveness of the person who was responsible for the administration of the science program
e. the teacher's degree of satisfaction with the present science curriculum
f. the degree with which the administration encouraged and provided the opportunity for the elementary teacher to attend professional meetings and workshops in science education
g. the degree that classroom quantities of science materials were readily available for the classroom teacher to teach science
h. the frequency with which natural materials were brought into the classroom for science study
i. the frequency with which students were taken outdoors to study things in the natural environment

j. the extent with which the teachers read selected science-related journals

The independent variables which were related at the 0.05 level of significance with the dependent variable of teacher's perception of how the students enjoyed science were e, f, and h. The results showed that the more an elementary teacher perceived that students enjoyed science, the greater the likelihood that: the teacher was satisfied with the present science curriculum; that the administration encouraged and provided the opportunity for the elementary teacher to attend professional meetings and workshops in science education; and natural materials were brought into the classroom for study.

The regression model for the above analysis was:

$$Y = 40.973 + 32.699(e) + 23.685(f) + 18.546(h)$$

<u>Multiple regression analysis of the dependent variable - frequency with which natural materials were brought into the classroom</u>

A multiple regression model was calculated using the dependent variable of the frequency with which natural materials were brought into the classroom for study with the following list of independent variables:

a. the age of the teacher
b. the number of years of teaching experience
c. the amount of class time devoted to science instruction
d. the teacher's degree of satisfaction with the present science curriculum

e. the teacher's perception of how the students enjoyed science
f. the degree that classroom quantities of science materials were readily available for the classroom teacher to teach science
g. the frequency with which students were taken outdoors to study things in the natural environment
h. the extent with which the teachers read selected science-related journals

The independent variables which were related at the 0.05 level of significance with the dependent variable of the frequency with which natural materials were brought into the classroom for study were g and e. The results showed that the more frequently natural materials were brought into the classroom for the study, the greater the likelihood that students were being taken outdoors to study things in the natural environment and that the teachers perceived the students enjoyed science.

The regression model for the above analysis was

$$Y = 22.471 + 19.730(g) + 32.670(e)$$

<u>Multiple regression analysis of the dependent variable - amount of class time devoted to teaching science</u>

A multiple regression model was calculated using the dependent variable of the amount of class time per week devoted to science instruction with the following list of independent variables:

a. age of the teacher
b. the number of years of teaching experience
c. the degree with which the building principal was knowledgeable of new programs and approaches in elementary school

d. the teacher's degree of satisfaction with the present science curriculum
e. the teacher's perception of how students enjoyed science
f. the degree with which the administration encouraged and provided the opportunity for the elementary teacher to attend professional meetings and workshops in science education
g. the degree that classroom quantities of science materials were readily available for the classroom teacher to teach science
h. the frequency with which natural materials were brought into the classroom for science study
i. the frequency with which students were taken outdoors to study things in the natural environment
j. the extent with which the teachers read selected science-related journals.

The independent variables which were related at the 0.05 level of significance with the dependent variable of the amount of class time per week devoted to science instruction were

a. the infrequency of reading articles in Scientific American
b. the infrequency of reading articles in National Wildlife
c. the frequency of reading articles in Ranger Rick
d. the teacher's degree of satisfaction with the present science curriculum
e. the number of years of teaching experience

The results showed that the more class time that is devoted to science instruction, the greater the likelihood that: the teacher is reading articles in Ranger Rick but not in Scientific American or National Wildlife; the teacher is highly satisfied with the present science curriculum; and the teacher has a relatively large number of years of teaching experience.

The regression model for the above analysis was:

$$Y = 7.4257 - 21.424(a) - 23.019(b) + 38.214(c) - 80.345(d) - 56.554(e)$$

Multiple regression analysis of the dependent variable - effectiveness of the person responsible for administering the science program

A multiple regression model was calculated using the dependent variable of the relative effectiveness of the person responsible for the administration of the science program with the following list of independent variables:

a. the degree with which the administration encouraged and provided the opportunity for elementary teachers to attend professional meetings and workshops in science education
b. the degree to which classroom quantities of science materials were readily available for the classroom teachers to teach science

There were no significant differences found in the regression model.

In addition to the multiple regression analysis, the analysis of variance statistic was calculated to compare the means of a number of items in the questionnaire. It was used on items that contained non-continuous variables as opposed to the continuous variables used in the multiple regression analysis.

Analysis of variance comparing amount of class time for science and teacher's satisfaction with the science curriculum

An analysis of variance was calculated to determine if there was any relationship between the amount of class time devoted to science instruction and the teacher's degree of satisfaction with the present building science curriculum. Table 39 lists the classmeans for each

Table 39. Comparisons of the classmeans of the amount of class time devoted to science instruction for the different ways in which the building science curriculum was selected.

Selection method	Science instructional time	
	Frequency	*Mean
By a building principal	8	2.62
By a curriculum specialist	12	3.83
By a single classroom teacher	10	3.80
By a science consultant	12	3.92
By the board of education	5	4.00
By the entire elementary staff	31	3.94
By a committee of elementary teachers from your school	37	3.30
By a committee of elementary teachers representing the entire school district	101	3.28

* Note: Mean values are based on the following rating scale:

1 - 1-30 min/wk
2 - 31-60
3 - 61-90
4 - 91-120
5 - 121-150

different method by which the building science curriculum was selected. The results of the F test showed that there was no significant difference between the amount of class time devoted to science instruction and the method used for selecting the building science curriculum.

Analysis of variance comparing the teacher's satisfaction of the science program with the science program selection method

An analysis of variance was calculated to determine if there was any relationship between the teacher's degree of satisfaction with the present science curriculum and the method that was used to select the building science curriculum. Table 40 lists the classmeans for each different method by which the building science curriculum was selected. The results of the F test showed that there was no significant difference between the teacher's degree of satisfaction with the present science program and the method used for selecting the building science curriculum.

Table 40. Comparisons of the classmeans of the teacher's degree of satisfaction with the present building science curriculum for the different ways in which the building science curriculum was selected.

Selection method	Teacher's satisfaction	
	Frequency	*Mean
By a building principal	17	2.59
By a curriculum specialist	19	2.74
By a single classroom teacher	13	2.38
By a science consultant	13	3.15
By the board of education	10	3.20
By the entire elementary staff	39	2.31
By a committee of elementary teachers from your school	43	2.37
By a committee of elementary teachers representing the entire school district	108	2.66

* Note: Mean values are based on the following rating scale:
1 = highly satisfied 3 = indifferent 5 = highly unsatisfied
2 = satisfied 4 = unsatisfied

Analysis of variance comparing the teacher's perception of the student's enjoyment of science with the science program selection method

An analysis of variance was calculated to determine if there was any relationship between the teacher's perception of how the students enjoyed science with the method that was used to select the building science curriculum. Table 41 lists the classmeans of the teacher's perception of how the students enjoyed science for the different ways in which the building science curriculum was selected. Table 41 lists the classmeans for each different method by which the building science curriculum was selected. The results of the F test showed that there was no significant difference between the teacher's perception of how the students enjoyed science and the method used for selecting the building science curriculum.

Analysis of variance comparing the position of the person administering the science program with his effectiveness

An analysis of variance was calculated to determine if there were any relationships between the position of the person responsible for the administration of the science program and the relative effectiveness of the person's action in that role. Table 42 lists the classmeans of the relative effectiveness of the person responsible for the administration of the science program. The results of the F test showed that there was no significant difference between the position of the person

Table 41. Comparisons of the classmeans of the teacher's perception of how the students enjoyed science for the different ways in which the building science curriculum was selected.

Selection method	Teacher's perceiption of students liking science	
	Frequency	*Mean
By a building principal	17	2.06
By a curriculum specialist	19	2.00
By a single classroom teacher	13	2.38
By a science consultant	13	2.54
By the board of education	10	2.30
By the entire elementary staff	39	2.15
By a committee of elementary teachers from your school	45	2.02
By a committee of elementary teachers representing the entire school district	109	2.24

* Note: Mean values are based on the following rating scale:
1 = very enjoyable
2 = moderately enjoyable
3 = enjoyable
4 = slightly enjoyable
5 = dislike

Table 42. Comparisons of the classmeans of the relative effectiveness of the person responsible for the administration of the science program.

Position of the person responsible for administrating the science program	Effectiveness	
	Frequency	*Mean
Principal	21	1.71
Classroom teacher	61	1.98
Science consultant or supervisor	11	2.27
District curriculum specialist	2	2.00

* Note: Mean values are based on the following rating scale:
1 = very effective
2 = moderately effective
3 = slightly effective
4 = ineffective

responsible for administering the science program and his relative effectiveness.

Analysis of variance comparing how the teachers perceived the students liking science with the three science programs - S-APA, ESS and SCIS

An analysis of variance was calculated to determine if there was any significant difference between the three science curriculum improvement projects, i. e. S-APA, ESS and SCIS, in how the teachers perceived the students liking science. Table 43 shows the classmeans comparing the three science programs. An F value of 7.511 indicated that there was a significant difference at the 0.05 level for the three science programs. Further examination revealed that there was a significant difference between S-APA and ESS, between S-APA and SCIS, but not between ESS and SCIS in comparing the variable of the teacher's perception of how the students enjoyed science. The results showed that students enjoyed science significantly better when involved in ESS and SCIS than when in S-APA.

Analysis of variance comparing the frequency with which natural materials were brought into the classroom with the three science programs - S-APA, ESS and SCIS

An analysis of variance was calculated to determine if there was any significant difference between the three science curriculum improvement projects, i.e. S-APA, ESS and SCIS, in the frequency

Table 43. Comparison of the classmeans of the teacher's perception of how the students enjoyed science for the three science curricula - S-APA, ESS and SCIS.

Science Curriculum Improvement Projects	Teacher's perception of how students liked science	
	Frequency	*Mean
S-APA	90	2.36
ESS	60	1.80
SCIS	22	1.73

* Note: Mean values are based on the following rating scale:
1 = very enjoyable
2 = moderately enjoyable
3 = enjoyable
4 = slightly enjoyable
5 = dislike

with which natural materials were brought into the classroom for study. Table 44 shows the classmeans comparing the three science programs. An F value of 4.236 indicated that there was a significant difference at the 0.05 level for the three science programs. Further examination indicated that there was a significant difference between S-APA and ESS, between ESS and SCIS, but not between S-APA and SCIS in comparing the variable of frequency with which natural materials were brought into the classroom for study. The results showed that where ESS was taught there was a greater frequency with which natural materials were brought into the classroom for study.

Table 44. Comparisons of the classmeans of the frequency with which natural materials were brought into the classroom for study for the three science curricula - S-APA, ESS and SCIS.

Science Curriculum Improvement Projects	Frequency with which materials were brought in	
	Frequency	*Mean
S-APA	88	2.53
ESS	57	2.01
SCIS	21	2.24

* Note: Mean values are based on the following rating scale:
1 = at least once a week
2 = about once every two weeks
3 = about once a month
4 = about once a semester

<u>Analysis of variance comparing the frequency with which students were taken outdoors to study science with the three science programs - S-APA, ESS and SCIS</u>

An analysis of variance was calculated to determine if there was any significant difference between the three science curriculum projects - S-APA, ESS and SCIS, in the frequency with which students were taken outdoors to study things in the natural environment. Table 45 shows the classmeans comparing the three science programs. An F value of 7.896 indicated that there was a significant difference at the 0.01 level for the three science programs. Further examination indicated that there was a significant difference between S-APA and SCIS, between ESS and SCIS, but not between S-APA and ESS in comparing the variable of frequency with which the students were taken

Table 45. Comparisons of the classmeans of the frequency with which students are taken outdoors to study things in the natural environment for the three science curricula - S-APA, ESS and SCIS.

Science Curriculum Improvement Projects	Frequency students are taken outdoors	
	Frequency	*Mean
S-APA	88	3.80
ESS	59	3.46
SCIS	22	2.73

* Note: Mean values are based on the following rating scale:
1 = at least once a week
2 = about once every two weeks
3 = about once a month
4 = about once a semester
5 = about once a year

outdoors to study things in the natural environment. The results showed that where SCIS was taught, students were more likely to be taken outdoors to study things in the natural environment.

Analysis of variance comparing the teacher's familiarity of the psychology of Piaget with the three science programs - S-APA, ESS and SCIS

An analysis of variance was calculated to determine if there was any significant difference between the three science curriculum projects - S-APA, ESS and SCIS, in the teacher's degree of familiarity with the psychology of Jean Piaget. Table 46 shows the classmeans comparing the three science programs. An F value of 3.028 indicated that there was no significant difference at the 0.05 level for the three science programs.

Table 46. Comparisons of the classmeans of familiarity with the psychology of Jean Piaget for the teachers involved in the science curricula - S-APA, ESS and SCIS.

Science Curriculum Improvement Projects	Psychology of Piaget	
	Frequency	*Mean
S-APA	91	1.96
ESS	60	1.75
SCIS	22	1.50

* Note: Mean values are based on the following rating scale:
1 = familiar
2 = slightly familiar
3 = unfamiliar

Summary

In summary, the results from ETQ-I showed that the following conditions existed in elementary school science in Oregon during the 1973-74 school year:

1. The majority of science instruction was conducted by a regular elementary teacher in a self-contained classroom.

2. A classroom teacher was the person most frequently appointed to administer the science program in a particular school.

3. S-APA was the most commonly adopted elementary science program in Oregon.

4. The majority of the schools no longer considered the availability of materials as a barrier to effective teaching.

5. The classroom technique used most by the elementary teacher was teacher-led discussion.

6. The two science-related journals which were read most frequently by elementary classroom teachers were National Geographic and National Wildlife.

7. When comparing the method used to select the building science curriculum with the criterion variables of: amount of class time devoted to science instruction; the teacher's degree of satisfaction with the science program; and the teacher's perception of how the students enjoyed science, no significant differences were found.

8. Teachers perceived that students enjoyed science better in ESS and SCIS programs than in S-APA.

9. Natural materials were more likely to be brought into a science class where ESS was taught than in science classes where S-APA and SCIS were taught.

10. Teachers were more likely to take students outdoors to study things in the natural environment where SCIS was taught than where S-APA or ESS was taught.

11. Oregon elementary teachers were significantly more satisfied with ESS and SCIS than with S-APA.

Section 2 - Secondary School Science - I

Sections 2 and 3 of Part A will focus on the status of science in Oregon secondary schools. Two separate questionnaires were used to obtain information necessary to determine the status of secondary science education. Section 2 will focus on the results for SSSQ-I.

Of the total of 188 questionnaires returned, 92 percent were from males and eight percent were from females.

The grade levels taught in the buildings in which the respondents were teaching are shown in Table 47. The grades most frequently represented by this questionnaire (SSSQ-I) were 9-12.

Table 47. Frequency distribution showing the grade levels represented by the respondents to SSSQ-I.

Grades taught in building	Frequency
7	67
8	69
9	124
10	124
11	123
12	123
No reply	1

When asked to indicate the minimum number of yearly science courses required for graduation or for transfer to another school, the responses ranged from zero to four (see Table 48). The information only has value in that some schools in the state, regardless of size, required more than the one year of a laboratory science for a graduating senior.

Table 48. Frequency distribution of the number of yearly science courses required for graduation or for movement to another school.

Number of science courses	Frequency	Promotion
0	5	3
1/2	4	2
1	101	54
2	51	27
3	20	11
4	3	2
5	0	0
6	0	0
No reply	4	2

The total years of experience teaching secondary school science is shown in Table 49. There appeared to be a normal distribution of years of experience. The modal value was four to nine years of experience. Cummins (1960 p. 52) had similar results showing that 32 percent of the high school teachers had 4-9 years of experience.

Table 49. Frequency distribution of total years of experience teaching secondary school science.

Years of experience	Frequency	Percentage
one	4	2
2-3	24	13
4-9	67	36
10-15	50	27
16-25	35	19
26 or more	7	4
No reply	1	< 1

The typical amount of daily preparation time for science teachers was one period. It would appear that more preparation time be considered for those teachers who were responsible for teaching more than one laboratory science course. Table 50 shows that less than 10 percent of all teachers had more than one preparation period per day.

When asked the question "Do you perceive the philosophy of the science program to be compatible with the written philosophy of the school?" 87 percent said yes (see Table 51). This was higher than the 80 percent value indicated by the elementary teachers. This may

Table 50. Frequency distribution of daily preparation periods for secondary teachers.

Allotted preparation time	Frequency	Percentage
0 periods	9	5
1 period	163	87
2 periods	11	6
3 periods	2	1
No reply	3	2

Table 51. Frequency distribution of the number of science teachers who felt there was compatibility between the school philosophy and the science philosophy.

Response	Frequency	Percentage
Yes	161	86
No	18	10
No reply	9	5

be accounted for in part by the fact that more laboratory sciences are taught in secondary schools. One of the advantages of a laboratory science is that a teacher is able to spend considerable time with students on an individual basis. Many school philosophy statements usually include a statement or two considering individual differences as an important facet of their total school program.

Appendix R contains the responses to the second part of the philosophy question. The 18 science teachers who checked no were asked to explain why there was a discrepancy between the two philosophies. The responses were as varied as the number responding.

Tradition has it that high school teachers blame junior high teachers who in turn blame elementary teachers for the poor academic performance of students. When secondary science teachers were asked if there was any formal articulation between the elementary science program and the secondary science program, 26 percent said there was. Table 52 indicates that 72 percent said there was no articulation. Appendix S contains the responses to those teachers who said there was. Most articulation was performed by one person or was assumed to occur simply because science was taught at both levels.

Table 52. Frequency distribution of responses to the question - "Is there any formal articulation between the elementary school and secondary school science programs?".

Response	Frequency	Percentage
Yes	49	26
No	135	72
No reply	4	2

When asked, "To what degree does the administration encourage and provide the opportunity for science teachers to attend professional meetings and workshops related to science education?", 75 percent of the respondents indicated their administration was encouraging to some or considerable degree. Table 53 shows that approximately 20 percent of the respondents received little or no encouragement to

Table 53. Frequency distribution of the degree to which the teacher's administration encouraged science teachers to attend professional meetings and workshops in science education.

Degree of encouragement	Frequency	Percentage
Considerable	47	25
Some	99	53
Little	28	15
None	12	6
No reply	2	1

attend professional meetings or workshops in science education.

Most teachers (94 percent) have received some post-baccalaureate training in science or science education. Table 54 shows the type of training which they have received. Approximately 50 percent of Oregon teachers have participated in National Science Foundation (NSF) Summer Institutes and 20 percent have participated in National Science Foundation Academic Year Institutes. If the assumption is made that the two groups are mutually exclusive, then 70 percent of the Oregon science teachers have benefitted from National Science Foundation Institutes.

When asked to indicate which experience they felt was best, 27 percent agreed that NSF Summer Institutes were the best. Table 55 shows the distribution of responses to be different than those in Table 54. One might expect the rank order of both tables to be similar, but upon examination they are different. University courses were most frequently used for post-baccalareate training while they

Table 54. Frequency distribution of the type of post-baccalaureate training for secondary science teachers - SSSQ-I.

Type of training	Frequency	Percentage based on total responses - 188
University courses	148	79
Workshop	85	45
In-service	90	48
NSF Academic Year Institute	37	20
NSF Summer Institute	96	51
Other*	11	6
No reply	2	1

* "Other" responses:

NSF conferences
CAP - U.S.A.F.
Inservice - NSF Institute
District curriculum studies - Division of Continuing Education
Shell Merit Scholar
MAT
Extension
Lecture series
Traveling science program participant - NSF
Navy nuclear power program

were rated as the third best type of experience for additional training. This evidence does not support the contention made by many scientists, educators and granting agencies that special institutes have little significance in the preparation of science teachers.

A similar question but more specific, asked the science teachers if they had had any special training to help in the teaching of such programs as BSCS, PSSC, ESCP, etc. Table 56 shows that 52 percent of them had received such training in one form or another.

Of the 52 percent who indicated they had, Table 57 shows the

Table 55. Frequency distribution of the best type of post-baccalaureate training for secondary science teachers - SSSQ-I.

Best type of experience	Frequency	Percentage based on 176 responses
University courses	23	13
Workshop	14	8
In-service	4	2
NSF Academic Year Institute	27	16
NSF Summer Institute	47	27
Other	2	1
No reply	57	33

Table 56. Frequency distribution of the science teachers who had received special training to teach such courses as BSCS, PSSC, ESPC, etc. - SSSQ-I.

Response	Frequency	Percentage
Yes	98	52
No	84	45
No reply	6	3

Table 57. Frequency distribution of the source of training for specific science courses like BSCS, PSSC, ESCP, etc. - SSSQ-I.

Source of training	Frequency	Percentage based on 98 yes responses from Table 56
University courses	55	56
In-service	25	26
Division of Continuing Education	14	14
Workshops	31	32
Other	20	20
No reply	0	0

distribution of responses for the different kinds of training. University courses were the most popular way to receive training in such courses as BSCS, PSSC, ESCP, etc. Those responding to the "other" category can be found in Appendix T. Those comments generally focused on specific programs.

Secondary science teachers were asked the same question about contemporary psychologists as were the elementary teachers. Table 58 shows that secondary science teachers were more familiar with B. F. Skinner than with the other psychologists. This may be a reflection on the nature of the special NSF institute programs. This may also account for the relative emphasis on the teaching of facts which is revealed in Table 59.

Secondary science teachers were asked to estimate the relative percentages of their teaching time devoted to process skills, values, social aspects and factual knowledge. As revealed in Table 59, it was found that teachers spent the most time teaching factual knowledge and process skills. The classmean values are somewhat misleading because the intervals of percentage of time were quite large.

Teachers were asked the frequency with which they and their students brought in natural materials to the classroom for study. Sixty-six percent used natural materials at least every other week. Forty-five percent used them at least once a week. Table 60 shows that 19 percent utilized them less than once a month. Compared to

Table 58. Frequency distribution of the degree of familiarity with various selected contemporary psychologists.

Psychologists	Familiar		Slightly Familiar		Unfamiliar	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Jean Piaget	31	17	47	26	101	56
Jerome Bruner	16	9	46	26	117	65
C. T. Frank	1	1	16	9	162	90
Carl Rogers	31	17	37	21	111	62
William Glasser	56	31	49	27	74	41
Robert Gagne	8	4	12	7	159	89
B. F. Skinner	77	43	56	31	46	26
Abraham Maslow	21	12	41	23	117	65

Table 59. Classmeans for the relative percentages of time devoted to teaching process skills, values, social aspects and factual knowledge - SSSQ-I.

Objectives of teaching	*Classmeans
Process skills	1.85
Values	1.07
Social aspects	1.02
Factual knowledge	1.95

* Classmeans were calculated based on the following scale:

1 = 0-25 percent
2 = 26-50
3 = 51-75
4 = 76-100

Table 60. Frequency distribution for how often natural materials were brought into the secondary science classroom for study.

Frequency with which natural materials were brought into the science classroom	Frequency	Percentage
At least once a week	85	45
About once every two weeks	39	21
About once a month	14	7
Less than once a month	36	19
No reply	14	7

elementary teachers, secondary science teachers make greater use of natural materials. Fifty-three percent of the elementary teachers utilized them at least every other week, and only 26 percent used them at least once a week.

When asked to check which of three classroom practices best described the courses they taught, the results were as follows in Table 61. With the exception of earth science classes, approximately 75 percent of the teachers placed more emphasis on student laboratory and less on teacher demonstration. The practice of more emphasis on teacher demonstration and less on student laboratory work was generally the least selected item, with the exception of earth science teachers. The evidence implies that consideration should be given to the improvement of greater laboratory emphasis for students in earth science. In comparing the three main high school courses, biology, chemistry, and physics, chemistry and physics have about 10 percent greater emphasis on student laboratory activities.

There is a marked trend in the present emphasis on student laboratory and less on teacher demonstration. Cummins (1960 p. 179) showed that nine percent of the general science, 32 percent of the biology, 58 percent of the chemistry, and 40 percent of the physics classes were represented by that category.

The science teachers were asked to select the one laboratory procedure most commonly used. As seen in Table 62, the choices were as follows: individual laboratory work, pupils grouped in pairs, pupils grouped three or more to a group, teacher demonstration, or pupil demonstration. The most common practice was the same for all science classes - pupils grouped in pairs. This evidence reveals

Table 61. Frequency distribution for the present ratio of emphasis between student laboratory work and teacher demonstration.

Practice	Gen Sci		Bio		Chem		Phy		Earth Sci		Phy Sci		ISCS	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
More emphasis on student laboratory and less on teacher demonstration	25	71	61	71	39	81	27	79	14	52	17	81	7	100
More emphasis on teacher demonstration and less on student laboratory work	3	9	5	6	2	4	0	0	7	26	3	14	0	0
More emphasis on balance between teacher demonstration and student laboratory work	7	20	20	23	7	15	7	21	6	22	1	5	0	0

Table 62. Frequency distribution of the most commonly used laboratory procedure for the different sciences.

Procedure	Gen Sci		Biol		Chem		Phy		Earth Sci		Phy Sci		ISCS	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Individual laboratory work	5	15	10	12	8	29	4	12	8	25	3	14	2	29
Pupils grouped in pairs	18	52	53	65	14	50	16	49	16	50	13	62	4	57
Pupils grouped three or more to a group	8	24	19	23	6	21	13	39	7	22	3	14	1	14
Teacher demonstration	3	9	0	0	0	0	0	0	1	3	2	0	0	0
Pupil demonstration	0	0	0	0	0	0	0	0	0	0	0	0	0	0

a shift in importance of teaching methodology as reported in the survey by Cummins (1960 p. 176). He revealed that 60 percent of the general science classes were using teacher demonstration as the preferred practice. Likewise there was a general increase in the use of individual laboratory work for general science from 6-15 percent, for chemistry from 19 to 29 percent and for physics from 7 to 12 percent. Two possible explanations could account for this change: the influx of NSF monies for laboratory facilities or the gain in popularity of laboratory science classes.

The methods most commonly used in scheduling laboratory work in the various science courses are listed in Table 63. Regular single periods were the most common practice in providing for laboratory work. A flexible laboratory schedule was the second most commonly used method of scheduling. Compared to Cummins (1960 p. 178), there has been a marked change in scheduling laboratory work during the last 14 years. He reported that a flexible laboratory schedule was most commonly used and that integrated laboratory and recitation were next in frequency use. It is interesting to note that there has been an increase in the frequency of use of regular single periods and regular double periods while the following decreased in use since 1960: a flexible laboratory schedule, integrated laboratory and recitation, and none scheduled.

Table 63. Frequency distribution for the method used to schedule laboratory work in secondary schools.

Type of scheduling	Gen Sci		Biol		Chem		Phy		Earth Sci		Phy Sci		ISCS	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
None scheduled	2	6	3	4	2	5	1	3	1	3	0	0	0	0
Regular single periods	14	41	40	49	12	32	12	36	14	45	9	43	4	57
Regular double periods	6	18	7	9	5	13	6	18	3	10	2	10	0	0
A flexible laboratory schedule	4	12	19	23	17	45	9	27	9	29	6	29	2	29
Integrated laboratory and recitation	6	18	13	16	2	5	5	15	4	13	4	19	1	14
Laboratory optional	2	6	0	0	0	0	0	0	0	0	0	0	0	0

Table 64 lists the facilities which were reported as being available for science instruction. Generally, science facilities appeared to be satisfactory. There was a marked improvement in this study over the facilities reported by Cummins (1960 p. 106). The range of improvement was between one and 30 percent.

The responses to the question asking the science teachers to "List and describe those science activities that students are engaged in that are related to career education" were quite varied. Appendix U contains the list of those activities that science teachers were doing in career education. Apparently more inservice work is needed in order that secondary science teachers develop a more complete concept of what career education is concerned with. The majority indicated that career education was concerned in certain specific science courses.

When asked the question, "Have you ever conducted any scientific research at the college level?", 36 percent of the science teachers indicated they had. However, when asked a related question "Do you currently conduct any scientific research in your school?", 19 percent said they did. Upon examination of the type of research they were engaged in as found in Appendix U, this research discovered that from their descriptions much of what they were doing was very informal.

Table 65 indicates that even though a relatively small percentage of teachers were engaged in personal research, 38 percent of them

Table 64. Frequency distribution of facilities available for instruction in secondary schools.

Facilities	Frequency	Percentage
Water available	184	98
Rooms have chalkboards	184	98
Electrical outlets	183	97
Rooms have bulletin boards	178	95
Demonstration tables	172	92
Rooms can be darkened for slide and movie projection	170	90
Gas outlets	166	88
Equipment storage cases	153	81
Dark room for photography	127	68
Library of textbooks in the room	119	63
Exhibit cases	113	60
Preparation room	106	56
Rooms have wall and window tables	93	50
Facilities are inadequate in size	80	43
Demonstration table on wheels	75	40
Plant growing room	59	31
Fume hoods	59	31
Rooms are fitted for television reception	52	28
Facilities are old and in need of replacement	46	24
Project areas for individuals	45	24
Greenhouse (separate)	44	23
Project room (separate)	43	23
Animal room	43	23
Rooms have classroom libraries and reading tables	43	23
Weather station	25	13
Radio room or shack	20	11
Nature trail	19	10
School farm	14	7
Reforestation area	11	6
Garden plot	9	5
School camp	7	4
School museum	6	3
Others	6	3

Table 65. Frequency distribution of the responses to the question asking the teacher if they had any students engaged in research other than normal class activities.

Response	Frequency	Percentage
Yes	71	38
No	110	58
No reply	7	4

had students who were conducting research projects other than the normal classroom activities.

Extra-curricular activities which were performed by science teachers were both voluntary and involuntary in nature. Forty-six percent were engaged in voluntary extra-curricular activities while 68 percent were engaged in involuntary extra-curricular activities. Table 66 shows that the modal value is one activity for both types of extra-curricular activities. However, it is interesting to note that 13 percent of the science teachers were required to participate in a minimum of three extra-curricular activities. This raises the question of what effect their participation in those activities had on their performance as a classroom science teacher.

The science teachers were asked to judge the overall success of the science program in their school. Table 67 shows that the majority of the teachers felt their science program to be successful. Only five percent believed it was fair and none reported it to be poor. The question has value only in that the science education community knows

Table 66. Frequency distribution of the number of extra-curricular activities which science teachers participated in.

Number of extra-curricular activities	Frequency	Percentage
Voluntary		
0	9	5
1	45	24
2	17	9
3	14	7
4	1	1
5	1	1
No reply	101	54
Involuntary		
1	67	36
2	36	19
3	16	9
4	4	2
5	4	2
No reply	61	32

Table 67. Frequency distribution of the degree of success that science teachers feel about their school's science program.

Degree of success	Frequency	Percentage
extremely successful	22	12
successful	100	53
average	48	25
fair	9	5
poor	0	0
no reply	9	5

how the science teachers feel about their own science programs.

Table 68 lists the number of science teachers who reported being members of various professional organizations and their highest degree of involvement. Seventy-one percent of the science teachers were members of the National Education Association, a decrease of 12 percent since 1960 (Cummins, 1960 p. 93). Seventy-one percent were members of the Oregon Education Association, a decrease of 11 percent since 1960. Thirty-nine percent were members of the National Science Teachers Association, an increase of six percent since 1960. There has been no percentage increase in membership since 1960 of the National Association for Research in Science Teachers, the Central Association of School Science, and Mathematics Teachers, and the National Association of Biology Teachers. Four percent were members of the American Association of Physics Teachers, an increase of two percent since 1960; three percent were members of the American Association for the Advancement of Science, an increase of one percent; three percent were members of the American Chemical Society, an increase of one percent; two percent were members of the Oregon Academy of Science, a decrease of two percent; and forty-seven percent were members of the Oregon Science Teachers Association, an increase of 25 percent. Seven percent were members of local science teachers associations, a decrease of 13 percent since 1960.

Table 68. Frequency distribution of the highest degree of participation by science teachers in professional organizations.

Organization	Frequency of highest degree of involvement					Percentage Involvement
	Pay dues	Attend meeting	Participate in program	Committee Work	Past or present officer	
National Education Association	107	13	6	6	1	71
Oregon Education Association	72	26	10	17	9	71
National Science Teachers Association	26	29	13	5	0	39
National Association for Research in Science Teaching	1	0	1	0	0	1
Central Association of School Science and Mathematics Teachers	2	0	0	0	0	1
National Association of Biology Teachers	16	0	0	0	0	9
American Association of Physics Teachers	2	4	1	1	0	4
American Association for the Advancement of Science	5	1	0	0	0	3
American Chemical Society	5	0	1	0	0	3
American Institute of Biological Science	3	0	0	0	0	2
Oregon Academy of Science	1	1	2	0	0	2
Oregon Science Teachers Association	28	37	14	3	7	47

Table 68. Continued

Organization	Frequency of highest degree of involvement					Percentage Involvement
	Pay dues	Attend meeting	Participate in program	Committee Work	Past or present officer	
Astronomical League	0	1	1	0	0	1
Local Science Teachers Association	2	2	2	3	5	7
American Nature Society	0	0	0	0	0	0
American Federation of Teachers	1	1	2	1	2	4
Others	35					19
No reply (26)						14

Nineteen percent of the science teachers indicated involvement in organizations other than those listed. For more specific information concerning those organizations and the number of respondents, see Appendix W.

Statistical Treatment of the Data for SSSQ-I

Multiple regression analysis of the dependent variable - teachers overall success of the school science program

A multiple regression model was calculated using the dependent variable of the teacher's opinion of the overall success of the school science program with the following list of independent variables:

a. the years of experience teaching secondary school science
b. the number of preparation periods
c. the degree with which the administration encouraged and provided the opportunity for science teachers to attend professional meetings and workshops related to science education
d. the frequency with which natural materials were brought into the classroom for science study

The independent variables which were related at the 0.05 level of significance with the teacher's opinion of the overall success of the school science program were c and a. The results showed that in schools where teachers judged the overall success of the school science program to be high, there was the likelihood that the administration encouraged and provided the opportunity for science teachers to attend professional meetings and workshops related to science education and that the teachers had relatively few years of teaching experience in secondary school science.

The regression model for the above analysis was:

$$Y = 2.152 + 23.147(c) - 11.810(a)$$

Summary

In summary, the results from SSSQ-I showed that the following conditions existed in secondary school science in Oregon during the 1973-74 school year:

1. The majority of science teachers had one preparation period per day.
2. There was little formal articulation between the elementary science programs and the secondary science programs.
3. That secondary science teachers were generally less familiar with selected learning psychologists than were elementary teachers.
4. There was a marked improvement in the science facilities available to teachers in 1960.
5. That 65 percent of the teachers judged the science program to be above average.
6. The majority of classroom instruction was devoted to processes of science and factual information.
7. That the current practice used most widely was to place greater emphasis on student laboratory work and less on teacher demonstration.
8. That the laboratory procedure most commonly used was to group pupils in pairs.

9. The most commonly used method for scheduling laboratory work was regular single periods.

10. The professional organizations which science teachers were most likely to participate in were the: National Education Association, Oregon Education Association, Oregon Science Teachers Association, and National Science Teachers Association.

Section 3 - Secondary School Science - II

This section contains the second half of the status information for secondary school science teachers. It originally was a part of SSSQ-I, however the researcher decided to divide the information into two separate questionnaires, thus initiating SSSQ-II.

Of the total of 185 questionnaires returned, 87 percent were males and 13 percent were females. This proportion is in agreement with Cummins (1960 p. 46) figures of 85 percent males and 15 percent females compared to the proportion of 92 percent males and eight percent females reported for SSSQ-I. However, there still appears to be a slight increase in the ratio of males to females for secondary science teachers in Oregon.

The grade levels taught by the respondents are shown in Table 69. The grades most frequently represented by this questionnaire (SSSQ-II), were 9-12.

When asked to indicate the minimum number of yearly science courses required for graduation or for movement to another school, the responses ranged from zero to four (see Table 70).

Table 69. Frequency distribution showing the grade levels represented by the respondents to SSSQ-II.

Grades taught in building	Frequency
7	63
8	66
9	121
10	123
11	116
12	116

Table 70. Frequency distribution of the number of yearly science courses required for graduation or for movement to another school.

Minimum number of science courses	Frequency	Percentage
0	7	4
1/2	3	2
1	99	53
2	57	31
3	13	7
4	3	2
5	0	0
6	0	0
No reply	3	2

The total years of experience teaching secondary school science is shown in Table 71. Similarly to Table 41, there appears to be a normal distribution of years of experience in teaching science.

Two questions were asked concerning the articulation between different schools. The first question asked, "Is there any formal articulation between the elementary science program and the secondary science program?". Table 72 reveals that 22 percent

Table 71. Frequency distribution of total years of experience teaching secondary school science.

Years of experience	Frequency	Percentage
one	3	2
2-3	21	11
4-9	68	37
10-15	57	31
16-25	27	15
26 or more	8	4
No reply	1	< 1

Table 72. Frequency distribution of responses to the question "Is there any formal articulation between the elementary school and secondary school science programs?"

Response	Frequency	Percentage
Yes	40	22
No	141	76
No reply	4	2

of the secondary teachers said yes while 76 percent reported no. Science programs, properly designed and developed, should reveal articulation beginning in the kindergarten through grade twelve according to the literature. Oregon appears to be remiss in this category.

The second question that was asked was "Is there any formal articulation between the junior high science program and the senior high science program?". Table 73 shows that 41 percent of the teachers reported in the affirmative. Several reasons could account

Table 73. Frequency distribution of responses to the question "Is there any formal articulation between the junior high science program and the senior high science program?".

Response	Frequency	Percentage
Yes	75	41
No	105	57
No reply	5	3

for this difference. In some instances close proximity of the junior high to the senior high school might enhance formal articulation. Also the fact that the junior and senior high teachers have a common bond, namely science, could enhance formal articulation. Finally junior high science teachers may find that because students are beginning to take an interest in one of the sciences, they are encouraged to communicate with the senior high science teachers about a a student's progress.

Appendix X contains the explanations of both questions regarding articulation between elementary school and secondary school and between junior high science and senior high science.

The science teachers were asked to "Indicate how your science curriculum was selected?". Table 74 shows that the most common procedure was to allow the entire science staff to make the selection. Comparing these results with those of the elementary teachers from Table 14, page 63, it is evident that similarities exist and that the group decision is most prevalent in both elementary and secondary

Table 74. Frequency distribution of how secondary science teachers indicated the science curriculum was selected.

Selection method	Frequency
Building principal	16
Curriculum specialist	16
Department chairman	30
Consultant	2
Board of Education	11
Entire science staff	98
Committee of science teachers	43
Some other committee	12
Other	25
No reply	3

schools, whether the group consists of elementary teachers or secondary science teachers.

Appendix Y contains the responses to the categories "some other committee" and "other". The responses were quite varied and generally spin-offs from the stated categories.

Table 75 shows the secondary science teacher's degree of familiarity with certain selected contemporary psychologists. The results are very similar to the results of Table 58 page 107 which supports the validity of the sampling procedure for the survey.

Ninety-four percent of the science teachers reported some post-baccalaureate training in science or science education. This compares exactly with the results of SSSQ-I. Table 76 gives a summary of the various kinds of post-baccalaureate training. These results are relatively close to those in Table 54. The range of variation is

Table 75. Frequency distribution of degree of familiarity with various selected contemporary psychologists.

Psychologists	Familiar		Slightly Familiar		Unfamiliar	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Jean Piaget	44	24	39	21	102	55
Jerome Bruner	28	15	30	16	127	69
C. T. Frank	1	1	7	4	177	96
Carl Rogers	35	19	33	18	117	63
William Glasser	51	28	59	32	75	41
Robert Gagne	10	5	14	8	161	87
B. F. Skinner	87	47	37	20	61	33
Abraham Maslow	29	16	37	20	119	64

Table 76. Frequency distribution of the type of post-baccalaureate training for secondary science teachers - SSSQ-II.

Type of training	Frequency	Percentage
University courses	155	84
Workshop	95	51
In-service	106	57
NSF Academic Year Institute	35	19
NSF Summer Institute	88	48
Other*	15	8
No reply	0	0

* "Other" responses:
- M. S. degree (7)
- Summer employment
- NSF night course
- NSF quarter institute
- NSFIS
- Extension course
- Camp Arago
- Relating with kids
- Curriculum development

is from one to nine percent.

When asked to indicate which experience they felt was best, 33 percent agreed that NSF Summer Institutes were the best. This compares with 27 percent of the respondents in SSSQ-I. Table 77 shows the distribution of responses along with the results from Table 54 for comparison.

A similar question, but more specific, asked the science teachers if they had had any special training to help in the teaching of such programs as BSCS, PSSC, ESCP, etc. Table 78 shows that 55 percent of them had received such training in one form or another. This value compares very closely with 52 percent receiving such

Table 77. Frequency distribution of the best type of post-baccalaureate training for secondary science teachers - SSSQ-II.

Best type of experience	Frequency	Percentage based on 174 responses	Percentages from Table 54
University courses	38	22	13
Workshop	13	7	8
In-service	7	4	2
NSF Academic Year Institute	24	13	16
NSF Summer Institute	58	33	27
Other	5	3	1
No reply	25	14	33

Table 78. Frequency distribution of the science teachers who had received special training to teach such courses as BSCS, PSSC, ESCP, etc. - SSSQ-II.

Response	Frequency	Percentage
Yes	102	55
No	78	42
No reply	5	3

training in SSSQ-I.

Of the 55 percent who indicated they had received special training, Table 79 reveals the distribution of responses for the different kinds of training. University courses were the most popular way to receive training in such courses as BSCS, PSSC, ESCP, etc. Those responding to the other category can be found in Appendix Z. Those comments focused on specific programs. In addition, the percentage figures were quite similar to those for Table 59, the same

Table 79. Frequency distribution of the source of training for specific science courses like BSCS, PSSC, ESCP, etc. - SSSQ-II.

Source of training	Frequency	Percentage based on 102 yes responses from Table 78	Percentages from Table 58
University courses	65	64	56
In-service	24	24	26
Division of Continuing Education	12	12	14
Workshops	26	25	32
Other	18	18	20
No reply	0	0	0

question in SSSQ-I. The only difference was the relative percentages for those selecting university courses and workshops.

Secondary science teachers were asked to "List and briefly describe those activities that students are doing in the area of ecological concerns.". The responses were quite varied, so for ease of handling the data, the researcher recorded the numbers of different kinds of activities which were listed. Table 80 shows that the teaching of ecological concepts appeared to be in a transitory stage of development. Twenty percent of the teachers had listed six different kinds of activities while 15 percent listed a unit or special course was offered.

The science teachers were asked to estimate the relative percentages of their teaching time devoted to process skills, values, social aspects, and factual knowledge. Classmeans were calculated

Table 80. Frequency distribution of the number of ecologically related activities conducted by the secondary science teacher.

Number of activities	Frequency	Percentage
0	3	2
1	25	14
2	32	17
3	13	7
4	8	4
5	3	2
6	36	19
A unit	14	8
A course	7	4
A yearly course	3	2
Integrated with other subjects	1	1
Several courses	1	1
No reply	38	20

similarly to those found in table 59. The results in Table 81 indicate that teachers were primarily concerned with the teaching of process skills and factual knowledge.

Table 81. Classmeans for the relative percentages of time devoted to teaching process skills, values, social aspects, and factual knowledge - SSSQ-II.

Objectives of teaching	Classmeans
Process skills	1.84
Values	1.08
Social aspects	1.07
Factual knowledge	1.79

The question "Is provision made for students to use the science facilities beyond regularly scheduled class periods on a weekly basis" was asked. The results are found in Table 82. Fifty-nine percent of the science teachers allowed students to make use of the science facilities beyond regular classroom use. In other words, nearly 40 percent of the students in Oregon did not have access to science facilities in order to pursue personal interests in science.

Table 82. Frequency distribution of those teachers who allowed students to make use of science facilities beyond normal classroom use.

Response	Frequency	Percentage
Yes	109	59
No	75	41
No reply	1	< 1

Table 83 reveals the results to the question, "Do provisions exist for ordering and receiving small amounts of chemicals and expendable materials during the school year, outside the regular budget?". Eighty-one percent indicated that they could. When asked if the procedure was easy and expedient, 65 percent said that it was. Similar figures exist also for the elementary teachers.

Table 83. Frequency distribution of the responses to the question, "Do provisions exist for ordering and receiving small amounts of chemicals and expendable materials during the school year, outside the regular budget?".

Response	Frequency	Percentage
Yes	150	81
No	33	18
No reply	2	1

When asked if classroom quantities of laboratory materials were available for students, 79 percent of the teachers indicated that they had sufficient materials. Cummins (1960 p. 111) had discovered that 36 percent of the teachers said that materials were adequate. The researcher concludes that individual school districts have allotted more funds for the purchase of laboratory equipment during the last thirteen years. The data does not indicate where the funds are from, however the assumption can be made that some of the materials resulted from federal sources.

Table 84 lists the number of teachers reporting the use of various textbooks and the ratings which were given in terms of meeting pupil needs. The majority of textbooks were rated good, indicating that teachers were generally satisfied with the textbooks in current use.

Table 85 reveals the extent to which science teachers reported making provisions for problem-solving abilities in their respective classes. Cummins (1960 p. 165) asked the same question and had found that general science teachers were the least concerned with problem solving abilities. Currently teachers are, in general, more concerned with problem solving abilities than they were in 1960. The data in Table 85 indicates that earth science teachers were less concerned with problem solving abilities than were other teachers. The percentages listed in Table 85 are figured on the total number of

Table 84. Frequency distribution of textbooks used by secondary science teachers and their comparative ratings.

Name of textbook	Number of teachers using text	Excellent	Good	Fair	Poor
General Science					
Modern Science, Blanc Series	8		6	2	
Interaction of Man and the Biosphere	5	2	3		
Interaction of Matter and Energy	4	1	2	1	
Life: Its Forms and Changes	3		3		
Man and His Environment	2			2	
New Directions in Science	1				1
Science - Key to Future	1				1
Modern Science, Holt	1		1		
The World of Matter and Energy	1		1		
Atom and Earth	1			1	
Biology - Patterns in Environment	1			1	
Environmental Crisis	1	1			
Biology					
BSCS Green Version	14	5	8	1	
Modern Biology (Otto, Towle)	13	2	8	3	
BSCS Yellow Version	9	5	2	2	
Biology	6	2	2	2	
Patterns and Processes	5	2	2	1	
An Inquiry Into The Nature of Life	3		2		
The Earth: Its Living Things	2		1	1	
Biology: Inquiry Introduction	1			1	
Molecule and Biosphere	1		1		
Basic Life Science	1			1	
Life Science	1			1	

Table 84. Continued.

Name of textbook	Number of teachers using text	Excellent	Good	Fair	Poor
Biology					
Modern Biology - World of Living Things					
Modern Biology	1			1	
Chemistry					
Modern Chemistry	8	2	6		
Chemistry: Experimental Foundations	8	1	5	1	1
Chemistry: A Modern Approach	4	1	3		
CHEM Study	4	2	1	1	
Chemistry: Experiments and Principles	3		2	1	
CHEMS	3	1	2		
Chemistry - An Investigative Approach	1	1			
Living Chemistry	1	1			
Chemistry	1		1		
Chemistry for Changing Times	1	1			
IAC (Harper & Row)	1	1			
Physics					
Project Physics	12	2	9	1	
PSSC	10	3	4	2	1
Modern Physics	8	4	3	1	
Physics (Genzar & Younger)	2		2		
Concepts in Physics	2		1	1	
Physics (Miller & Dillon)	1			1	
Earth Science					
Modern Earth Science	4	1	2	1	
ESCP	4	1	2	1	
Earth Science	3		3		

Table 84. Continued.

Name of textbook	Number of teachers using text	Excellent	Good	Fair	Poor
Earth Science					
Earth Science: The World We Live In	3		1	2	
Investigating the Earth (AGI)	2	1	1		
Focus on Earth Science	2		1	1	
The Earth: Its Changing Forms	2		1		1
Earth and Space Science (Hibbs & Eiss)	1		1		
Spaceship Earth	1		1		
Crusty Problems	1		1		
Earth and Space Science	1		1		

teachers as follows:

48 - General Science
79 - Biology
43 - Chemistry
36 - Physics
38 - Earth Science
20 - Physical Science
7 - Intermediate Science Curriculum Study (ISCS)

The extent to which science teachers made provisions for the pupils in their classes who were rapid learners is indicated in Table 86. The most commonly used method of providing for rapid learners was individual encouragement and personal guidance which was reported by 71 percent of the science teachers. Sixty percent

Table 85. Frequency distribution of teachers who made provisions for teaching problem-solving abilities in secondary schools.

Problem Solving Abilities	Gen Sci		Biol		Chem		Phy		Earth Sci		Phy Sci		ISCS	
	Yes	%	Yes	%	Yes	%	Yes	%	Yes	%	Yes	%	Yes	%
Identifying and stating assumptions	44	92	72	91	42	98	35	97	33	87	20	100	6	86
Defining problems	43	90	77	97	42	98	35	97	29	76	18	90	5	72
Setting up controlled experiments	42	88	76	96	40	93	31	86	29	76	18	90	7	100
Interpreting evidence	46	96	77	97	41	95	34	94	36	95	20	100	7	100
Making applications of generalizations	41	85	71	90	41	95	36	100	33	87	20	100	5	72
Formulating conclusions and generalizations from evidence	45	94	74	94	41	95	34	94	35	92	20	100	5	72
Proposing and testing hypotheses	42	88	75	95	40	93	32	89	29	76	18	90	5	72

Table 86. Frequency distribution of the teachers who made provisions for teaching the rapid learner in secondary schools.

Provisions for rapid learners	Often		Sometimes		Seldom		Never		No reply	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Encourage students to compete for superior scholarship awards	23	12	64	35	56	30	32	17	10	5
Individual encouragement and personal guidance	131	71	45	24	3	2	0	0	6	3
Participation in science fairs with projects	11	6	10	5	71	38	84	45	9	5
Encourage study of the applications of science and mathematics	76	41	81	44	16	9	4	2	8	4
Encourage student self-evaluation	85	46	63	34	21	11	8	4	8	4
Encourage pupil to set up special experiments and deminstrations	53	29	85	46	36	19	5	3	6	3
Provide opportunities to work as laboratory assistant	80	43	66	36	23	12	11	6	5	3
Provide opportunity for enrichment with advanced study	44	24	92	50	35	19	6	3	8	4
Encourage students to make aids to instruction	33	18	67	36	63	34	14	8	8	4
Provide special science seminars	9	5	23	12	48	26	99	54	6	3
Encourage enrichment through advanced reading	57	31	81	44	34	18	7	4	6	3
Work experiences off campus in the area of science	19	10	37	20	50	27	67	36	12	6
Encourage each pupil to work at his own rate but require the student to continue regular class work	111	60	48	26	15	8	2	1	9	5

of the science teachers reported that they encouraged each pupil to work at his own rate but required the pupil to continue regular class work. The three areas, (a) encourage student self-evaluation, (b) encourage study of the applications of science and mathematics and (c) provide opportunities to work as a laboratory assistant were nearly equally popular in their use. The least popular method listed on the questionnaire was the provision of special science seminars, as 54 percent of the science teachers reported that they did not use this method. Forty-five percent of the science teachers reported that they did not encourage rapid learners to participate in science fairs with projects. Cummins (1960 p. 172) reported similar results except for one item, providing opportunities to work as a laboratory assistant. He reported that 32 percent of the science teachers did not provide opportunities to work as laboratory assistants. The researcher found that currently only five percent do not provide for that opportunity.

Table 87 is a listing of some of the more common periodicals in various areas of science and the extent to which the science teacher reported reading them. National Geographic was read thoroughly by 38 percent of the science teachers. Science News, National Wildlife, Scientific American, and The Science Teacher were reported as being read thoroughly by approximately 20 percent of the science teachers. Scientific American, National Geographic, Science Digest,

Table 87. Frequency distribution of the science related periodicals read by science teachers.

Periodicals	Read thoroughly		Read about one article per issue		Do not read	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
American Biology Teacher	23	12	29	16	133	72
Journal of Chemical Education	3	2	17	9	165	89
School Science and Mathematics	2	1	13	7	170	92
Science Education	9	5	30	16	146	79
School Science Review	0	0	6	3	179	97
Science and Children	4	2	14	8	167	90
The Science Teacher	32	17	64	35	89	48
Earth Science	6	3	13	7	166	90
National Geographic	71	38	68	37	46	25
Science	12	6	61	33	112	61
Science News	49	26	53	29	83	45
National Wildlife	42	23	45	24	98	53
Physics Today	4	2	12	6	169	91
Science Digest	27	15	68	37	90	49
Popular Mechanics	16	9	51	28	118	64
Scientific American	37	20	98	53	50	27
Science World	36	19	35	19	114	62
Journal of Research in Science Teaching	0	0	4	2	181	98
Chemistry	24	13	11	6	150	81
Physics Teacher	6	3	18	10	161	87
Environmental Education	4	2	15	8	166	90

The Science Teacher and Science News were the five periodicals in which science teachers most reported reading about one article per issue. The reader should be cautioned about the low percentages of science teachers reported reading such journals as Physics Today, Chemistry, Physics Teacher, etc. These journals are written for science teachers in specific fields of science, rather than for all science teachers in general. Therefore, relatively low percentages might in reality indicate a high percentage of chemistry teachers reading a journal such as Chemistry. Other journals which were reported to be read in total or in part by science teachers can be found listed in Appendix AA.

When asked the question, "Would you describe your evaluation of students as being individualized or group evaluated?", 50 percent of the science teachers reported a combination of the two methods. Table 88 shows that 12 percent reported that whole class or group evaluations were being employed. Compared with elementary teachers on the same question, 49 percent of the elementary teachers reported a combination of both methods.

A second question concerning evaluation was asked - "Is any provision made for evaluating the total science program in your school or district?". Table 89 reveals that 45 percent of the science teachers reported that such provision existed. Fifty percent of the science teachers reported that no such provisions existed. In the researcher's

Table 88. Frequency distribution of the type of evaluation process used to measure children's learning in science - SSSQ-II.

Type of evaluation of students	Frequency	Percentage
Individualized	62	33
Group	22	12
A combination of the above	92	50
None of the above	2	1
No reply	7	4

Table 89. Frequency distribution of responses to the question, "Is any provision made for evaluating the total science program in your school or district?".

Response	Frequency	Percentage
Yes	84	45
No	93	50
No reply	8	4

opinion this is an area which definitely needs to be examined more thoroughly.

When asked to briefly describe the procedure for making such an evaluation, the science teachers responses were quite varied (see Appendix BB for their individual responses).

Table 90 gives the results of how the science teachers described the overall success of the science program in their school. Sixty-four percent of the science teachers described their program as being very successful or successful. Only two percent rated their science program as being poor. One interesting note of comparison can be

Table 90. Frequency distribution of the science teachers ratings of the overall success of the science program.

Degree of success	Frequency	Percentage
Extremely successful	13	7
Successful	105	57
Average	49	26
Fair	6	3
Poor	3	2
No reply	8	4

made between the 45 percent who reported that provisions did exist for evaluating the total science program and the 64 percent who described their science program as being successful or very successful. The researcher would like to raise the question of what criteria was used to rate the overall success of the science program.

Statistical Treatment of the Data for SSSQ-II

Multiple regression analysis of the dependent variable - teacher's opinion of the success of the school science program

A multiple regression model was calculated using the dependent variable of the teacher's opinion of the overall success of the school science program with the following list of independent variables:

a. the years of experience teaching secondary school science
b. the degree which teachers encouraged students to compete for superior scholarship work
c. the degree which teachers provided individual encouragement and personal guidance

d. the degree which the teachers encouraged participation in science fairs
e. the degree which teachers encouraged the study of applications of science and mathematics
f. the degree which teachers encouraged each pupil to work at his own rate but required the student to continue regular class work
g. the degree which teachers encouraged student self-evaluation
h. the degree which teachers encouraged the pupil to set up special experiments and demonstrations
i. the degree which teachers provided the opportunities for students to work as laboratory assistants
j. the degree which teachers provided opportunity for enrichment with advanced study
k. the degree which teachers encouraged students to make aids to instruction
l. the degree which teachers provided special science seminars
m. the degree which teachers encouraged enrichment through advanced reading
n. the degree which teachers encouraged work experiences off campus in the area of science
o. the extent to which the science teacher read the periodical, The Science Teacher

The independent variables which were related at the 0.05 level of significance with the teacher's opinion of the overall success of the school science program were a and n. The results showed that in schools where teachers judged the overall success of the school science program to be high, there was the likelihood that the teachers had relatively few years of teaching experience in secondary school science and that the teachers encouraged work experiences for students off campus in the area of science.

The regression model for the above analysis was:

$$Y = 2.452 - 14.434(a) + 12.750(n)$$

Summary

In summary, the results from SSSQ-II showed that the following conditions existed in secondary school science in Oregon during the 1973-74 school year:

1. The majority of science curricula was selected by an entire science staff.
2. Less than half the senior high schools had formal articulation with the junior high schools regarding their respective science programs.
3. Over 90 percent of the teachers had some post-baccalaureate training in science or science education.
4. Slightly more than half of the secondary students have access to the science facilities beyond regularly scheduled periods on a weekly basis.
5. The majority of the science teachers rated their textbooks as good or excellent.
6. Earth science teachers were less concerned with teaching problem solving abilities than were other science teachers.
7. The most commonly used method of providing for rapid learners was individual encouragement and personal guidance.
8. National Geographic, Science News, National Wildlife, Scientific American, and The Science Teacher were the most frequently read science-related journals by secondary science teachers.
9. The majority of the science teachers described their science program as being very successful or successful.
10. Teachers who had relatively few years of teaching experience were likely to judge the overall success of the school science program as high.

Part B - Needs Opinion of Science Education

Introduction

Part A of this chapter described the current status of science education in grades K-12 in Oregon Public Schools. Information was obtained from both elementary teachers and secondary science teachers. Part B of this chapter reports data obtained from five different populations concerning what they believe should be taking place in science education in grades K-16. The five populations from which information was gathered were: elementary teachers, secondary science teachers, secondary students, PTA officers and OSU scientists. Each sample will be treated separately in the first five sections. Section six will compare the five populations on identical questions which were asked the various groups.

Section 1 - Elementary Teacher Questionnaire - II

Of the 255 questionnaires which were returned, 22 percent were from males and 78 percent were from females. Table 91 reveals the age distribution of the elementary teachers reported in this section. Fifty-seven percent of the teachers were under forty years of age. Nineteen percent were over fifty years of age.

Table 91. Frequency distribution of the ages of the elementary teachers ETQ-II.

Age	Frequency	Percentage
21-30 years	80	31
31-40	66	26
41-50	60	24
51-60	40	16
61-70	9	3

The elementary teachers were asked "Indicate your number of years of teaching experience at the elementary level (K-8), counting this year.". Table 92 shows that approximately 50 percent of the teachers reported having less than nine years of teaching experience. The table shows that there was a normal distribution of years of elementary teaching experience reported.

Table 92. Frequency distribution of elementary (K-8) teaching experience including the current year, 1973 - ETQ-II.

Teaching experience	Frequency	Percentage
one year	4	2
2-3	31	12
4-9	95	37
10-15	58	23
16-25	45	18
> 25	22	9

The elementary teacher was asked to state the average minutes spent per week on science instruction. Table 93 was constructed at 30 min/week intervals. The modal interval was 61-90

Table 93. Frequency distribution of average time spent teaching science in minutes per week by elementary teachers.

Science Class Time	Frequency	Percentage
0 min/week	14	5
1-30	22	9
31-60	44	17
61-90	60	24
91-120	38	15
121-150	15	6
151-180	18	7
> 180	25	10
No reply	19	7

min/week.

The teachers were asked to indicate which phrase best described their elementary school. The majority of elementary teachers indicated that the self-contained classroom was still the predominate organization for instruction. Table 94 does not include percentages due to the fact that some teachers checked more than one item.

Table 94. Frequency distribution of type of school organization for elementary schools - more than one item could be checked - ETQ-II.

Type of Elementary School	Frequency
Self-contained classroom	184
Departmentalized	15
Semi-departmentalized	39
Nongraded	18
Team teaching	23
Other	9

There was an even distribution of teachers at all grade levels represented in the sample with the exception of kindergarten which is not supported, or offered in many school districts, sixth, seventh and eighth grade teachers. Table 95 reveals the distribution of grade levels taught by elementary teachers on the ETQ-II. Again, percentages were not included in Table 95 because more than one item could be checked.

Table 95. Frequency distribution of grade levels taught by elementary teachers - ETQ-II.

Grades	Frequency
Kindergarten	3
First grade	44
Second grade	50
Third grade	40
Fourth grade	52
Fifth grade	50
Sixth grade	15
Seventh grade	16
Eighth grade	3

The elementary teachers were asked, "What is your feeling concerning the quality of science currently being taught in your school?". Table 96 shows that 75 percent reported that the quality of science in their school was average or above. Twenty percent described the quality as being either fair or poor, with only eight percent considering program quality as excellent.

Table 96. Frequency distribution of the elementary teachers' opinion of the quality of science instruction in their school.

Quality of Science	Frequency	Percentage
Excellent	20	8
Good	99	39
Average	71	28
Fair	42	16
Poor	10	4
No reply	13	5

As in Table 23 page 69 of ETQ-I, Table 98 shows that S-APA was the most frequently adopted elementary science program in Oregon. In fact the percentages for Tables 23 and 97 were very closely related. The percentages were based on the total sample size of 255 rather than on the total number of responses which were 350, due to the fact that many schools were using a combination of two or more programs.

Four questions were asked regarding elementary teachers' academic training in science education. The first question was "Do you feel that elementary teachers in general are adequately prepared to teach elementary school science?". Forty-nine percent said yes, 49 percent said no and two percent did not reply. Those who indicated that the training was inadequate were asked to state what changes they would recommend in order to improve the teacher's undergraduate preparation. Appendix CC lists the

Table 97. Frequency distribution of the type or types of science program being used in the teachers' building - ETQ-II.

Type of science program	Frequency	Percentage (Based on a sample of 255)
Science - A Process Approach (S-APA)	108	42
Elementary Science Study (ESS)	56	22
Science Curriculum Improvement Study (SCIS)	21	8
Textbook series (Publisher)*	73	29
Locally developed program	14	5
None	1	< 1
Other**	60	24
No reply	17	7

* Responses for textbook series:

Frequency	Response
18	Holt Rinehart & Winston
12	Harper & Row
10	Silver Burdett
5	McGraw-Hill
4	Brandewein
2	Scott Foresman
1	Allyn Bacon
1	Singer
1	Cambridge Work-A-Text
19	No reply

** Responses for those who checked "other":

Frequency	Response
24	Experiences in Science (EIS)
17	Teacher's Units
3	ISCS
3	Variety of things
2	Supplementary Science Kits
2	Student interest

teachers' individual responses to this question. The responses were quite varied, but the majority of elementary teachers were concerned basically with two areas: working with the "new" elementary science programs like ESS, SCIS, and S-APA and more practical science experiences that could be used in the elementary classroom. In spite of the fact that Maben (1971) reported that Oregon was highest of all the states in workshops and in-service training for teachers, it appears that teachers still consider the importance of additional training in the new science curricula.

The second question focused on the number of hours of science that were taken as a part of the teacher's undergraduate preparation. Table 98 shows that 10 percent of the elementary teachers reported between 0-6 term hours of academic training in science, while 35 percent had more than 18 term hours. Approximately 90 percent had at least a minimum of one year of science while approximately 60 percent had at least two years of science. Considering the reluctance with which pre-service elementary teachers take science courses, it is encouraging to see that 60 percent had a minimum of two years of science.

The third question asked the teachers to rate their pre-service training in general science, geology or earth science, biological science, physical science and science teaching methods. Table 99 shows the distribution of institutions from which the elementary

Table 98. Frequency distribution of the number of undergraduate term hours of science taken by elementary teachers.

Term hours	Frequency	Percentage
0-6	26	10
7-12	76	30
13-18	62	24
18	88	35
No reply	3	1

Table 99. Frequency distribution of the institutions of higher learning granting undergraduate degrees to Oregon elementary teachers.

Institution	Frequency	Percentage
Out of state	72	28
Oregon College of Education	39	15
University of Oregon	23	9
Southern Oregon College	21	8
Oregon State University	20	8
Portland State University	19	7
Eastern Oregon College	17	7
Lewis & Clark College	6	2
Mt. Angel College	2	1
Marylhurst College	2	1
University of Portland	2	1
Linfield College	1	< 1
Cascade College	1	< 1
No reply	30	12

teachers received their degrees. Twenty-eight percent of the teachers reported they had received their degrees from institutions of higher learning outside the state of Oregon. Oregon College of Education had the largest number of graduates from Oregon with 15 percent. The following institutions were grouped fairly closely with between seven and nine percent of the graduates: University of Oregon, Southern Oregon College, Oregon State University, Portland State University, and Eastern Oregon College. Table 100 gives the frequency distribution for the year the degree was granted. Seventy-five percent of the teachers had received their degrees since 1960.

Table 100. Frequency distribution of the year the elementary teachers received their undergraduate degree.

Year	Frequency	Percentage
1930-34	1	< 1
1935-39	1	< 1
1940-44	3	1
1945-49	10	4
1950-54	13	5
1955-59	32	13
1960-64	45	18
1965-69	66	26
1970-73	45	18
No reply	39	15

Table 101 shows that seventy-three percent of the elementary teachers reported that their training in the biological sciences was helpful to very helpful. Forty-seven percent of the elementary teachers reported that the science teaching methods course was helpful to very helpful. After the biological science course the rank order of degree of helpfulness of the science courses was as follows: general science, 62 percent; physical science, 58 percent;

Table 101. Frequency distribution of the degree to which certain selected undergraduate courses were described by elementary teachers as being helpful.

Undergraduate course	very helpful		moderately helpful		helpful		slightly helpful		not helpful		no reply	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
General science	43	17	45	18	69	27	31	12	6	2	61	24
Geology or Earth Science	44	17	41	16	48	19	35	14	18	7	69	27
Biological science	63	25	58	23	65	25	30	12	9	3	30	12
Physical science	50	20	42	16	57	22	32	13	20	8	54	21
Science teaching methods	36	14	34	13	50	20	58	23	45	18	32	12

and geology or earth science, 52 percent. From this evidence, the researcher concluded that greater emphasis should be placed on the quality of the undergraduate method course in elementary science. The inference should not be made that the other courses do not need improvement. When the reader examines the percentage of teachers checking the two columns of "very helpful" and "moderately helpful", the relative percentages ranged between 27 and 48 percent.

Appendix DD contains the teachers' responses to the second part of the question, namely "What should have been done in those classes that you feel could have been more helpful?". Generally the responses were similar to those in Appendix CC in that the teachers were concerned with practical applications of science for the classroom.

The fourth question was directed at obtaining information that might be useful for planning for in-service programs or for use in current teacher education programs. The question was "Indicate which kinds of additional training you feel would be most helpful to improve your ability as an elementary science teacher.". More than one item could be checked, therefore, the percentages were figured on a total of 255 rather than on the total of 368 responses. Table 102 shows that 42 percent of the teachers agreed that a supervised practicum in science would be most helpful, 39 percent indicated that strategies of teaching would be most helpful and eight percent of the teachers reported that training in learning psychologies such as Piaget, Bruner, Gagne, etc. would be helpful. The researcher concluded that in general, elementary teachers were more concerned with practical classroom ideas rather than with basic psychological theory.

Table 102. Frequency distribution of the kinds of training that would be most helpful to elementary teachers in improving their ability as an elementary science teacher.

Kind of training	Frequency	Percentage based on a sample size of 255
Supervised practicum in science	117	42
Strategies of teaching	100	39
Science courses	70	27
Classroom management	43	17
Other*	34	13
Learning psychologies, i.e. Piaget, Bruner, Gagne, etc.	21	8
No reply	13	5

* Other responses

Frequency	Response
5	In-service for new programs
4	Workshops
3	Adequate materials
3	Observation of other programs
3	None - more time
2	More training in experiments and demonstrations

Table 103 reports the frequency distribution of responses to the question, "Do you feel that the proper emphasis is being placed on the amount of science currently being taught in your school?". Sixty-eight percent of the elementary teachers felt that the proper emphasis was being placed on science. The 29 percent who indicated that the improper emphasis was being placed on science, gave their recommendations to improve the situation. Those responses can be found in Appendix EE. Generally the teachers were concerned with more or better equipment and materials and with the lack of time or a specialist to teach elementary school science.

Table 103. Frequency distribution of the responses to the question, "Do you feel that the proper emphasis is being placed on the amount of science currently being taught in your school?".

Response	Frequency	Percentage
Yes	174	68
No	74	29
No reply	7	3

Elementary teachers were asked their opinion on the following question: "Do you feel that the science taught in your elementary school is adequately contributing to the development of children for a role in modern society?". Table 104 shows that 28 percent of the elementary teachers checked "definitely". Sixty-nine percent checked "sometimes", "seldom", or "never".

Table 104. Frequency distribution of the elementary teachers' responses to the question, "Do you feel that the science taught in your elementary school is adequately contributing to the development of children for a role in modern society?".

Response	Frequency	Percentage
definitely	70	28
sometimes	158	62
seldom	18	7
never	1	< 1
no reply	8	3

Table 105 reveals the distribution of responses to the question, "Do you feel that elementary students should have some input as to what the contents of an elementary science course should be?". Seventy-five percent either agreed or strongly agreed that elementary students should have some input. Thirteen percent either disagreed or strongly disagreed. This raises a basic question of what or how much input should an elementary student give.

Table 105. Frequency distribution of the elementary teachers' response to the question, "Do you feel that elementary students should have some input as to what the contents of an elementary science course should be?".

Response	Frequency	Percentage
strongly agree	48	19
agree	143	56
no opinion	27	11
disagree	27	11
strongly disagree	6	2
no reply	4	2

In 1971, the National Science Teachers Association set forth a list of goals for science education. The elementary teachers were asked to rank five of the eight in their relative order of importance. The results were tabulated by assigning numerical points to the responses in the following manner:

1 was given 5 points
2 was given 4 points
3 was given 3 points
4 was given 2 points
5 was given 1 point

Table 106 lists the rank order of importance of the eight goals. The most important goal was "learning how to learn, how to attack new problems, how to acquire new knowledge". The next two goals in order of importance were, "building competence in basic skills" (496 points), and "learning to live harmoniously with the biosphere" (482 points). "Understanding concepts and generalizations" and "using rational processes" were also ranked fairly closely with 450 and 439 points respectively. The two goals of "developing vocational competence" and "developing intellectual competence" were reported as being the two least important goals.

It is the investigator's opinion that building competence in basic skills was rated high due to the fact that elementary teachers are very concerned with skill building in all areas of the elementary school curriculum.

numerical points to the responses in the following manner:

Table 106. Rank order of importance of NSTA goals for science education - ETQ-II.

NSTA goals for science education	Total Points
learning how to learn, how to attack new problems, how to acquire new knowledge	1031
building competence in basic skills	496
learning to live harmoniously with the biosphere	482
understanding concepts and generalizations	450
using rational processes	439
exploring values in new experiences	333
developing vocational competence	148
developing intellectual competence	142

The elementary teachers were asked to rate how well they thought their school was carrying out those goals. The three choices for rating were: good, average or poor. The mean score was then computed by ascribing a numerical score of (1) for good, a (2) for average, and a (3) for poor and dividing the total points by the number of teachers responding to the item. Table 107 shows that elementary teachers reported that "building competence in basic skills" was being achieved better than any other goal while "developing vocational competence" was being achieved the least of any other goal.

Table 108 shows the rank order of the five areas of greatest concern in science teaching for elementary teachers. The reader can refer to question number seventeen in Appendix C for the total listing of fifteen concerns. The results were tabulated by assigning numerical points to the responses in the following manner:

Table 107. Rank order of elementary teachers' perception of how well their school science program was achieving the NSTA goals for science education.

NSTA goals for science education	Mean score
building competence in basic skills	1.67
learning how to learn, how to attack new problems, how to acquire new knowledge	1.75
learning to live harmoniously with the biosphere	1.78
exploring values in new experiences	1.78
understanding concepts and generalizations	1.80
developing intellectual competence	1.82
using rational processes	1.86
developing vocational competence	2.17

Table 108. Rank order of importance of the five areas of greatest concern in science education for elementary teachers.

Concerns in science education	Total Points
1. Improving my ability to present scientific concepts in an interesting manner	663
2. Finding adequate preparation time for experiments and demonstrations	540
3. Acquiring and teaching new or modern concepts in science	419
4. Finding time for helping individual pupils	331
5. Knowing how to teach problem solving or scientific method	281

1 was given 5 points
2 was given 4 points
3 was given 3 points
4 was given 2 points
5 was given 1 point

The five areas of greatest concern were focused on teaching methodology, lack of preparation time, learning new concepts, individualizing instruction and problem solving. Essentially the teachers were saying that they were not adequately trained and did not have enough time to teach science.

The elementary teachers were asked the following question: "What is your feeling concerning the integration of science with other subject areas such as mathematics, social studies, reading, etc.?". Table 109 shows that 93 percent of the teachers reported that they were either favorable or highly favorable to the idea. This is a concept generally agreed upon by science educators but there is little evidence of it being done in classrooms. It requires cooperative curriculum design and development.

Table 109. Frequency distribution of the elementary teachers' opinion to integrate science with other subject areas.

Teachers' opinion	Frequency	Percentage
Highly favorable	107	42
Favorable	130	51
No opinion	6	2
Unfavorable	8	3
Highly unfavorable	2	1
No reply	2	1

The elementary teachers were asked to rank a list of five science-related concerns. The results were tabulated by weighting the responses as was done for Table 108. Table 110 indicates that environmental quality was the most important science-related concern of elementary school teachers. Family living was ranked second

Table 110. Rank order of importance of five selected science-related concerns of elementary teachers.

Science-related concerns	Total Points
1. Environmental quality	1006
2. Family living	887
3. Career education or preparation	734
4. Population control	664
5. Divine creation of the universe	406

in importance reflecting the recent emphasis in sex education in public schools.

When asked the question, "To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?", elementary teachers responded with a wide variety of answers. Table 111 shows that the modal value was "little conflict". Thirty-four percent agreed that there was either serious or moderate conflict between science and religion in their explanations of the origin of man.

Table 111. Frequency distribution of the responses by elementary teachers to the question: "To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?".

Degree of conflict	Frequency	Percentage
serious conflict	27	11
moderate conflict	60	23
little conflict	94	37
no conflict	66	26
no reply	8	3

Statistical treatment of the data in ETQ-II

Multiple regression analysis of the dependent variable - amount of class time devoted to science instruction

A multiple regression model was calculated using the dependent variable of the amount of class time per week devoted to science instruction with the following list of variables:

a. age of the teacher
b. the number of quarter hours of science taken in undergraduate school
c. the degree of helpfulness of the undergraduate general science courses
d. the degree of helpfulness of undergraduate geology or earth science courses
e. the degree of helpfulness of the undergraduate biological science courses
f. the degree of helpfulness of the undergraduate physical science courses
g. the degree of helpfulness of the undergraduate science teaching methods course
h. the teachers' feeling that the science taught in their school was adequately contributing to the development of children for a role in modern society
i. the teachers' feeling that elementary students should have some input as to what the contents of an elementary science course should be
j. the degree which teachers perceived a conflict between science and religion in their explanations of the origin of man.

There were no significant differences found in the regression model.

Multiple regression analysis of the dependent variable - teacher's opinion concerning the quality of elementary school science

A multiple regression model was calculated using the dependent variable of the teacher's opinion concerning the quality of science currently being taught in their schools with the following list of independent variables:

a. age of the teacher
b. the number of years of teaching experience
c. the amount of class time per week devoted to science instruction
d. the number of quarter hours of science taken in undergraduate school
e. the degree of helpfulness of the undergraduate general science courses
f. the degree of helpfulness of the undergraduate general science courses
f. the degree of helpfulness of the undergraduate geology or earth science courses
g. the degree of helpfulness of the undergraduate biological science courses
h. the degree of helpfulness of the undergraduate physical science courses
i. the degree of helpfulness of the undergraduate science methods courses

The independent variables which were related at the 0.05 level of significance with the dependent variable of the teacher's opinion concerning the quality of science currently being taught in their schools were b and f.

The results showed that the better the elementary teacher perceived the quality of science currently being taught in her school, the greater the likelihood that she was relatively inexperienced and

The results showed that the stronger the elementary teacher agreed with the suggestion that elementary students should have some input as to what the contents of an elementary science course should be, the greater the likelihood that the teacher was relatively young and that the teacher felt that science taught in her school was adequately contributing to the development of children for a role in modern society. The implication being that if new teachers can be convinced that science education is essential for the total growth of a child, the effect will be to allow children to have a say in their own growth.

The regression model for the above analysis was:

$$Y = 1.350 + 17.184(a) + 21.407(e)$$

Multiple regression analysis of the dependent variable - teacher's opinion of whether science was contributing to the development of children for a role in modern society

A multiple regression model was calculated using the dependent variable of the teacher's opinion that science taught in her school was adequately contributing to the development of children for a role in modern society with the following list of independent variables:

a. age of the teacher
b. the number of years of teaching experience
c. the amount of class time per week devoted to science instruction
d. the number of quarter hours of science taken in undergraduate school

The independent variable which was related at the 0.05 level of significance with the dependent variable of the teacher's opinion that science taught in her school was adequately contributing to the development of children for a role in modern society was the age of the teacher.

The results showed that relatively older teachers felt that science taught in their school was adequately contributing to the development of children for a role in modern society.

The regression model for the above analysis was:

$$Y = 1.970 - 691.89(a)$$

<u>Multiple regression analysis of the dependent variable - degree to which teachers perceived a conflict between science and religion in their explanations of the origin of man</u>

A multiple regression model was calculated using the dependent variable of the degree which teachers perceived a conflict between science and religion in their explanations of the origin of man with the following list of independent variables:

a. age of the teacher
b. the number of years of teaching experience
c. the teachers' feeling concerning the quality of science currently being taught in their schools
d. the number of quarter hours of science taken in undergraduate school
e. the teachers' feeling that the science taught in their school was adequately contributing to the development of children for a role in modern society.

There were no significant differences found in the regression model.

Analysis of variance comparing the amount of instructional class time for S-APA, ESS and SCIS

An analysis of variance was calculated to determine if there was any significant difference between the three science curriculum improvement projects - S-APA, ESS and SCIS, and the amount of class time per week devoted to science instruction.

Table 112 shows the classmeans comparing the three science programs. An F value of 1.21 was calculated which indicated there was no significant difference at the 0.05 level for the three science programs.

Table 112. Comparisons of the classmeans of the amount of time per week devoted to science instruction for the three science curricula - S-APA, ESS and SCIS.

Science Curriculum Improvement Projects	Frequence	*Mean
S-APA	80	3.31
ESS	42	3.78
SCIS	21	3.71

* Note - Mean values are based on the following rating scale:
1 = 0 min/week
2 = 1-30
3 = 31-60
4 = 61-90
5 = 91-120
6 = 121-150
7 = 151-180
8 = > 180

Analysis of variance comparing the quality of the three science programs - S-APA, ESS and SCIS

An analysis of variance was calculated to determine if there was any significant difference between the three science curriculum improvement projects - S-APA, ESS, and SCIS and how the teachers felt about the quality of science which was being taught in their schools. Table 113 shows the classmeans comparing the three science programs. An F value of 5.36 was calculated which indicated there was a significant difference at the 0.05 level for the three science programs. Further examination revealed that there was a significant difference between S-APA and SCIS, between ESS and SCIS, but not between S-APA and ESS. The results showed that teachers felt the quality of their science program was better when SCIS was being used than when S-APA or ESS was in use.

Table 113. Comparisons of the classmeans of the teachers' opinion about the quality of science being taught in their schools for the three science curricula - S-APA, ESS and SCIS.

Science Curriculum Improvement Projects	Teachers' feeling about the quality of science in their schools	
	Frequency	*Mean
S-APA	90	2.84
ESS	45	2.55
SCIS	20	2.05

* Note - Mean values are based on the following rating scale:
1 - excellent   4 - fair
2 - good   5 - poor
3 - average

Analysis of variance comparing the undergraduate training of teachers for the three science programs - S-APA, ESS and SCIS

An analysis of variance was calculated to determine if there were any significant differences between the three science curriculum improvement projects - S-APA, ESS and SCIS, and the amount of undergraduate science preparation of elementary teachers. Table 114 shows the classmeans comparing the three science programs. An F value of 0.4719 was calculated which indicated that there was no significant difference in the teacher's undergraduate preparation in the sciences for the three science curricula.

Table 114. Comparisons of the classmeans of the number of quarter hours of science undergraduate preparation for the teachers who were teaching S-APA, ESS and SCIS.

Science Curriculum Improvement Projects	Quarter hours of undergraduate preparation in the sciences	
	Frequency	*Mean
S-APA	92	2.10
ESS	47	2.30
SCIS	21	1.95

* Note - Mean values are based on the following rating scale:

1 = 0-6 term hours
2 = 7-12
3 = 13-18
4 = >18

Analysis of variance comparing the teacher's opinion of whether science taught in their school was contributing to the development of children for a role in modern society with the three science programs - S-APA, ESS and SCIS

An analysis of variance was calculated to determine if there were any significant differences between the three science curriculum projects - S-APA, ESS and SCIS, and how the teachers felt that the science taught in their elementary school was contributing to the development of children for a role in modern society. Table 115 shows the classmeans comparing the science programs. An F value of 1.909 was calculated which indicated that there was no significant difference at the 0.05 level for the three science programs.

Table 115. Comparisons of the classmeans of how elementary teachers felt that the science taught in their elementary school was contributing to the development of children for a role in modern society.

Science Curriculum Improvement Projects	Teachers' opinion	
	Frequency	*Means
S-APA	93	1.83
ESS	49	1.92
SCIS	18	1.61

* Note - Mean values are based on the following rating scale:
1 = definitely
2 = sometimes
3 = seldom
4 = never

Analysis of variance comparing the teacher's opinion of whether students should have some input as to the contents of a science course for the three science programs - S-APA, ESS and SCIS

An analysis of variance was calculated to determine if there were any significant differences between the three science curriculum projects - S-APA, ESS and SCIS, and if the teachers felt that elementary students should have some input as to what the contents of the science course should be. Table 116 shows the classmeans comparing the three science programs. An F value of 0.809 was calculated which indicated that there was no significant difference between the three science programs and the teachers' opinion about having student input as to what the contents of the science course should be.

The investigator was puzzled with these results. S-APA is a very highly structured program demanding little or no student input. In comparison, ESS and SCIS are less structured and call for greater student input. Further investigation should be made in order to validate the above results.

Table 116. Comparisons of the classmeans of how teachers felt about allowing student input as to what the contents of the elementary science program should be.

	Student input	
Science Curriculum Improvement Projects	Frequency	*Means
S-APA	92	2.15
ESS	49	2.18
SCIS	21	2.14

* Note - Mean values are based on the following rating scale:
1 = strongly agree; 2 = agree; 3 = no opinion; 4 = disagree;
5 = strongly disagree

Summary

In summary, the results from ETQ-II showed that elementary teachers had the following opinions about science education:

1. Nearly 75 percent of the elementary teachers felt that the quality of science being taught in their school was average or above.

2. Approximately half the teachers felt that elementary teachers were adequately prepared to teach elementary school science.

3. Sixty-eight percent of the teachers felt that elementary school science was receiving the proper emphasis in their schools.

4. Ninety percent of the teachers felt that the science being taught in their school was adequately contributing to the development of children for a role in modern society.

5. Over 90 percent of the teachers were in favor of integrating science with other subject areas.

6. Environmental quality was the most important science-related concern of elementary teachers.

7. The teachers felt that the quality of their science program was better when SCIS was being used than when ESS or S-APA was in use.

8. Improving the teacher's ability to present scientific concepts in an interesting manner was selected as the greatest concern of elementary teachers.

9. "Learning how to learn, how to attack new problems, how to acquire new knowledge" was selected as the most important goal of science education by the elementary teachers.

10. If new teachers can be convinced that science education is essential for the total growth of a child, the effect will be to allow children to have a say in their own growth.

Section 2 - Secondary School Science Questionnaire - III

Of the 208 questionnaires which were returned, 86 percent were male and 14 percent were female. Table 117 gives the distribution of the ages of the secondary science teachers reporting. Sixty-three percent of the secondary science teachers were forty years of age or younger. Eleven percent were over fifty years of age. The modal age group was 31-40 years of age.

Table 117. Frequency distribution of the ages of the secondary science teachers - SSSQ-III.

Age	Frequency	Percentage
21-30	60	29
31-40	71	34
41-50	53	26
51-60	20	9
61-70	4	2

Table 118 gives the frequency distribution of the highest degree earned by secondary science teachers. It is interesting that 71 percent of the teachers had earned the master's degree which would place Oregon science teachers among the highest in the nation in academic preparation.

When asked to list the subject area of undergraduate preparation, the majority (51 percent) of the teachers received their training in biology. Table 119 lists the subject areas of undergraduate preparation with the percentages calculated on the sample size of 208 rather

Table 118. Frequency distribution of the highest degree earned by secondary science teachers.

Degree	Frequency	Percentage
Bachelor's	59	28
Master's	147	71
Doctorate	1	< 1
Other	1	< 1

Table 119. Frequency distribution of the areas of undergraduate preparation for secondary science teachers.

Subject area	Frequency	Percentage
Biology	106	51
Chemistry	46	22
General Science	62	30
Mathematics	34	16
Physical Science	33	16
Physics	22	11

than the total responses.

When asked the question, "Do you feel that secondary science teachers in general are adequately prepared to teach secondary school science?", 81 percent of the teachers agreed that their training was adequate while fifteen percent indicated that their training was inadequate. The results are not surprising due to the fact that 71 percent of the science teachers have the master's degree.

Secondary school science teachers were asked the question, "What is your feeling concerning the quality of science currently being taught in your school?" Table 120 shows that only five percent of the

Table 120. Frequency distribution of the responses to the question, "What is your feeling concerning the quality of science currently being taught in your school?".

Quality of science	Frequency	Percentage
Excellent	35	17
Good	124	60
Average	39	19
Fair	8	4
Poor	2	1

teachers reported that the quality was either fair or poor. The remainder of the teachers indicated that the quality of science was average or above. The results were what one might expect, due to the fact that teachers were essentially rating themselves.

In response to the question, "Do you feel that the proper emphasis is being placed on the amount of science currently being taught in your school?", 67 percent of the teachers thought that the proper emphasis was being placed on science, 32 percent disagreed. Those who disagreed were asked to make recommendations which would improve the situation. Those recommendations can be found in Appendix FF.

Seventy-four percent of the science teachers responded affirmatively to the question, "Do you feel that the science taught in your secondary school is adequately contributing to the development of young adults for a role in modern society?". Twenty-four percent felt that young adults were not adequately being prepared for a role in modern society. When asked what recommendations could be made to improve the situation, the teachers were quite varied in their responses. Appendix GG contains the list of those recommendations. The responses generally focused on more or less required subject matter along with very specific responses for a particular school.

The secondary science teachers were presented with sixteen items which could be checked if they believed that they would improve the science program in their school. More than one item could be checked, therefore each percentage figure was calculated on a sample size of 208. Table 121 gives the frequency distribution for the sixteen items. The six items which received the most responses, in decreasing order were: 1) more field trips; 2) guest appearances by persons employed in science-related fields; 3) more emphasis on concepts or ideas; 4) easier reading materials; 5) more laboratory materials; and 6) an elective system with mini-courses. Generally, science teachers were looking for ways to enrich their present courses. One item which called for an elaboration by the science teacher was - "more interesting science courses". Those responses can be found in Appendix HH. Examination should be given to improving the feasibility of providing field-trip experiences for students.

When asked "What is your feeling concerning the integration of science with other subject areas such as mathematics, social studies, vocational education etc.?", 74 percent of the science

Table 121. Frequency distribution of those items that science teachers felt would improve their science program.

Items	Frequency	Percentage based on sample size of 208
Fewer required science courses	20	10
More required science courses	39	19
More field trip experiences	124	60
Guest appearances by persons employed in science related fields	116	56
More science activities	70	34
Easier reading materials	77	37
More interesting science courses	61	29
More laboratory materials	73	35
An elective system with mini-courses	72	35
Longer class periods	55	26
Shorter class periods	14	7
Less emphasis on facts	29	14
More emphasis on facts	18	9
Less emphasis on concepts or ideas	2	1
More emphasis on concepts or ideas	76	37
More reading materials	37	18
No reply	8	4

teachers reported it to be favorable or highly favorable. This raises the question of how teachers can best be prepared to teach and develop curriculum materials for such a course. Fifteen percent reported that they were unfavorable or highly unfavorable to the idea of integrating science with other subject areas. Table 122 gives the frequency distribution for the individual items.

Table 122. Frequency distribution of the secondary science teachers opinion to integrate science with other subject areas. SSSQ-III.

Opinion	Frequency	Percentage
Highly favorable	68	33
Favorable	86	41
Unfavorable	28	13
Highly unfavorable	5	2
No opinion	20	10
No reply	1	< 1

A common complaint frequently heard among secondary science students is that the grading system in science is harder than in other areas. Therefore the researcher asked the secondary science teachers the following question: "What is your opinion of the "fairness" of the grading system in science classes compared with other subjects?". Table 123 shows that 72 percent of the science teachers reported the science grading system was fair and 17 percent indicated that it was the same as in other courses. Less than 10 percent reported that it was unfair compared with other subjects.

Table 123. Frequency distribution of the secondary science teachers opinion about the "fairness" of the grading system in science compared with other subject areas.

Opinion	Frequency	Percentage
Fair	149	72
Unfair	16	8
Same	36	17
No reply	7	3

The secondary science teachers were asked if they felt that ten credits of science should be equated with ten credits of business, music, art or physical education. Sixty-one percent reported that they should be equated and 35 percent indicated that they should not be equated. Those teachers who reported that it should not be equated explained their response. The explanations are found in Appendix II. Generally the teachers expressed concern that science was more demanding in time and effort.

Table 124 shows the distribution of responses to the question, "Do you feel that students should have some input as to what the contents of a science course should be?". Seventy-one percent either agreed or strongly agreed that students should have some input. Nineteen percent either disagreed or strongly disagreed.

Table 124. Frequency distribution of the secondary science teachers responses to the question, "Do you feel that students should have some input as to what the contents of a science course should be?".

Response	Frequency	Percentage
strongly agree	34	16
agree	115	55
no opinion	13	6
disagree	37	18
strongly disagree	3	1
no reply	6	3

Table 125 shows the rank order of five different kinds of additional training that would be most helpful in improving the competence of the secondary science teacher. The results were tabulated and the responses were assigned numerical values as follows:

1 was given 5 points
2 was given 4 points
3 was given 3 points
4 was given 2 points
5 was given 1 point

Strategies of teaching was expressed as the most desirable kind of additional training for secondary science teachers. Information about learning psychologies such as those of Piaget and Bruner were reported as being the least desirable kind of training.

Table 125. Rank order of importance of the kinds of additional training to imporve the secondary science teachers' competence - SSSQ-III.

Kind of training	Total Points
Strategies of teaching	559
Science courses	528
Advanced science methods	461
Classroom management	374
Learning psychologies; e.g., Piaget, Bruner, etc.	233
No reply	26

A second question concerning improving the competence of the science teacher was asked. This question focused on specific areas of science. Table 126 shows the frequency distribution of responses. The three areas which approximately 50 percent of the teachers expressed the greatest need for additional subject matter training were computer science, earth science and bio-chemistry. Earth science consisted of astronomy, geology and meteorology.

Table 126. Frequency distribution of subject matter areas which secondary science teachers expressed the greatest need for additional training in.

Science area	Frequency	Percentage
computer science	126	61
geology	103	50
bio-chemistry	102	49
astronomy	101	49
ecology	99	48
meteorology	89	43
botany	86	41
zoology	74	36
general physics	74	36
organic chemistry	73	35
nuclear physics	70	34
genetics	68	33
mathematics	66	32
nuclear chemistry	66	32
psychology	65	31
general chemistry	53	25
sociology	23	17
other	13	6
no reply	6	3

The secondary science teachers were asked to rank the list of NSTA goals for science education. The results were tabulated and assigned values as were for Table 125.

Table 127 lists the rank order of importance of the eight goals. The most important goal was "learning how to learn, how to acquire new knowledge". The next two goals, "learning to live harmoniously with the biosphere" and "building competence in basic skills" were ranked fairly closely with 418 and 406 points respectively. "Using rational processes" and "understanding concepts and generalizations" were also ranked fairly closely with 393 and 390 points respectively. The least important goal was reported as being "developing vocational competence".

Table 127. Rank order of importance of NSTA goals for science education - SSSQ-III.

NSTA goals for science education	Total Points
learning how to learn, how to attack new problems, how to acquire new knowledge	773
learning to live harmoniously with the biosphere	418
building competence in basic skills	406
using rational processes	393
understanding concepts and generalizations	390
developing intellectual competence	220
exploring values in new experiences	181
developing vocational competence	115

The secondary science teachers were asked to rate how well they thought the junior high school and senior high school were achieving those goals. The three choices for rating were: good, average or poor. The mean score was then computed by assigning a value of (1) for good, a (2) for average, and a (3) for poor and dividing the total points by the number of teachers responding to the item. Table 129 shows that secondary science teachers reported that "building competence in basic skills" was being met better in both the junior high and senior high schools than any other goal. "Developing vocational competence" and "learning to live harmoniously with the biosphere" were being met the least of all the goals. In addition, it can be seen from Table 128 that in every item except "exploring values in new experiences", the senior high school was reported as meeting those goals better than the junior high school.

Table 128. Secondary science teachers' perception of how well their school science program was achieving the NSTA goals for science education.

NSTA goals for science education	Mean Score	
	Junior High School	Senior High School
learning how to learn, how to attack new problems, how to acquire new knowledge	1.84	1.76
using rational processes	1.87	1.86
building competence in basic skills	1.81	1.71
developing intellectual competence	2.06	1.91
developing vocational competence	2.33	2.11
exploring values in new experiences	1.99	2.01
understanding concepts and generalizations	1.90	1.73
learning to live harmoniously with the biosphere	2.33	2.11

The secondary science teachers were asked to rank a list of five science-related concerns. The results were tabulated by assigning the responses the following numerical points:

1 was given 5 points
2 was given 4 points
3 was given 3 points
4 was given 2 points
5 was given 1 point

Table 129 shows that the greatest science-related concern was environmental quality and the least concern was divine creation of the universe.

Table 129. Rank order of importance of five selected science-related concerns of secondary science teachers.

Science-related concerns	Total Points
1. Environmental quality	832
2. Population control	684
3. Career education or preparation	610
4. Family living	584
5. Divine creation of the universe	508

Table 130 shows the rank order of the five areas of greatest concern in science teaching for secondary science teachers. The reader can refer to question number 18 in Appendix F for the total listing of 15 concerns. The results were tabulated by weighting the responses as were in Table 130. The five areas of greatest concern were focused on teaching method, preparation time, new concepts, individualized instruction and improving experiments.

Elementary teachers were also asked to respond to the same question as secondary teachers. Tables 109 and 131 show that both groups are concerned with improving their ability to present scientific

Table 130. Rank order of importance of the five areas of greatest concern in science education for secondary science teachers.

Concerns in science education	Total Points
1. Improving my ability to present scientific concepts in an interesting manner	286
2. Finding adequate preparation time for experiments and demonstrations	220
3. Improving laboratory experiments and demonstrations	199
4. Finding time for helping individual pupils	199
5. Acquiring and teaching new or modern concepts in science	146

concepts in an interesting manner, finding adequate preparation time for experiments and demonstrations and acquiring and teaching new or modern concepts in science.

The last question which was asked of secondary science teachers was "To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?". Table 131 shows that the modal value was "no conflict". Twenty-seven percent agreed that there was either serious or moderate conflict between science and religion in their explanations of the origin of man.

Table 131. Frequency distribution of the responses by secondary science teachers to the question: "To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?".

Degree of conflict	Frequency	Percentage
serious conflict	16	8
moderate conflict	40	19
little conflict	66	32
no conflict	81	39
no reply	4	2

Statistical treatment of the data for SSSQ-III

Multiple regression analysis of the dependent variable - teacher's opinion about the quality of science taught in their school

A multiple regression model was calculated using the dependent variable of the teacher's opinion concerning the quality of science taught in their schools with the following list of independent variables:

a. age of the teacher
b. the teachers' opinion concerning the integration of science with other subject areas such as mathematics, social studies, vocational education, etc.
c. the teachers' opinion about students having some input as to what the contents of a science course should be
d. the degree with which the teachers perceived any conflict between science and religion in their explanations of the origin of man.

The independent variables which were related at the 0.05 level of significance with the dependent variable of the teachers' opinion concerning the quality of science taught in their schools were a and c.

The results showed that younger teachers and teachers whose opinion was that students should have some input as to the contents of a science course should be were more likely to have the opinion that the quality of science taught in their schools was very good.

The regression model for the above analysis was:

$$Y = 2.38 - 16.60(a) + 492.42(c)$$

Summary

In summary, the results from SSSQ-III showed that secondary science teachers had the following opinions about science education:

1. The majority of science teachers had the opinion that the quality of their science program was above average.

2. Nearly three-quarters of the science teachers had the opinion that the science being taught in their school was adequately contributing to the development of young adults for a role in modern society.

3. The majority of science teachers had the opinion that science should be integrated with other subject areas.

4. Nearly three-quarters of the science teachers agreed that their grading system was fair.

5. Seventy-one percent of the science teachers agreed that students should have some input as to what the contents of a science course should be.

6. Strategies of teaching was ranked as the most important kind of additional training needed by science teachers.

7. "Learning how to learn, how to attack new problems, how to acquire new knowledge" was ranked as the most important NSTA goal of science education.

8. Environmental quality was ranked as the most important science-related concern of science teachers.

9. Computer science and earth science were the two science subject areas which science teachers desired additional improvement.

10. Improving the teachers' ability to present scientific concepts in an interesting manner was ranked as the greatest teaching concern of science teachers.

Section 3 - Student Questionnaire - SQ

Of the 287 questionnaires which were returned, 48 percent were from males and 52 percent were from females. Table 132 gives the distribution of the grade levels of the secondary students responding to the questionnaire. The majority (89 percent) of the students were in the eleventh and twelth grades. The instructions given to the social studies teachers indicated that students should be in grades 10-12. The results show that two percent of the students were in the ninth grade.

Table 132. Frequency distribution of the grades of the students responding to SQ.

Grade level	Frequency	Percentage
9	5	2
10	27	9
11	103	36
12	152	53

The composition of the students based on the type of academic program taken in high school is shown in Table 133. Thirty-eight percent of the students were preparing for college, 44 percent were in general studies and 13 percent were in vocational training.

Table 133. Frequency distribution of the type of academic program taken by the students responding to SQ.

Academic major	Frequency	Percentage
college prep	110	38
vocational	37	13
general	126	44
no reply	14	5

The students were asked to list the highest amount of formal education for both parents. Table 134 reveals that fathers had a greater variation of educational experience. Mothers had more terminal high school and junior college degrees than did the fathers. However, the overall educational background of the fathers is slightly greater than that of the mothers.

When the students were asked to rate their overall performance in science classes since grade seven, the majority rated themselves as a B or C student. How the students graded themselves in science is revealed in Table 135.

In order to obtain information concerning the types of science clubs and/or related extra-curricular activities that students were

Table 134. Frequency distribution of the educational background of the parents of the students responding to SQ.

Highest amount of parent's education	Parent			
	Mother		Father	
	Frequency	Percentage	Frequency	Percentage
grade school	4	1	11	4
junior high school	16	6	33	11
senior high school	166	58	120	42
junior college	56	20	49	17
bachelor's degree	27	9	37	13
master's degree	9	3	23	8
doctor's degree	0	0	2	1
no reply	9	3	12	4

Table 135. Frequency distribution of the student's self-reported performance in all science classes since grade seven.

Rating	Frequency	Percentage
A	39	14
B	129	45
C	97	34
D	18	6
E	1	< 1
no reply	3	1

participating in, the students were asked to list those activities that they were <u>currently</u> engaged in. Table 136 contains that list along with the number of students in that particular extra-curricular activity. If the assumption is made that the 144 who did not reply were not participating in a science-related extra-curricular activity, then less than ten percent of the students were pursuing an extra-curricular science-related activity.

Table 136. Frequency distribution of the students currently participating in a science club or related extra-curricular activity.

Science-related extra-curricular activity	Frequency
None	121
Laboratory assistant	5
Environmental education	2
OMSI (Oregon Museum of Science and Industry)	2
Lab work after school	1
CLAW (Clean land, air and water)	1
Candy striper	1
Aerospace club	1
Mushroom class at community college	1
Space science club	1
Outdoor junior counselor (soil science)	1
Medical explorer post	1
Science club	1
Regeneration of irrigation pond	1
Outdoor Life Club	1
Science club and planetarium	1
Photography	1
No reply	144

The students were asked to check if they had ever taken a specific NSF science course. In addition, they were asked to list any other course they had taken, e.g. photography, horticulture, etc. Table 137 shows that 72 percent of the students had taken BSCS, 52 percent had taken IPS and 40 percent had taken ISCS. Appendix JJ contains the responses to the "other" courses taken.

Table 137. Frequency distribution of the NSF courses taken by secondary students.

Science course	Frequency	Percentage
ISCS - Intermediate Science Curriculum Study	115	40
IPS - Introductory Physical Science	150	52
ESCP - Earth Science Curriculum Project	89	31
BSCS - Biological Science Curriculum Study	208	72
CHEM Study	81	28
PSSC - Physical Science Study Committee	22	8
HPP - Harvard Project Physics	4	1
Other	50	17
No reply	12	4

When asked if they would recommend any of the courses to a friend, 80 percent reported they would and 15 percent indicated they would not. Table 138 contains the frequency distribution of those who indicated they would recommend a science course to a friend. The percentages are based on the total number taking the course as indicated in Table 139. Seventy-five percent of the students who had taken HPP recommended it to a friend. The reader should be cautioned of the high percentage figure because of the low number of students who had taken HPP. Sixty-two percent of the students who had taken BSCS recommended it to a friend. ISCS was recommended less than the other courses with 29 percent recommending it to a friend.

Table 138. Frequency distribution of responses of high school student's recommendation of a selected science course to a friend.

Science course	Frequency	Percentage based on individual totals in Table 124
ISCS	33	29
IPS	66	44
ESCP	32	36
BSCS	130	62
CHEM Study	45	56
PSSC	8	36
HPP	3	75
No reply	9	3

The students were asked to respond to the question: "Do you feel that enough emphasis is placed on the importance of science by teachers, administrators and students in your school?". Fifty-nine percent indicated yes while 40 percent indicated no. An interesting observation is that during a time when enrollments were supposed to be down in science classes, 40 percent of the students reported that greater emphasis should be placed on science courses.

When asked the question, "What is your opinion concerning the science course offerings in your school?", 29 percent of the students requested the need for additional courses. Table 139 shows that 21 percent agreed that the courses were perfect for them and 48 percent had no opinion. Appendix KK contains the suggestions for new courses made by the 82 students who desired new courses.

Table 139. Frequency distribution of the student's responses concerning the science offerings in their school.

Response	Frequency	Percentage
No opinion	138	48
The perfect courses for me	59	21
Wish there were some new courses	82	29
No reply	9	3

The secondary students were presented with sixteen items which could be checked if they felt that they would improve the science program in their school. More than one item could be checked, therefore each percentage figure is calculated on a sample size of 287. Table 140 gives the frequency distribution for the sixteen items. The six items which received the most responses, in decreasing order were: 1) more field trip experiences; 2) guest appearances by persons employed in science-related fields; 3) an elective system with mini-courses; 4) more science activities; 5) more interesting science courses; and 6) more laboratory materials. Four of the six items were in agreement with the secondary science teachers' list of the six most important items. The two not included were more science activities and more interesting science courses. Comparing Tables 122 and 141, the reader will discover that the students and the science teachers are in near agreement with one another on the items which would improve the science program.

Table 140. Frequency distribution of those items that secondary students feel would improve the science program.

Items	Frequency	Percentage based on sample size of 287
Fewer required science courses	30	10
More required science courses	44	15
More field trip experiences	193	67
Guest appearances by persons employed in science related fields	133	46
More science activities	96	33
Easier reading materials	62	22
More interesting science courses	94	33
More laboratory materials	94	33
An elective system with mini-courses	104	36
Longer class periods	52	18
Shorter class periods	16	6
Less emphasis on facts	43	15
More emphasis on facts	42	15
Less emphasis on concepts or ideas	20	7
More emphasis on concepts or ideas	79	28
More reading materials	15	5
No reply	0	0

When asked "What is your feeling concerning the integration of science with other subject areas such as social studies, mathematics, humanities, vocational education, etc.?", 61 percent of the students reported it to be favorable or highly favorable. Sixteen percent reported that they were unfavorable or highly unfavorable to the idea of integrating science with other subject areas. Table 141 gives the frequency distribution for the individual items.

Table 141. Frequency distribution of the students' opinion to integrate science with other subject areas.

Response	Frequency	Percentage
Highly favorable	32	11
Favorable	143	50
Unfavorable	37	13
Highly unfavorable	10	3
No opinion	65	23
No reply	0	0

The question, "What is your opinion of the "fairness" of the grading system in science classes compared with other subjects?" was presented to the students. Table 142 shows that 57 percent of the students thought it was fair, 13 percent reported it to be unfair and 29 percent indicated that it was the same as other subject areas. The 13 percent who indicated that it was unfair were asked to comment on how to make it fair. Those comments can be found in Appendix LL.

Table 142. Frequency distribution of the students' opinion about the "fairness" of the grading system in science compared with other subject areas.

Opinion	Frequency	Percentage
Fair	165	57
Unfair	36	13
Same	83	29
No reply	3	1

Secondary science teachers were asked the same question about the fairness of grading in science classes. Comparisons show what one might anticipate, namely that a greater percentage of science teachers feel the grading system to be fair. In fact 15 percent more science teachers reported it to be fair than did the students. Likewise, five percent more students reported it to be unfair than did the secondary science teachers.

When asked the question, "Do you feel that ten credits of science should be considered equal to ten credits of business, music, art or physical education?", 70 percent of the students agreed that they should be equated. Twenty-nine percent indicated that they should not. Appendix MM contains their explanations for their response. Generally their comments centered on the idea that science is harder and requires more time, therefore additional credit should be given.

When the students were asked if they were planning on a career in a science-related field 31 percent indicated that they were. Sixty-three percent reported that they had no such plans. Appendix NN contains a listing of the types of careers that the students were planning to pursue.

The students were asked the question, "Have you received any instruction in your science classes related to career education in the field of science?". Sixteen percent reported that they did receive some type of instruction. Their descriptions of what kinds of career education instruction they received is found in Appendix OO.

Table 143 shows the distribution of responses to the question, "Do you feel that students should have some input as to what the contents of a science course should be?". Eighty-three percent either agreed or strongly agreed that students should have some input. Four percent either disagreed or strongly disagreed.

Table 143. Frequency distribution of the students' responses to the question, "Do you feel that students should have some input as to what the contents of a science course should be?".

Response	Frequency	Percentage
strongly agree	94	33
agree	143	50
no opinion	36	13
disagree	10	3
strongly disagree	2	1
no reply	2	1

The students were asked to rank a list of five science-related concerns. The results were tabulated by assigning the responses the following numerical points:

1 was given 5 points
2 was given 4 points
3 was given 3 points
4 was given 2 points
5 was given 1 point

Table 144 shows that the greatest science-related concern of the students was environmental quality and the least concern was divine creation of the universe.

Table 144. Rank order of importance of five selected science-related concerns of students.

Science-related concerns	Total Points
1. Environmental quality	1118
2. Population control	938
3. Career education or preparation	829
4. Family living	749
5. Divine creation of the universe	505

When asked the question, "Which one word best describes the degree to which you "like" science?", 48 percent of the students agreed that it was enjoyable. Table 145 shows that 10 percent thought it was exciting and 10 percent thought it was boring.

Table 145. Frequency distribution of the students' responses to the degree to which they enjoy science.

Response	Frequency	Percentage
exciting	30	10
enjoyable	137	48
tolerable	84	29
boring	29	10
no opinion	7	2
no reply	0	0

The students were asked the question, "To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?". Table 146 shows that the modal value was "moderate conflict". Eighteen percent agreed that there was no conflict between science and religion in their explanations of the origin

Table 146. Frequency distribution of the responses by students to the question, "To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?".

Response	Frequency	Percentage
serious conflict	82	29
moderate conflict	90	31
little conflict	60	21
no conflict	51	18
no reply	4	1

of man.

The students were asked to rank the list of NSTA goals for science education. The results were tabulated by weighting responses as they were for Table 143. Table 147 lists the rank order of importance of the eight goals. The most important goal was "learning how to learn, how to acquire new knowledge". The next important goal was "building competence in basic skills". The next three goals, "understanding concepts and generalizations", "developing intellectual competence" and exploring values in new experiences" were ranked fairly closely with 468, 465, and 416 points respectively. The least important goal was reported as being, "learning to live harmoniously with the biosphere".

The students were asked to rate how well they thought their school was carrying out the eight NSTA goals of science education. The three choices were: good, average, or poor. The mean score

Table 147. Rank order of importance of NSTA goals for science education - SQ.

NSTA goals for science education	Total Points
learning how to learn, how to attack new problems, how to acquire new knowledge	1074
building competence in basic skills	543
understanding concepts and generalizations	468
developing intellectual competence	465
exploring values in new experiences	416
developing vocational competence	377
using rational processes	363
learning to live harmoniously with the biosphere	300

was then computed by ascribing a one for good, a two for average, and a three for poor and dividing the total points by the number of students responding to the item. Table 148 shows that the students reported that "building competence in basic skills" was being achieved better than any other goal. "Developing vocational competence" and "exploring values in new experiences" were being achieved the least of all goals.

Table 148. Students' perception of how well their school science program is achieving the NSTA goals for science education.

NSTA goals for science education	Mean Score
learning how to learn, how to attack new problems, how to acquire new knowledge	1.88
using rational processes	1.88
building competence in basic skills	1.75
developing intellectual competence	1.94
developing vocational competence	2.03
exploring values in new experiences	2.08
understanding concepts and generalizations	1.88
learning to live harmoniously with the biosphere	2.11

Statistical Treatment of the Data for SQ

Multiple Regression Analysis of the Dependent Variable - Student's Opinion of How They Liked Science

A multiple regression model was calculated using the dependent variable of student's opinion of how they liked science with the following list of independent variables:

a. the students' self-assessment of their performance in science classes.
b. the students' opinion of the fairness of the grading system in science compared with other subjects
c. the students' opinion about having some input as to what the contents of a science course should be
d. the degree with which they perceived a conflict to exist between science and religion in their explanations of the origin of man.

The independent variables which were related at the 0.05 level of significance with the dependent variable of the students' opinion of how they liked science were a and b.

The results showed that students who liked science were likely to rate their performance high in science and stated that the grading system in science was as fair as other subjects.

The regression model for the above analysis was:

$$Y = 1.032 + 54.560(a) + 759.58(b)$$

Summary

In summary, the results from SQ showed that secondary students had the following opinions about science education:

1. The majority of the students felt that enough emphasis was placed on the importance of science by teachers, administrators and students in their school.

2. Less than one-fourth of the students agreed that the science course offerings were the perfect courses for their needs.

3. The students agreed that more field trip experiences and guest appearances by persons employed in science-related fields were the two best ways to improve their science program.

4. The majority of the students were favorable or highly favorable with the idea of integrating science with other subject areas.

5. The majority of the students agreed that the grading system in science was as fair as other subjects.

6. Eighty-three percent of the students agreed or strongly agreed that students should have some input as to what the contents of a science course should be.

7. Environmental quality was ranked as the most important science-related concern by the students.

8. The majority of the students described science as being either exciting or enjoyable.

9. Sixty percent of the students perceived either a serious or moderate conflict between science and religion in their explanations of the origin of man.

10. "Learning how to learn, how to attack new problems, how to acquire new knowledge" was ranked as the most important NSTA goal for science education.

Section 4 - PTA Questionnaire

Of the 225 questionnaires which were returned 16 percent were males and 84 percent were females. Table 149 gives the distribution of the ages of the PTA officers responding to the questionnaire. The majority of the officers were in the 31-40 age group. The researcher assumed that the reason for the majority of officers falling in this age group was due to the fact that the officers had children in school, thus the reason for belonging to the PTA.

Table 149. Frequency distribution of the ages of the PTA officers responding to PTAQ.

Age in years	Frequency	Percentage
20-30	46	20
31-40	123	55
41-50	48	21
51-60	8	4
61-70	0	0

Most PTA officers had two or three children in school. Table 150 shows that two percent did not have children in school. The modal value was two children.

When asked to indicate which office they currently held, 61 percent reported that they were the president of the organization. Table 151 gives the distribution of the other officers. One possible explanation for the disproportionate number of presidents compared

Table 150. Frequency distribution of the number of children that the PTA officers currently had in school.

Number of children	Frequency	Percentage
0	4	2
1	38	17
2	89	40
3	60	27
4	23	10
more than 4	10	4
no reply	1	<1

with the combined total of other officers was due to the fact that all the questionnaires had to pass through the hands of the president. It may have been that in some organizations, only the president received the questionnaire.

Table 151. Frequency distribution of the PTA office held by the respondents to PTAQ.

	Frequency	Percentage
President	138	61
Vice president	32	14
Secretary	18	8
Treasurer	21	9
Other	15	7
No reply	1	<1

The officers were asked to indicate the grades their children were currently enrolled in. Table 152 shows that the modal value was at the fourth grade. The results also showed that there was a greater likelihood to find a child of a PTA officer in grades two through seven. The importance of the PTA would appear to decrease in the junior and senior high schools.

Table 152. Frequency distribution of the grades of children of PTA officers.

Grade in school	Frequency	Grade in school	Frequency
Kindergarten	29	Seventh	50
First	35	Eighth	40
Second	53	Ninth	24
Third	56	Tenth	33
Fourth	69	Eleventh	29
Fifth	56	Twelfth	29
Sixth	51	No reply	2

The PTA officers were asked the question, "Do you feel that your children's schools are adequately contributing to the development of children for a role in modern society?". Table 153 indicates that PTA officers felt that elementary schools were preparing children better for a role in society than were either the junior high schools or the senior high schools. Eighty-four percent agreed that elementary schools were adequately contributing to the development of children compared with 42 percent for junior high school and 36 percent for senior high school. Because of the relative high number of "no reply" responses, a second set of percentages were calculated. It appears that because PTA officers had relatively few children in the secondary schools, they were reluctant to comment about the secondary schools. When the "no reply" responses were omitted and the percentage figures were calculated based on the total of "yes" and "no" responses, the discrepancies between elementary and secondary schools were reduced considerably.

Table 153. Frequency distribution of the PTA officers' responses to the question, "Do you feel that your children's schools are adequately contributing to the development of children for a role in modern society?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
yes	189	84	88
no	25	11	22
no reply	11	5	
Junior high school			
yes	95	42	77
no	29	13	23
no reply	101	45	
Senior high school			
yes	82	36	69
no	36	16	31
no reply	107	48	

When asked the question, "Do you feel that your children's schools are educating children better today than compared to when you went to school?", the PTA officers generally agreed that their children were receiving a better education than they did when they were in school. Table 154 shows that 73 percent of the officers agreed that elementary schools were doing better as compared to 41 and 39 percent respectively for the junior high and senior high schools. Because of the relative high number of "no replies", a second set of percentages were calculated. When the "no replies" were omitted and the percentage figures were calculated based on the total of "yes" and "no" responses, the discrepancies between elementary and secondary schools were reduced considerably.

Table 154. Frequency distribution of the PTA officers' responses to the question, "Do you feel that your children's schools are educating children better today than compared to when you went to school?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
better	164	73	74
same	32	14	15
poorer	24	11	11
no reply	5	2	
Junior high school			
better	92	41	66
same	27	12	13
poorer	21	9	10
no reply	85	38	
Senior high school			
better	87	39	64
same	23	10	17
poorer	26	12	19
no reply	89	40	

The PTA officers were asked, "Do you feel that the science being taught in your children's schools is adequately contributing to the development of children for a role in modern society?". Table 155 shows that 73 percent of the officers agreed that the science being taught in the elementary schools was contributing to their child's development, while approximately 40 percent agreed that the secondary schools were contributing to their child's development. However, because of the relative high number of "no replies", a second set of percentages were calculated omitting the no replies and using the "yes" and "no" response total. By doing this the discrepancies between elementary and secondary schools were reduced considerably.

The question, "Do you feel that your children's schools are placing the proper emphasis on the amount of science current being taught?" was asked of the PTA officers. Table 156 shows that 67 percent of the officers agreed that the elementary schools were placing the proper emphasis on science while approximately 36 percent thought secondary schools were not. As in the three previous questions, because of the relative high number of "no replies", a second set of percentages were calculated by the previously mentioned method. Again the discrepancies between elementary and secondary schools were reduced considerably.

Table 155. Frequency distribution of the PTA officers' responses to the question, "Do you feel that the science being taught in your children's schools is adequately contributing to the development of children for a role in modern society?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
yes	164	73	77
no	48	21	23
no reply	13	6	
Junior high school			
yes	90	40	76
no	26	12	24
no reply	109	48	
Senior high school			
yes	92	41	81
no	22	10	19
no reply	111	49	

Table 156. Frequency distribution of the PTA officers' responses to the question, "Do you feel that your children's schools are placing the proper emphasis on the amount of science currently being taught?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
yes	151	67	73
no	57	25	27
no reply	17	8	
Junior high school			
yes	81	36	70
no	35	16	30
no reply	109	48	
Senior high school			
yes	83	37	73
no	31	14	27
no reply	111	49	

The next five tables (157-161) include two sets of percentage figures. The first is calculated on the raw data and the second is calculated on the total number of responses minus the "no replies".

The PTA officers were asked, "Do you feel that enough emphasis is placed on the importance of science by teachers, administrators, and students in your school district?". Using the percentage figures based on the omission of the "no replies", Table 157 shows that secondary schools are placing the proper importance on science to a greater extent than are elementary schools.

Table 157. Frequency distribution of the PTA officers' responses to the question, "Do you feel that enough emphasis is placed on the importance of science by teachers, administrators, and students in your school district?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
yes	142	63	66
no	72	32	34
no reply	11	5	
Junior high school			
yes	87	39	70
no	37	16	30
no reply	101	45	
Senior high school			
yes	86	38	72
no	34	15	28
no reply	105	47	

The question, "Do you feel that students should have some input as to what the contents of a science course should be?", was asked of the PTA officers. Table 158 shows a marked difference between the officers' opinion for the elementary and secondary schools. Using the percentage figures based on the omission of the "no replies" for the elementary school, 54 percent of the respondents either agreed or strongly agreed that students should have some input concerning the contents of a science course. For the junior high school, 72 percent either agreed or strongly agreed that students should have some input. For the senior high school 81 percent either agreed or strongly agreed that students should have some input. The apparent trend is that the higher the grade in school, the greater the student input concerning the contents of a science course should be.

The PTA officers were asked the question, "How would you compare the quality of science teaching today with that which you received when attending school?". Table 159 shows very little difference between the PTA officers' opinion for the elementary, junior high and senior high schools. Using the percentage figures based on the omission of the "no replies", 71 percent of the officers agreed that the quality of science teaching in the elementary school was better or much better than when they went to school. Seventy-five percent of the officers agreed that the quality of science teaching in the secondary schools was better or much better than when they went to school.

Table 158. Frequency distribution of the PTA officers' responses to the question, "Do you feel that students should have some input as to what the contents of a science course should be?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
strongly agree	33	15	15
agree	85	38	39
no opinion	32	14	15
disagree	58	26	27
strongly disagree	10	4	5
no reply	7	3	
Junior high school			
strongly agree	34	15	23
agree	72	32	49
no opinion	11	5	7
disagree	26	12	18
strongly disagree	4	2	3
no reply	78	35	
Senior high school			
strongly agree	52	23	36
agree	65	29	45
no opinion	10	4	7
disagree	15	7	10
strongly disagree	3	1	2
no reply	80	36	

Table 159. Frequency distribution of the PTA officers' responses to the question, "How would you compare the quality of science teaching today with that which you received when attending school?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
much better	89	40	40
better	70	31	31
the same	49	22	22
worse	14	6	6
much worse	0	0	0
no reply	3	1	
Junior high school			
much better	58	26	42
better	45	20	33
the same	24	11	18
worse	8	4	6
much worse	2	<1	1
no reply	88	39	
Senior high school			
much better	58	26	45
better	39	17	30
the same	24	11	18
worse	9	4	7
much worse	0	0	0
no reply	95	42	

Table 160 shows the responses by the PTA officers to the question, "Do you feel that teachers in general are adequately trained to teach science to children in the elementary school, junior high school, and senior high school?". Using the percentage figures based on the omission of the "no replies", PTA officers felt that senior high school science teachers were better trained to teach science than were junior high school science teachers or elementary school teachers.

Table 160. Frequency distribution of the PTA officers' responses to the question, "Do you feel that teachers in general are adequately trained to teach science to children in the elementary school, junior high school and the senior high school?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
yes	130	58	62
no	79	35	38
no reply	16	7	
Junior high school			
yes	109	48	81
no	25	11	19
no reply	91	40	
Senior high school			
yes	107	48	91
no	21	9	9
no reply	97	43	

The PTA officers were asked the question, "What is your opinion of the adequacy of the science facilities found in your local school district?". Using the percentage figures found in Table 161 based on the omission of the "no replies", PTA officers felt that the adequacy of the science facilities were better in the senior high school than in the junior high school than in the elementary school.

Table 161. Frequency distribution of the PTA officers' responses to the question, "What is your opinion of the adequacy of the science facilities found in your local school district?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
more than adequate	12	5	6
adequate	116	52	54
inadequate	75	33	35
no opinion	14	6	6
no reply	8	4	
Junior high school			
more than adequate	16	7	12
adequate	76	34	55
inadequate	33	15	24
no opinion	13	6	9
no reply	87	39	
Senior high school			
more than adequate	24	11	17
adequate	80	36	59
inadequate	13	6	10
no opinion	18	8	13
no reply	90	40	

Table 162 lists the rank order of importance of the eight NSTA goals for science education. The PTA officers ranked "learning how to learn, how to attack new problems, how to acquire new knowledge" as the most important goal in science education. The next four goals in order of importance were: "building competence in basic skills", "using rational processes", "understanding concepts and generalizations", and "learning to live harmoniously with the biosphere". The least important goal was reported as being "developing vocational competence".

Table 162. Rank order of importance of NSTA goals for science education - PTAQ.

NSTA goals for science education	Total Points
learning how to learn, how to attack new problems, how to acquire new knowledge	866
building competence in basic skills	413
using rational processes	367
understanding concepts and generalizations	320
learning to live harmoniously with the biosphere	280
exploring values in new experiences	236
developing intellectual competence	225
developing vocational competence	185

The PTA officers were asked to rate how well they thought the elementary, junior high, and senior high schools were achieving those goals. The three choices for rating were: good, average, or poor. The mean score was then computed by ascribing a (1) for good, a (2) for average, and a (3) for poor and dividing the total points by the number of teachers responding to the item. Table 163 shows that PTA officers reported that elementary schools were achieving the goal "exploring values in new experiences", the best of the eight goals. In their opinion the goal of "developing vocational competence" was being achieved the least of the eight goals.

At the junior high level, the PTA officers reported that the goal of "building competence in basic skills" was being achieved best of all the goals. "Using rational processes" and "developing vocational competence", were reported as being achieved the least of all the goals.

At the senior high level, the PTA officers agreed that the goals of "learning how to learn, how to attack new problems, how to acquire new knowledge", "exploring values in new experiences" and "building competence in basic skills" were being achieved the best of all the goals. Again, "developing vocational competence" was being achieved the least of all the goals.

Comparing the mean scores of the three types of schools, the reader finds that PTA officers agreed that secondary schools were achieving the NSTA goals for science education better than the elementary and junior high schools. Also, the elementary schools were achieving the goals better than the junior high schools. The researcher concluded that greater emphasis should be placed at the junior high level of instruction in order to improve the quality of science instruction.

Table 163. PTA officers' perception of how well their school science program was achieving the NSTA goals for science education.

NSTA goals for science education	Mean Score		
	Elementary school	Junior high school	Senior high school
learning how to learn, how to attack new problems, how to acquire new knowledge	1.70	1.88	1.65
using rational processes	1.92	2.08	1.81
building competence in basic skills	1.74	1.81	1.67
developing intellectual competence	1.89	1.91	1.77
developing vocational competence	2.02	2.02	1.93
exploring values in new experiences	1.60	1.93	1.66
understanding concepts and generalizations	1.82	1.94	1.73
learning to live harmoniously with the biosphere	1.80	1.94	1.79

When asked the question, "do you feel that ten credits of science should be equated with ten credits of business, music, art or physical education?" 68 percent of the PTA officers agreed that they should be equated. Twenty-four percent indicated that they should not. Appendix PP contains their explanations for their responses. The comments were generally quite varied.

The question, "What is your feeling concerning the integration of science with other subject areas such as social studies, mathematics, humanities, vocational education, etc." was asked of the PTA officers. Table 164 shows that 82 percent of the officers were either favorable or highly favorable to the idea of integrating science with other subject areas. Less than 10 percent were unfavorable or highly unfavorable.

Table 164. Frequency distribution of the PTA officers' opinion to integrate science with other subject areas.

Response	Frequency	Percentage
Highly favorable	87	39
Favorable	97	43
Unfavorable	16	7
Highly unfavorable	4	2
No opinion	17	8
No reply	4	2

The PTA officers were asked to rank a list of five science-related concerns. The results were tabulated by assigning numerical points to the responses in the following manner:

1 was given 5 points
2 was given 4 points
3 was given 3 points
4 was given 2 points
5 was given 1 point

Table 165 indicates that the greatest science-related concern of the PTA officers was family living and the least concern was divine creation of the universe.

The PTA officers were asked the question, "To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?". Table 167 shows that 18 percent

Table 165. Rank order of importance of five selected science-related concerns of PTA officers.

Science-related concerns	Total Points
1. Family living	965
2. Environmental quality	761
3. Career education or preparation	622
4. Population control	531
5. Divine creation of the universe	481

of the PTA officers agreed that there was serious conflict. Twenty-seven percent agreed that there was no conflict between science and religion in their explanations of the origin of man.

Table 166. Frequency distribution of the responses by PTA officers to the question, "To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?".

Degree of conflict	Frequency	Percentage
serious conflict	40	18
moderate conflict	61	27
little conflict	55	24
no conflict	61	27
no reply	8	4

Statistical Treatment of the Data for PTAQ

Multiple regression analysis of the dependent variable - PTA officer's opinion comparing the quality of science teaching in elementary schools today with that which they received while attending school

A multiple regression model was calculated using the dependent variable of the PTA officer's opinion comparing the quality of science teaching in elementary schools today with that which they received while attending school with the following list of independent variables:

a. age of the PTA officer
b. the PTA officers' opinion that elementary students should have some input as to what the contents of a science course should be
c. the PTA officers' opinion of the adequacy of the science facilities found in their elementary school
d. the PTA officers' opinion that elementary school science should be integrated with other subject areas
e. the PTA officers' perception of what degree science and religion conflict in their explanations of the origin of man.

The independent variables which were related at the 0.05 level of significance with the dependent variable of the PTA officers' opinion comparing the quality of science teaching in elementary schools today with that which they received while attending school were c and e. The results showed that PTA officers who felt that the quality of science teaching in elementary schools was better than when they attended school also agreed that the present elementary school science facilities were adequate and that there was little or no conflict between science and religion in their explanations of the origin of man.

The regression model for the above analysis was:

$$Y = 1.206 + 44.838(c) - 12.413(e)$$

Multiple regression analysis of the dependent variable - PTA officer's opinion comparing the quality of science teaching in junior high schools today with that which they received while attending school

A multiple regression model was calculated using the dependent variable of the PTA officer's opinion comparing the quality of science teaching in junior high schools today with that which they received while attending school with the following list of independent variables:

a. age of the PTA officer
b. the PTA officers' opinion that junior high students should have some input as to what the contents of a science course should be
c. the PTA officers' opinion of the adequacy of the science facilities found in the junior high school
d. the PTA officers' opinion that junior high school science should be integrated with other subject areas
e. the PTA officers' perception of what degree science and religion conflict in their explanations of the origin of man

The independent variables which were related at the 0.05 level of significance with the dependent variable of the PTA officers' opinion comparing the quality of science teaching in junior high schools today with that which they received while attending school were c and b. The results showed that PTA officers who felt that the quality of science teaching in junior high schools was better than when they attended school also agreed that the present junior high school science facilities were adequate and that junior high school students should not have any input as to what the contents of a science course should be.

The regression model for the above analysis was:

$$Y = 1.178 + 50.683(c) - 16.536(b)$$

Multiple regression analysis of the dependent variable - PTA officer's opinion comparing the quality of science teaching in senior high schools today with that which they received while attending school

A multiple regression model was calculated using the dependent variable of the PTA officers' opinion comparing the quality of science teaching in senior high schools today with that which they received while attending school with the following list of independent variables:

a. age of the PTA officers
b. the PTA officers' opinion that senior high students should have some input as to what the contents of a science course should be
c. the PTA officers' opinion of the adequacy of the science facilities found in the senior high school
d. the PTA officers' opinion that senior high school science should be integrated with other subject areas
e. the PTA officers' perception of what degree science and religion conflict in their explanations of the origin of man

The independent variable which was related at the 0.05 level of significance with the dependent variable of the PTA officers' opinion comparing the quality of science teaching in senior high schools today with that which they received while attending school was the independent variable of the adequacy of the science facilities found in the senior high school. The results showed that those PTA officers who felt that the quality of science teaching in the senior high school was better today than when they attended school also agreed that the senior high school science facilities were adequate or more than adequate.

The regression model for the above analysis was:

$$Y = 1.231 + 31.972(c)$$

Summary

In summary, the results from PTAQ showed that PTA officers had the following opinions about science education:

1. Over three-fourths of the PTA officers agreed that science being taught in their children's schools was adequately contributing to the development of children for a role in modern society.

2. The majority of the PTA officers agreed that the proper emphasis was being placed on the amount of science being taught in the public schools.

3. The majority of the PTA officers agreed that students should have more input as to the contents of a science course in senior high, than in junior high, than in elementary school.

4. Approximately 75 percent of the PTA officers agreed that the quality of science teaching today was better or much better than when they attended school.

5. PTA officers agreed that secondary science teachers are better trained to teach science than are elementary teachers.

6. The majority of PTA officers agreed that science facilities are adequate or more than adequate compared to when they attended school.

7. Eighty-two percent of the PTA officers agreed that science should be integrated with other subject areas.

8. Family living was ranked as the most important science-related concern of PTA officers.

9. The majority of PTA officers agreed thatthere was little or no

conflict between science and religion and their explanations of the origin of man.

10. "Learning how to learn, how to attack new problems, how to acquire new knowledge" was ranked as the most important NSTA goal of science education.

Section 5 - OSU Scientists' Questionnaire

Of the 204 questionnaires which were returned, 98 percent were males, one percent were females and one percent did not indicate. Table 167 gives the distribution of the ages of the OSU scientists responding to the questionnaire. The modal interval for the scientists was 41-50 years of age, or approximately ten years older than the PTA officers.

Table 167. Frequency distribution of the ages of the OSU scientists responding to the questionnaire.

Ages in years	Frequency	Percentage
20-30	9	4
31-40	64	31
41-50	74	36
51-60	47	23
61-70	9	4
no reply	1	< 1

The scientists were asked to list their academic specialties. The distribution of those responses can be found in Appendix QQ.

Table 168 shows that the modal value of number of children currently in school was one. This value was lower than the modal value for PTA officers. Thirty percent of the respondents did not answer the question. The researcher did not understand why there was a high number of "no replies" for that particular question.

Table 168. Frequency distribution of the number of children that the OSU scientists currently had in school.

Number of children	Frequency	Percentage
0	37	18
1	61	30
2	27	13
3	13	6
4	5	2
5 or more	0	0
no reply	61	30

The OSU scientists were asked the question, "Do you feel that public schools in Oregon are generally contributing to the development of children for a role in modern society?" Using the percentage figures based on the omission of the "no replies", Table 169 shows that OSU scientists support the idea that Oregon public schools are generally contributing to the development of children for a role in modern society. However, one interesting observation is that the percentage of OSU scientists supporting the idea that the senior high school is contributing to the development of children for a role in modern society is less than the percentages for the other three schools. The researcher hypothesized that the reason is that college instructors are many times disappointed with the high school preparation of freshman students and thus tend to cast the blame on the high schools. Another possibility could be due to the fact that the OSU scientists have a relatively high percentage of their children in the secondary schools and are more familiar with the educational programs at that level.

Table 169. Frequency distribution of the OSU scientists' responses to the question, "Do you feel that public schools in Oregon are generally contributing to the development of children for a role in modern society?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
yes	169	83	95
no	9	4	5
no reply	26	13	
Junior high school			
yes	147	72	91
no	14	7	9
no reply	43	21	
Senior high school			
yes	131	64	83
no	27	13	17
no reply	46	23	
Community college			
yes	113	55	91
no	11	5	9
no reply	80	39	

The OSU scientists were asked, "Do you feel that the science being taught in Oregon public schools is adequately contributing to the development of children for a role in modern society?". Using the percentage figures based on the omission of the "no replies", Table 170 shows that 83 percent of the OSU scientists agreed that the science being taught in the elementary schools was contributing to the development of children for a role in modern society. Seventy-four and sixty-six percent were the figures for the junior high and senior high schools respectively. As stated in the previous paragraph, the researcher's explanation for the lower percentages in the junior high and senior high might be because the college instructors are closer to those schools than the elementary schools.

Table 170. Frequency distribution of the OSU scientists' responses to the question, "Do you feel that the science being taught in Oregon public schools is adequately contributing to the development of children for a role in modern society?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
yes	141	69	83
no	29	14	17
no reply	34	17	
Junior high school			
yes	110	54	74
no	38	19	26
no reply	56	27	
Senior high school			
yes	97	48	66
no	50	25	34
no reply	57	28	

The question, "Do you feel that Oregon public schools are placing the proper emphasis on the amount of science currently being taught?", was asked of the OSU scientists. Using the percentage figures based on the omission of the "no replies", Table 171 shows that OSU scientists reported that elementary schools were placing the proper emphasis on science to a greater extent than were the secondary schools. Eighty percent of the OSU scientists claimed that the elementary schools were placing the proper emphasis, while 64 and 62 percent respectively claimed the junior high and senior high schools were placing the proper emphasis on science instruction.

Table 171. Frequency distribution of the OSU scientists' responses to the question, "Do you feel that Oregon public schools are placing the proper emphasis on the amount of science currently being taught?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
yes	132	65	80
no	33	16	20
no reply	39	19	
Junior high school			
yes	101	50	64
no	46	23	36
no reply	57	28	
Senior high school			
yes	93	46	62
no	57	28	38
no reply	54	26	

The OSU scientists were asked, "Do you feel that enough emphasis is placed on the importance of science by teachers, administrators, and students in Oregon public schools?". Using the percentage figures based on the omission of the "no replies", Table 172 shows that the OSU scientists reported that elementary schools were placing enough emphasis on science better than were the secondary schools. Eighty-two percent of the OSU scientists claimed that the elementary schools were placing enough emphasis on the importance of science by teachers, administrators, and students in Oregon public schools while 65 and 59 percent respectively claimed the junior high and senior high schools were placing enough emphasis on the importance of science.

Table 172. Frequency distribution of the OSU scientists' responses to the question, "Do you feel that enough emphasis is placed on the importance of science by teachers, administrators, and students in Oregon public schools?".

Responses	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
yes	142	70	82
no	32	16	18
no reply	30	15	
Junior high school			
yes	103	50	65
no	55	27	35
no reply	46	23	
Senior high school			
yes	89	44	59
no	63	31	41
no reply	52	25	

Table 173 shows the responses by the OSU scientists to the question, "Do you feel that teachers in general are adequately trained to teach science to children in the elementary school, junior high school and senior high school?". Using the percentage figures based on the omission of the "no replies", OSU scientists feel that elementary and junior high teachers are better trained to teach science than are senior high teachers.

Table 173. Frequency distribution of the OSU scientists' responses to the question, "Do you feel that teachers in general are adequately trained to teach science to children in the elementary school, junior high school and the senior high school?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
yes	116	57	65
no	62	30	35
no reply	26	13	
Junior high school			
yes	94	46	61
no	61	30	39
no reply	49	24	
Senior high school			
yes	80	39	52
no	74	36	48
no reply	50	25	

The question, "Do you agree that students should have some input as to what the contents of a science course should be in the elementary school, junior high school, and senior high school?", was asked of the OSU scientists. Table 174 shows a difference between the scientists' opinion for the elementary and secondary schools. Using the percentage figures based on the omission of the "no replies" for the elementary school, 22 percent of the respondents either agreed or strongly agreed that students should have some input concerning the contents of a science course. Thirty-four percent of the respondents either agreed or strongly agreed that junior high school students should have some input. Fifty-one percent of the scientists either agreed or strongly agreed that senior high students should have some input.

The OSU scientists were asked to "Compare the quality of science teaching in Oregon public schools today with that which you received when attending elementary school, junior high school and senior high school.". Table 175 shows that OSU scientists agreed that the quality of science teaching in the elementary schools today was 81 percent better or much better than when they attended school. The quality of science teaching was better in the elementary schools than in the secondary schools compared to when they attended school. Sixty-eight percent agreed that the quality of science teaching today was better or much better than when they attended junior high school and 56 percent agreed that it was better or much better than when they attended senior high school.

Table 174. Frequency distribution of the OSU scientists' responses to the question, "Do you agree that students should have some input as to what the contents of a science course should be in the elementary school, junior high school and the senior high school?".

Response	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
strongly agree	9	4	5
agree	33	16	17
no opinion	6	3	3
disagree	85	42	45
strongly disagree	56	27	30
no reply	15	7	
Junior high school			
strongly agree	7	3	4
agree	55	27	30
no opinion	10	5	5
disagree	76	37	41
strongly disagree	37	18	20
no reply	19	9	
Senior high school			
strongly agree	16	8	9
agree	79	39	42
no opinion	11	5	6
disagree	52	25	28
strongly disagree	29	14	15
no reply	17	8	

Table 175. Frequency distribution of the OSU scientists' responses to the statement, "Compare the quality of science teaching in Oregon public schools today with that which you received when attending elementary school, junior high school and senior high school.".

Responses	Frequency	Percentage	Percentage figured without the "no reply" responses
Elementary school			
much better	73	36	42
better	68	33	39
the same	23	11	13
worse	8	4	5
much worse	2	1	1
no reply	30	15	
Junior high school			
much better	52	25	33
better	56	27	35
the same	32	16	20
worse	14	7	9
much worse	4	2	3
no reply	46	23	
Senior high school			
much better	43	21	28
better	43	21	28
the same	35	17	23
worse	20	10	13
much worse	11	5	7
no reply	52	25	

The OSU scientists were asked to identify one major weakness in the science preparation of incoming freshmen. Table 176 shows that according to the OSU scientists, the two most common weaknesses of incoming freshmen were the "inability to identify and analyze a problem" and the "inability to use language to express ideas". It appears that according to OSU scientists, the public schools are not achieving two very important goals of science education. None of the OSU scientists selected "poor laboratory skills" as a major weakness.

Table 176. Frequency distribution of the one major weakness of incoming freshmen as identified by the OSU scientists.

Weakness	Frequency	Percentage
poor mathematical training	23	11
inability to think critically	27	13
inability to identify and analyze a problem	44	22
poor development of major concepts and principles in the sciences	21	10
poor laboratory skills	0	0
inability to use language to express ideas	47	23
other*	8	4
no reply	34	17

* other responses:

all of the above
poor background in plant science
don't question enough
their rigid attitude toward science
mental laziness
lack of concept of excellence

The OSU scientists were asked to check as many responses as appropriate to the question: "What kinds of academic training do you feel would best help improve the quality of secondary science teachers in Oregon?". Table 177 shows that 51 percent of the OSU scientists agreed that "more required science courses" would improve the quality of secondary science teachers in Oregon. It seems incongruous that OSU scientists would concur that secondary school science teachers needed more required science courses when 71 percent of the teachers have master's degrees. Thirty-four percent reported that "more mathematics courses" and "independent science related research projects" would improve the quality of secondary science teachers. The responses to the item "other" can be found in Appendix RR.

When asked to identify one single change that could be made at the university undergraduate level that would improve the scientific literacy of college students in general, the OSU scientists compiled a lengthy list of 85 different suggestions. Those suggestions can be found in Appendix SS.

Table 178 lists the rank order of importance of the eight NSTA goals for science education. The OSU scientists ranked "learning how to learn, how to attack new problems, how to acquire new knowledge" as the most important goal in science education. The next four most important goals in order of importance were; "understanding concepts and generalizations", "using rational processes",

Table 177. Frequency distribution of the kinds of academic training that OSU scientists felt would best help improve the quality of secondary science teachers in Oregon.

Kind of academic training	Frequency	Percentage based on total sample size of 204
more required science courses	105	51
more mathematics courses	70	34
independent science related research projects	70	34
science courses geared for science teachers as opposed to courses for science majors in a particular field	56	27
more laboratory courses	41	20
courses in the philosophy of science	38	19
more courses in educational strategies and techniques	16	8
courses focused on the proper use of scientific instruments	15	7
other	32	16
no reply	8	4

"building competence in basic skills", and "developing intellectual competence". The least important goal was reported as being "developing vocational competence".

The OSU scientists were asked to rate how well they thought the elementary, junior high and senior high schools were achieving those goals. The three choices for rating were good, average, or poor. The mean score was then computed by ascribing a one for good, a two for average and a three for poor and dividing the total points by the number of scientists responding to the item. Table 179 shows that OSU scientists reported that the goal of "learning to live harmoniously

Table 178. Rank order of importance of NSTA goals for science education - OSUSQ.

NSTA goals for science education	Total Points
learning how to learn, how to attack new problems, how to acquire new knowledge	691
understanding concepts and generalizations	429
using rational processes	417
building competence in basic skills	412
developing intellectual competence	408
learning to live harmoniously with the biosphere	141
exploring values in new experiences	96
developing vocational competence	75

with the biosphere" was being achieved best in the elementary, junior high and senior high schools. In their opinion, the goal of "developing vocational competence" was being achieved the least of the goals in the elementary and junior high schools and that the goal of "learning how to learn, how to attack new problems, how to acquire new knowledge" was being achieved least of the goals in the senior high schools.

Comparing the mean scores of the three types of schools, the reader finds that the OSU scientists agreed that generally elementary schools were achieving the NSTA goals for science education better than the junior and senior high schools. Also the junior high schools were achieving the goals better than were the senior high schools.

One conclusion which can be made from this data is that the greatest emphasis on science education should be placed at the senior high schools because they are doing the "poorest" job of achieving the

Table 179. OSU scientists' perception of how well the Oregon public schools were achieving the NSTA goals for science education.

NSTA goals for science education	Mean Score		
	Elementary school	Junior high school	Senior high school
learning how to learn, how to attack new problems, how to acquire new knowledge	1.85	1.99	2.14
using rational processes	1.96	2.02	2.12
building competence in basic skills	1.76	1.91	2.04
developing intellectual competence	1.74	2.00	2.08
developing vocational competence	2.04	2.02	1.96
exploring values in new experiences	1.69	1.82	1.93
understanding concepts and generalizations	1.92	2.00	2.10
learning to live harmoniously with the biosphere	1.64	1.69	1.75

NSTA goals.

The OSU scientists were asked to check as many responses as appropriate to the question: "What kinds of academic training do you feel would best help improve the quality of elementary teachers' ability to teach science to elementary children?". Table 180 shows that 44 percent of the OSU scientists agreed that "more required science courses" would imrpove the quality of elementary teachers' ability to teach science. Thirty-nine percent agreed that "science courses geared for elementary teachers as opposed to science courses for science majors" would improve the elementary teachers' ability to teach science. The responses to the item "other" can be found in

Table 180. Frequency distribution of the kinds of academic training that OSU scientists felt would best help improve the ability of elementary teachers to teach science.

Kinds of academic training	Frequency	Percentage based on total sample size of 204
more required science courses	90	44
science courses geared for elementary teachers as opposed to science courses for science majors	79	39
independent science related research projects	57	28
more mathematics courses	46	23
more laboratory courses	45	22
courses in elementary science education	36	18
more courses in educational strategies and techniques	25	12
courses focused around proper laboratory techniques	19	9
other	15	7
no reply	23	11

Appendix TT.

When asked the question, "Do you feel that ten credits of science should be equated with ten credits of business, music, art or physical education in Oregon public schools?" 48 percent of the OSU scientists agreed that they should be equated. Thirty-six percent indicated that they should not. Appendix UU contains the explanations for the no responses.

The OSU scientists were asked the question, "What is your response to the suggestion to integrate science with other subject areas such as social studies, mathematics, humanities, vocational education, etc. in Oregon public schools?". Table 181 shows that 48 percent of the OSU scientists were either unfavorable or highly unfavorable with the suggestion. Forty percent were either favorable or highly favorable.

Table 181. Frequency distribution of the OSU scientists' opinion to integrate science with other subject areas.

Response	Frequency	Percentage
Highly favorable	30	15
Favorable	52	25
Unfavorable	56	27
Highly unfavorable	43	21
No opinion	13	6
No reply	10	5

The OSU scientists were asked to rank a list of five selected science-related concerns. The results were tabulated by weighting the responses as were in Table 129. Table 182 shows that the greatest science-related concern of the OSU scientists was environmental quality. The second greatest concern was career education or preparation and the least concern was divine creation of the universe.

Table 182. Rank order of importance of five selected science-related concerns of OSU scientists.

Science-related concerns	Total Points
1. Environmental quality	700
2. Career education or preparation	619
3. Population control	610
4. Family living	442
5. Divine creation of the universe	203

When asked the question, "Do you perceive any conflict between science and religion in their explanations of the origin of man?", 44 percent of the OSU scientists agreed that there was no conflict. Table 183 shows that 35 percent reported that there was serious or moderate conflict between science and religion in their explanations of the origin of man.

Table 183. Frequency distribution of the responses by OSU scientists to the question, "Do you perceive any conflict between science and religion in their explanations of the origin of man?".

Degree of conflict	Frequency	Percentage
serious conflict	34	17
moderate conflict	30	15
little conflict	37	18
no conflict	90	44
no reply	13	6

Statistical Treatment of the Data for OSUSQ

Multiple regression analysis of the dependent variable - OSU scientist's opinion that elementary, junior high and senior high students should have some input as to what the contents of a science course should be

A multiple regression model was calculated using the dependent variable of the OSU scientists' opinion that elementary students should have some input as to what the contents of a science course should be with the following list of independent variables:

a. age of the OSU scientist
b. the OSU scientists' opinion about the quality of science teaching in Oregon elementary public schools compared with when they attended school
c. the OSU scientists' opinion that science should be integrated with other subject areas
d. the OSU scientists' perception of what degree science and religion conflict in their explanations of the origin of man

The independent variable which was related at the 0.05 level of significance with the dependent variable of the OSU scientists' opinion that elementary students should have some input as to what the contents of a science course should be was the OSU scientists' opinion that science should be integrated with other subject areas. The results showed that OSU scientists who agreed that the elementary students should have some input as to what the contents of a science course should be also agreed that science should be integrated with other subject areas.

The regression model for the above analysis was:

$$Y = 2.860 + 33.651(c)$$

A similar regression model with similar results was calculated for the junior high school. The same relationship existed. The results showed that OSU scientists who agreed that the junior high students should have some input as to what the contents of a science course should be also agreed that science should be integrated with other subject areas.

The regression model for the junior high school analysis was:

$$Y = 2.205 + 43.562(c)$$

A similar regression model with similar results was calculated for the senior high school. The same relationship existed with the addition of the independent variable of the OSU scientists' opinion about the quality of science teaching in Oregon senior high schools compared with when they attended school. The results showed that OSU scientists who agreed that secondary students should have some input as to what the contents of a science course should be also agreed that science should be integrated with other subject areas and that the quality of science teaching in the senior high schools was better than when they attended school.

The regression model for the senior high school analysis was:

$$Y = 1.446 + 38.343(c) + 21.064(b)$$

Summary

In summary, the results from OSUSQ showed that OSU scientists had the following opinions about science education:

1. The majority of OSU scientists agreed that Oregon public schools are placing the proper emphasis on science currently being taught.

2. Approximately three-fourths of the OSU scientists agreed that the science being taught in Oregon public schools was adequately contributing to the development of children for a role in modern scoeity.

3. The majority of OSU scientists agreed that teachers in general were adequately trained to teach science in Oregon public schools.

4. Less than half of the OSU scientists agreed that students should have some input as to what the contents of a science course should be.

5. The majority of OSU scientists agreed that the quality of science teaching today was better or much better than when they attended school.

6. Approximately one-half of the OSU scientists agreed that more required science courses would improve the quality of secondary science teachers in Oregon.

7. Less than half of the OSU scientists agreed that more required science courses would improve the quality of elementary school teachers' ability to teach elementary school science.

8. Environmental quality was ranked as the most important science-related concern by OSU scientists.

9. Sixty-two percent of the OSU scientists agreed that there was either little or no conflict between science and religion in their explanations of the origin of man.

10. "Learning how to learn, how to attack new problems, how to acquire new knowledge" was ranked as the most important NSTA goal of science education by OSU scientists.

Section 6 - Comparisons between selected items from questionnaires - ETQ-II, SSSQ-III, SQ, PTAQ and OSUSQ

This section contrasts and/or compares responses to certain selected questions which were asked of three or more sample groups used in the study. Chi-square was the statistic used to determine any significant differences between the samples. Comparisons of the rank order of selected questions were used where chi-square was inappropriate.

Chi-square was used to compare the responses made by secondary science teachers, PTA officers and OSU scientists to the question which asked if they felt that the science which was taught in the secondary schools was adequately contributing to the development of children for their role in modern society. The chi-square value was equal to 7.92 with two degrees of freedom. The results showed that there was a significant difference at the 0.025 level for the three groups. By comparing the expected frequencies with the observed frequencies, the results showed that secondary science teachers and PTA officers had a significantly more positive response to the question than did the scientists in the study. One possible explanation might be that the scientists feel that more science should be taught.

A comparison was made between the elementary teachers, PTA officers and OSU scientists on the question which asked if they felt the proper emphasis was being placed on science in the elementary school. A chi-square value of 9.215 with two degrees of freedom was calculated. The results were significant at the 0.01 level. By comparing the expected frequencies with the observed frequencies, the results showed that the OSU scientists had a significantly more positive response to the question.

A similar question was asked of the secondary science teachers, PTA officers and OSU scientists about the proper emphasis placed on science in the secondary schools. A chi-square value of 3.475 with two degrees of freedom was calculated. The results showed that secondary science teachers and PTA officers were significantly (0.25) more positive in their responses to the question. OSU scientists agreed that too little emphasis was placed on science at the secondary level. The researcher hypothesized that because OSU scientists were so closely associated with science, they felt more emphasis should be placed on science in secondary schools.

Chi-square was used to compare the responses of the elementary teachers, PTA officers and OSU scientists on the question which asked if they felt that elementary teachers were adequately prepared to teach elementary school science. A chi-square value of 12.150 with two degrees of freedom was calculated. The results showed that elementary teachers agreed that they were not as adequately prepared to teach science while the PTA officers and OSU scientists felt they were (significance level = 0.005).

A similar question was asked of the secondary school science teacher, PTA officers and OSU scientists about the adequacy of preparation of secondary school science teachers. A chi-square value of 56.304 with two degrees of freedom was calculated. The results showed that OSU scientists agreed that secondary school science teachers were not as adequately prepared as did the PTA officers and secondary school science teachers (significance level = 0.0005).

A comparison was made between the elementary teachers, PTA officers and OSU scientists on the question of allowing elementary students some input in the science program. A chi-square value of 207 with 8 degrees of freedom was calculated. The results showed that OSU scientists tended to agree less with the idea of allowing input into the science course by elementary students than did the elementary teachers and PTA officers (significance level = 0.0005).

A similar question was asked of the secondary school science teachers, PTA officers, secondary school students and OSU scientists about allowing secondary school students to provide input into what the contents of a science course should be. By comparing the observed frequencies with the expected frequencies, the results showed that secondary school students and PTA officers most strongly agreed with the idea of allowing student input into the contents of a science course (significance level = 0.0005).

Chi-square was used to compare the responses of the elementary school teachers, secondary school science teachers, secondary school students, PTA officers and OSU scientists on the question if science should be integrated with other subject areas. A chi-square value of 334 with 16 degrees of freedom was calculated. The results showed that elementary school teachers, secondary school teachers and PTA officers more strongly agreed that science should be integrated with other subject areas. Secondary school students tended to disagree more than the other samples (significance level = 0.0005).

Table 184 shows the rank order of importance of the NSTA goals as listed by the five samples - elementary school teachers, secondary school science teachers, secondary school students, PTA officers and OSU scientists. All five samples ranked "learning how to learn, how to attack new problems, how to acquire new knowledge" as the most important goal for science education. The mean ranking number is shown in order to give a composite ranking for the goals. By comparing those values, the reader can see that "developing vocational competence" is viewed as being the least important NSTA goal for science education.

Table 184. Comparison of the rank order of importance of the NSTA goals for science education for ETQ-II, SSSQ-III, SQ, PTAQ and OSUSQ.

NSTA goals	Elementary school teachers	Secondary school science teachers	Secondary school students	PTA officers	OSU scientists	Mean ranking number
learning how to learn, how to attack new problems, how to acquire new knowledge	1	1	1	1	1	1.0
using rational processes	5	4	7	3	3	4.5
building competence in basic skills	2	3	2	2	4	2.6
developing intellectual competence	8	6	4	7	5	6.0
developing vocational competence	7	8	6	8	8	7.4
exploring values in new experiences	6	7	5	6	7	6.2
understanding concepts and generalizations	4	5	3	4	2	3.6
learning to live harmoniously with the biosphere	3	2	8	5	6	4.8

As seen in Table 185, environmental quality is the most important science-related concern of the five samples. The PTA officers were the only group that ranked something other than environmental quality as the most important science-related concern. Divine creation of the universe was unanimously ranked as the least important science-related concern.

Table 185. Comparison of the rank order of importance of selected science-related concerns by the five samples - ETQ-II, SSSQ-III, SQ, PTAQ and OSUSQ.

Science-related concerns	Elementary school teachers	Secondary school science teachers	Secondary school students	PTA officers	OSU scientists	Mean ranking number
Population control	4	2	2	4	3	3.0
Environmental quality	1	1	1	2	1	1.2
Career education or preparation	3	3	3	3	2	2.8
Family living	2	4	4	1	4	3.0
Divine creation of the universe	5	5	5	5	5	5.0

Chi-square was used to compare the responses of the elementary school teachers, secondary school science teachers, secondary school students, PTA officers and OSU scientists on the question of what degree of conflict they felt science and religion had in their explanations of the origin of man. A chi-square value of 113 with twelve degrees of freedom was calculated. The results showed that there was a significant difference (0.0005 level) between the opinions of the secondary school science teachers and OSU scientists and the secondary school students, elementary school teachers, and PTA officers. The secondary school science teachers and OSU scientists agreed there was less conflict between science and religion in their explanations of the origin of man than did the other three groups. The researcher hypothesized that the more science education individuals had, the less likely they would view a conflict between science and religion in their explanations of man.

In summary, Section 6 contained comparisons between certain questions selected from the needs opinion questionnaires. Chapter V contains a summary, conclusions and recommendations based on the findings of Chapter IV.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

In this chapter the study is summarized, and conclusions and recommendations are made based on the findings. Due to the large number of variables reported in the study, no attempt is made in this chapter to reiterate the significant findings presented in the previous chapter. Only outcomes of the study which the investigator judged to be of educational or statistical significance will be discussed here. For greater detail on specific results, the reader is directed to examine the summaries found at the closing of each section of Chapter IV.

Summary

The major problem of the study was to obtain information about the status of science education and the opinions of five different populations concerning what should be taking place in science education in Oregon for grades K-12 during the 1973-74 school year.

The design of the study included a stratified random sample plan where schools were selected based on the area of the state and size of the individual schools. A total of eight samples were selected from five different populations: elementary school teachers, secondary school science teachers, secondary school students, PTA officers and

Oregon State University scientists. Two different samples were selected from elementary teachers to obtain information about the status and needs opinion of elementary school science education. Three different samples were selected from secondary school science teachers to obtain information about the status and needs opinion of secondary school science education. One sample each was selected from secondary school students, PTA officers and OSU scientists about the needs opinion of science education in Oregon. Complete randomization occurred.

Analysis of the data was conducted through standard computer programs. Descriptive statistics were used to measure frequency distribution and percentages. Multiple regression analysis, analysis of variance and chi-square were used to analyze individual items within and between the various questionnaires.

The following results were selected as being the most significant for science education in Oregon:

Elementary

1. No significant differences were found when comparing the method used to select an elementary school science program with the criterion variables of: amount of class time devoted to science instruction; the teacher's degree of satisfaction with the science program; and the teacher's perception of the degree that elementary school students enjoyed science. The results contradicted the commonly accepted belief that a program has a greater likelihood of success if the individual teachers have a vested interest in the program.

2. S-APA was the most commonly adopted elementary science program in Oregon. However when comparisons were made between S-APA, ESS and SCIS, S-APA was consistently viewed with less favor on a number of variables than was ESS and SCIS.

3. The results indicated that elementary school teachers did not read many articles in science-related journals such as Science and Children.

4. Most elementary teachers agreed that their undergraduate preparation in the sciences could have been more extensive. However when asked which kind of additional training they needed to improve their ability as an elementary school science teacher, their first choice was to have a practicum in science.

5. Ninety percent of the elementary school teachers were in favor of integrating science with other subject areas.

6. Family living was ranked as the most important science-related concern by the PTA officers.

7. Less than half of the OSU scientists suggested that elementary school teachers needed more required science courses in order to improve their ability to teach elementary school science.

Secondary

8. Heavy emphasis is placed on laboratory activities where students work in pairs in the secondary schools.

9. Nearly three-fourths of the secondary school science teachers in Oregon have a master's degree.

10. Lack of earth science preparation and laboratory emphasis in earth science classes is a major concern of Oregon secondary school science teachers.

11. The majority of secondary school science teachers agreed that science should be integrated with other subject areas.

12. Strategies of teaching was ranked by secondary science teachers as the most important kind of additional training needed by them to improve their science teaching.

13. The majority of the science teachers rated their textbooks as either good or excellent.

14. Participation in NSF institute programs was listed as the most beneficial post-baccalaureate type of training.

15. The majority of secondary school students agreed that enough emphasis was placed on the importance of science, but that the science courses were not the best courses for their needs.

16. Secondary school students listed more field trips and guest appearances by persons employed in science-related fields as the best ways to improve the present science courses.

17. Over three-fourths of the secondary school students agreed that they should have some input as to what the contents of a science course should be.

18. Sixty percent of the secondary school students agreed that there was either a serious or moderate conflict between science and religion in their explanations of the origin of man.

Combination of elementary and secondary

19. Little formal articulation took place between elementary schools and secondary schools in science education.

20. Secondary science teachers are generally less familiar with many contemporary psychologists than are elementary school teachers.

21. The majority of PTA officers and OSU scientists agreed that the quality of science education in Oregon public schools is better today than when they attended school.

22. PTA officers and OSU scientists agreed that the quality of science facilities is better than when they attended school.

23. The majority of OSU scientists agreed that elementary school and secondary school teachers were adequately trained to teach science.

24. Less than half the OSU scientists agreed that students should have some input as to what the contents of a science course should be.

25. "Learning how to learn, how to attack new problems, how to acquire new knowledge" was ranked as the most important NSTA goal of science education by all five samples.

Conclusions

The poet, philosopher, Kahlil Gibran (1972, p. 55), said, "Say not that you have found the answer, but that you have found an answer". The purpose of a study of this nature is to provide information which can be used in making intelligent decisions. It is not the purpose to provide the answers to the problems that confront the science education community. Hopefully the information will be used to improve the future status of science education in Oregon.

It appears that schools must consider the development of a philosophical foundation upon which they can develop a total K-12 science program. Teachers are generally not cognizant of any underlying philosophical basis for their science programs. Tradition has it that elementary children should have some encounter with science, junior high school students should have something associated with general science and senior high students should have the opportunity to take biology, chemistry or physics. Consideration must be given to the development of a sound philosophical foundation if schools are to avoid a potpourri science program.

The opinions focused on the preparation of elementary and secondary school teachers were somewhat varied. Previous studies in Oregon revealed that both elementary school teachers and secondary school science teachers were deficient in their academic science training. The fact that this study determined that the majority of elementary school teachers had two years of science training and 71 percent of the secondary science teachers had obtained a master's degree, indicates that additional science preparation will probably not significantly improve the quality of science teaching in Oregon. This is contrary to the opinion of the OSU scientists who claimed that more science training would improve the quality of secondary school science teaching. Based on the evidence of this study, elementary school teachers need additional training in psychological foundations and practical, or "how to do it" types of activities. Secondary school science teachers need additional training in psychological foundations and strategies of learning.

The elementary science curriculum in Oregon is atypical when compared with the nation as a whole. This was revealed in Maben's (1971) regional study which singled out the Far Western States as being among the nation's leaders in the use of the elementary science curricula. However, the present study indicated that both elementary school teachers and elementary school children (as perceived by the elementary school teacher) were not satisfied with one of the new programs - S-APA. The evidence implies that consideration should be given to an in-service program for S-APA users or that greater emphasis should be given to the implementation of ESS or SCIS, if a science curricula of this kind is desirable based on the philosophy of the school.

The secondary school science curricula in Oregon appears to be relatively typical compared with that used by the rest of the nation. Approximately half of the secondary school science teachers have received some type of special training in the use of NSF science improvement programs. If the assumption is made that these programs are desirable, then consideration should be given to providing opportunities for special training in the use of the programs.

However, based on the evidence that most groups are in favor of integrating science with other subject areas both at the elementary level and secondary level of instruction, consideration must be given to the development and implementation of new curriculum materials as well as the training of teachers to use them.

Previous studies in Oregon revealed that the majority of instructional time was devoted to teacher led discussions and demonstrations. The trend appears to be moving away from a teacher centered curriculum to a student-centered curriculum. Greater emphasis is now being placed on student activities.

Further research is needed to determine if students are learning how to learn. All five populations stated that "learning how to learn, how to attack new problems, how to acquire new knowledge" was the most important NSTA goal for science education. Assuming that this is the most important goal for science education, then additional studies should be focused on the assessment of that goal and the best ways to achieve it.

Previous studies in Oregon revealed that the lack of equipment and poor facilities were barriers to effective teaching. That problem no longer has the magnitude that it once did. Apparently federal or local monies have been obtained to alleviate the problem. The reader should be cautioned not to conclude that lack of equipment and poor facilities do not exist in many schools throughout the state. While working with the Oregon State Department of Education, the investigator saw many schools that needed to improve their facilities and purchase new equipment.

The evidence in this study discloses that the area of evaluation needs to be examined further. Student's performance is judged either in total or in part by the total group's performance, and total programs are for the most part not being evaluated at all. The two are not mutually exclusive. In good conscience, how can a teacher evaluate a student's performance in a particular science program when the program itself is not being evaluated?

In summary, the status of science education in Oregon has improved considerably over the last twenty years. Those barriers to effective teaching once perceived to be of primary importance are no longer the problems recognized by the majority of teachers. Considerable sums of money have been granted to the science education community for the purpose of improving science facilities, purchasing new equipment, developing new science programs and upgrading the quality of science instruction in the schools. It no longer appears that vast sums of monies have to be channeled into the science education community similar to the conditions which existed in the 1960's. The programs have been developed, facilities and equipment are at hand and teachers have the science background to teach children.

The emphasis should now be with using the resources at hand to accomplish the goals of science education. Support should be maintained to continue the improvement of science teaching by providing practical experience through the use of pre-service and in-service programs.

Recommendations

On the basis of the data, the following recommendations are made for Oregon public schools. It is recommended that:

1. ...greater emphasis should be placed on the study of contemporary psychologists at the pre-service and in-service level of instruction.

2. ...a decision be made to either in-service existing S-APA programs or provide those schools with alternative programs.

3. ...greater attention should be given to the selection of a philosophical position for elementary and secondary school science programs.

4. ...elementary school teachers and secondary school science teachers should be encouraged to read more articles in science-related journals.

5. ...school districts should make provisions for evaluating the total school science programs.

6. ...consideration should be given to the development of an environmental science program for the elementary school.

7. ...pre-service and in-service opportunities should be provided for teachers to learn practical ways of presenting science concepts in an interesting manner.

8. ...formal communication channels should be provided between schools in order that a continuous K-12 science program be developed and implemented.

9. ...consideration should be given to the problem of providing more preparation time for teachers to teach science.

10. ...field trips or outdoor experiences should be considered as an integral part of the science program.

11. ...developing vocational competence should receive relatively little emphasis in the total science program.

12. ...efforts be made to improve the quality of earth science training for teachers either through pre-service or in-service learning experiences.

13. ...evaluation instruments should be designed to determine what experiences will best achieve the objective of "learning how to learn, how to attack new problems, how to acquire new knowledge".

Recommendations for further studies:

1. Determine the importance of career education and vocational competence as related to science teaching in the elementary and secondary schools.

2. Compare the needs opinion of pre-service teachers with the five populations of this study.

3. Compare the amount of input which students provide for the contents of the three major elementary science programs - S-APA, ESS and SCIS.

4. Determine the importance of an understanding of contemporary psychologists to good teaching.

5. Determine the importance of integrating science with other subject areas.

6. Follow-up studies could be conducted utilizing first hand observations of classroom activities.

BIBLIOGRAPHY

Auletto, John Xavier. 1955. The teaching of science in the public elementary schools of Delaware. Ed. D. thesis, Philadelphia, Temple University, 246 numb. leaves.

Baker, James H. 1973. A survey of science teaching in the public secondary schools of the Plains, Rocky Mountain, and Southeast regions of the United States in the 1970-71 school year. Ph. D. thesis, Columbus, The Ohio State University. 350 numb. leaves.

Blackwood, Paul E. 1965. Science teaching in the elementary school: a survey of practices. Journal of research in science teaching. 3:177-197.

Bowles, Joseph E. 1964. A study of science programs in grades seven, eight and nine of Michigan public schools. Ed. D. thesis, East Lansing, Michigan State University. 166 numb. leaves.

Buckeridge, Ellen C. 1973. A survey of science teaching in the public secondary schools of the New England, Mideast, and Southwest states of the United States. Ph. D. thesis, Columbus, The Ohio State University. 265 numb. leaves.

Carleton, Robert H. and John W. Hall. 1960. A plan for quality in science education. The nation's schools 65(2): 65-68.

Challand, Helen Jean. 1956. An appraisal of elementary school science instruction in the state of Illinois. Ph. D. thesis, Evanston, Northwestern University. 189 numb. leaves.

Chin, Long Fay. 1971. A survey of science teaching in the public secondary schools of the Great Lakes and Far West regions of the United States in the 1970-71 school year. Ph. D. thesis, Columbus, The Ohio State University. 393 numb. leaves.

Crawley, Jr., Harold B. 1967. The status of science education in Iowa high schools. Ph. D. thesis, Iowa City, The University of Iowa. 187 numb. leaves.

Cummins, E. L. 1960. Science education in public high schools of Oregon. Ed. D. thesis, Corvallis, Oregon State College. 241 numb. leaves.

Gibran, Kahlil. 1972. The Prophet. New York, Alfred A. Knopf. 96 p.

Guthrie, Donald, Carole Avery, and Keith Avery. 1973. Statistical interactive programming system (SIPS). Oregon State University. 111 p.

Kish, Leslie. 1965. Survey sampling. John Wiley and Sons, Inc. 643 p.

Moorehead, William D. 1965. The status of elementary school science and how it is taught. Ph. D. thesis, Norman, The University of Oklahoma. 152 numb. leaves.

Moser, C. A. and G. Kalton. 1972. Survey methods in social investigation. Basic Books, Inc. 549 p.

Moser, Gene W. 1964. The post-secondary science training of one thousand nine hundred and forty-five New York State elementary school teachers. Ed. D. thesis, Ithaca, Cornell University. 361 numb. leaves.

McCurdy, Donald W. 1967. Science education in the public high schools of Missouri. Ed. D. thesis, Columbia, University of Missouri. 346 numb. leaves.

National Association of State Directors of Teacher Education and Certification - American Association for the Advancement of Science. 1963. National Science Foundation Publication No. 63-10. U. S. Government Printing Office. Washington, D. C.

National Science Teachers Association. 1971. NSTA position statement on school science education for the 70's. The science teacher 38(8): 46-51.

National Education Association. 1965. Sampling and statistics handbook for surveys in education pp. 320-358.

Nelson, Bessie E. 1973. A survey of science teaching in the public elementary schools of the New England, the Mideast, and the Southwest regions of the United States during the 1970-71 school year. Ph. D. thesis, Columbus, The Ohio State University. 334 numb. leaves.

Obourn, Ellsworth S. 1960. The crisis in science education research. Science education 44(1): 19-22.

Oregon Blue Book. 1973-74. Secretary of State, Clay Meyers. 325 p.

Popham, W. James. 1967. Educational statistics: use and interpretation. New York, Harper and Row. 429 p.

Quaintance, Charles, Homer Dodds, and Wayne Wells. 1945. Elementary school science teaching problems in Oregon. Oregon education journal 19 (6):14.

Ricker, Kenneth Scott. 1963. Guidelines for effective selection of science equipment for elementary schools and a survey of the utilization of science equipment in elementary schools in the state of Maryland. Ed. D. thesis, College Park, University of Maryland. 172 numb. leaves.

Snedecor, George W. and William G. Cochran. 1967. Statistical methods. The Iowa State University Press, Ames Iowa. 593 p.

Snoble, Joseph J. 1967. Status and trends of elementary school science in Iowa Public schools, 1963-1966. Ph. D. thesis, Iowa City, The University of Iowa. 311 numb. leaves.

Sternig, John. 1960. Purposeful science for elementary grades. The Nation's Schools 65(2):91-98.

Stewart, Clinton E. 1970. The status of science curriculums, programs, and student activities in Texas secondary schools. Ed. D. thesis, Waco, Baylor University. 265 numb. leaves.

Thaw, Richard. 1958. Teaching load of teachers of science in Oregon. Ed. D. Thesis, Corvallis, Oregon State College. 102 numb. leaves.

Tyler, Ralph. 1967. Analysis of strength and weaknesses in current research in science education. Journal of research in science teaching 5:52-63.

Voss, Burton E. 1958. The status of science education in Iowa high schools. Ph. D. thesis, Iowa City, State University of Iowa. 264 numb. leaves.

Webb, Melvin R. 1972. Teaching science in public elementary schools of the Plains, Rocky Mountain and Southeast regions of the United States. Ph. D. thesis, Columbus, The Ohio State University. 213 numb. leaves.

Zweig, Carl G. 1967. The status of science education in the public secondary schools of New Mexico. Ed. D. thesis, Albuquerque, The University of New Mexico. 384 numb. leaves.

APPENDICES

APPENDIX A

Sample page used in the random selection process

OREGON SECONDARY SCHOOLS

Enrollment as of Fall 1972

WEST AREA

District School	Stratum 1	2	3	4
BENTON COUNTY				
Alsea District 7J				
Alsea HS			132	
Corvallis District 509J				
Cheldelin JHS		672		
Highland View JHS		626		
Western View JHS		564		
Corvallis HS	1060			
Cresent Valley HS		802		
Farm Home Jr.-Sr. HS				84
Monroe UH District 1J				
Monroe Union HS			181	
CLATSOP COUNTY				
Astoria District 1				
Astoria JHS		665		
Astoria HS		739		
Jewell District 8				
Jewell HS				51
Seaside District 10				
Seaside HS		49	496	
Warrenton District 30				
Warrenton HS			242	
COLUMBIA COUNTY				
Columbia District 5J				
Clatskanie HS			360	
Knappa HS			214	

APPENDIX B

ELEMENTARY TEACHER QUESTIONNAIRE--I

Instructions for the Elementary Teacher

Background

The attached questionnaire is part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with elementary science education and how it relates to what is currently happening in Oregon elementary schools. No attempt is being made to evaluate individual teachers or individual schools. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of science education in Oregon.

You have been randomly selected and should not feel threatened to participate in this survey. Anonymity will be maintained throughout the study. The questionnaires are mailed to your principal and he randomly selects you based on your position on an alphabetical listing of teachers in your building.

Directions

A. For those questions which are multiple choice, place an (X) in the appropriate blank.

B. For those questions which require short answers, please write or print legibly.

C. If for any reason you wish to clarify a given response, add your comments in the margin of the questionnaire.

D. If you wish to add additional questions that you feel should have been asked but were not, add them at the end of the questionnaire along with the appropriate response.

E. Please complete and return the questionnaire in the enclosed self-addressed stamped envelope by October 19, 1973.

Your cooperation will be greatly appreciated in seeing that this information can be obtained in order to improve the quality of education in Oregon.

1. Sex

( ) MALE ( ) FEMALE

2. What is your age?

( ) 20 - 30
( ) 31 - 40
( ) 41 - 50
( ) 51 - 60
( ) 61 - 70

3. Indicate your number of years of teaching experience at the elementary level (K-8) counting this year.

( ) one year
( ) 2 - 3
( ) 4 - 9
( ) 10-15
( ) 16-25
( ) 26 or more

4. Indicate which phrase <u>best</u> describes your elementary school.

( ) self-contained classrooms
( ) departmentalized
( ) semi-departmentalized
( ) nongraded
( ) team teaching
( ) other (specify)________________

5. Indicate the present grade level or levels that you are currently teaching.

( ) Kindergarten
( ) First grade
( ) Second grade
( ) Third grade
( ) Fourth grade
( ) Fifth grade
( ) Sixth grade
( ) Seventh grade
( ) Eighth grade

6. How much class time do you devote on the average to science instruction per week?

________________________ min/week

7. Indicate how your building science curriculum was selected.

( ) By a building principal
( ) By a curriculum specialist
( ) By a single classroom teacher
( ) By a science consultant
( ) By the board of education
( ) By the entire elementary staff
( ) By a committee of elementary teachers from your school
( ) By a committee of elementary teachers representing the entire school district
( ) By some other committee (describe)
____
( ) Other (describe)
____

8. a. Is there one person responsible for the administration of the science program in your building?

( ) YES ( ) NO

b. If yes, indicate the position of that person.

( ) principal
( ) classroom teacher
( ) science consultant or supervisor (not housed in the same building)
( ) district curriculum specialist
( ) other (specify)________________

c. Check the one statement that best describes the relative effectiveness of that person's action in that role.

( ) very effective
( ) moderately effective
( ) slightly effective
( ) ineffective

d. What do you think that person could do to improve his effectiveness?

____
____
____

9. Do you perceive the philosophy of the science program to be compatible with the written philosophy of the school?

( ) YES ( ) NO

If not, explain why there is a discrepency.

____
____
____
____

10. To what degree is the building principal knowledgeable of newer programs and approaches currently available in elementary school science?

( ) very knowledgeable
( ) moderately knowledgeable
( ) knowledgeable
( ) slightly knowledgeable
( ) unknowledgeable

11. Indicate whether science is taught as a separate course or if it is integrated with other subjects such as art, social studies, mathematics, etc.

( ) separate
( ) integrated
( ) separate at times and integrated at other times
( ) neither

12. Indicate the person primarily responsible for teaching science in your classroom.

( ) yourself
( ) science teacher
( ) science consultant or resource person
  ( ) district
  ( ) building
  ( ) visitor (outside district)
( ) self-contained classroom teacher who trades off some other subject such as social studies with some other teacher.
( ) other (specify)________________

____

13. a. Indicate the type of science program being utilized in your building. (You may check more than one box)

( ) Science, A Process Approach (SAPA) (AAAS)
( ) Elementary Science Study (ESS)
( ) Science Curriculum Improvement Study (SCIS)
( ) Textbook series (publisher)________________
( ) Locally developed program (describe)________________
( ) Combination of above (specify)________________
( ) None
( ) Other (specify)

____

b. Check the appropriate box to indicate your degree of satisfaction with your present science curriculum.

( ) highly satisfied
( ) satisfied
( ) indifferent
( ) unsatisfied
( ) highly unsatisfied

14. How do you perceive the students in your class liking science?

( ) very enjoyable
( ) moderately enjoyable
( ) enjoyable
( ) slightly enjoyable
( ) dislike

15. To what degree does the administration encourage and provide the opportunity for elementary teachers to attend professional meetings and workshops related to science education?

( ) considerable
( ) some
( ) little
( ) none

16. Since you started teaching in this district, indicate the type of experience that has been used by the school district to help you in the use of the existing science program in your building.

( ) university courses (specify) ______

( ) in-service (position of person who conducted) ______

( ) building
( ) district-wide
( ) local I.E.D.
( ) university level

( ) Division of Continuing Education course (specify) ______

( ) workshop (specify) ______

( ) national conference
( ) university level
( ) district
( ) building

( ) other (specify) ______

17. List and describe those science activities that students are engaged in that are related to career awareness.

1.______
2.______
3.______
4.______
5.______

18. To what degree are classroom quantities of science materials readily available to teachers in order to successfully conduct the science program?

( ) extensive
( ) adequate
( ) limited
( ) poor

19. Do provisions exist for ordering and receiving small amounts of simple chemicals and expendable materials during the school year?

( ) YES ( ) NO

If yes, is the procedure easy and expedient?

( ) YES ( ) NO

20. How often are natural materials such as living things, rocks and seashells brought into your classroom and used in science study?

( ) at least once a week
( ) about once every two weeks
( ) about once a month
( ) about once a semester

21. List the various kinds of science-related field trips that were taken by your students during this current school year.

1.______
2.______
3.______
4.______
5.______

22. On the average, how often do you take your students outdoors to study things in the natural environment?

( ) at least once a week
( ) about once every two weeks
( ) about once a month
( ) about once a semester
( ) about once a year
( ) never

23. List the kinds of incidental science that are found in your classroom (i.e., things spontaneously brought in by children and teacher for students to examine)

1.______
2.______
3.______
4.______
5.______

24. Check yes if you commonly (at least once every two weeks) use one of the activities in your science teaching and no if you do not use it commonly.

	Class Activity Types	Yes	No
a.	Discussion led by teacher.......	( )	( )
b.	Discussion led by pupil.........	( )	( )
c.	Teacher lecture or explanation..	( )	( )
d.	Teacher demonstration...........	( )	( )
e.	Laboratory activities...........	( )	( )
f.	Supervised individual study.....	( )	( )
g.	Supervised class project........	( )	( )
h.	Supervised small group project..	( )	( )
i.	Pupil recitation................	( )	( )
j.	Library reading.................	( )	( )
k.	Preparation of reports..........	( )	( )
l.	Visual aids.....................	( )	( )
m.	Other (specify)______	( )	( )

25. For each magazine you read, indicate the frequency by writing in a 1, a 2, or a 3 on the line next to the magazine after the following plan.

1 means - read thoroughly

2 means - read about one article per issue

3.means - do not read

Magazine

____a. Science and Children
____b. School Science and Mathematics
____c. Environmental Education
____d. National Geographic
____e. Ranger Rick
____f. Scientific American
____g. National Wildlife
____h. Other (specify)____________

26. Would you describe the evaluation of children in the area of science as being individualized or group evaluated?

( ) individualized
( ) group
( ) a combination of the above
( ) none of the above

27. Describe your familiarity (basic understanding) of the philosophies of the following individuals by checking the appropriate box.

	Familiar	Slightly Familiar	Unfamiliar
Jean Piaget	( )	( )	( )
Jerome Bruner	( )	( )	( )
C. T. Frank	( )	( )	( )
Carl Rodgers	( )	( )	( )
William Glasser	( )	( )	( )
Robert Gagne	( )	( )	( )
B. F. Skinner	( )	( )	( )
Abraham Maslow	( )	( )	( )

28. Is any provision made for evaluating the total science program in your school or district?

( ) YES ( ) NO

If yes, briefly describe the procedure for making such an evaluation.

____
____
____
____

APPENDIX C

ELEMENTARY TEACHER QUESTIONNAIRE--II

Instructions for the Elementary Teacher

Background

The attached questionnaire is part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with elementary science education and how it relates to what is currently happening in Oregon elementary schools. No attempt is being made to evaluate individual teachers or individual schools. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of science education in Oregon.

You have been randomly selected and should not feel threatened to participate in this survey. Anonymity will be maintained throughout the study. The questionnaires are mailed to your principal and he randomly selects you based on your position on an alphabetical listing of teachers in your building.

Directions

A. For those questions which are multiple choice, place an (X) in the appropriate blank.

B. For those questions which require short answers, please write or print legibly.

C. If for any reason you wish to clarify a given response, add your comments in the margin of the questionnaire.

D. If you wish to add additional questions that you feel should have been asked but were not, add them at the end of the questionnaire along with the appropriate response.

E. Please complete and return the questionnaire in the enclosed self-addressed stamped envelope by October 19, 1973.

Your cooperation will be greatly appreciated in seeing that this information can be obtained in order to improve the quality of education in Oregon.

1. Sex

   ( ) MALE ( ) FEMALE

2. Age

   ( ) 21 - 30
   ( ) 31 - 40
   ( ) 41 - 50
   ( ) 51 - 60
   ( ) 61 - 70

3. Indicate your number of years of teaching experience at the elementary level (K-8), counting this year.

   ( ) One year
   ( ) 2 - 3
   ( ) 4 - 9
   ( ) 10-15
   ( ) 16-25
   ( ) 26 or more

4. How much class time do you devote on the average to science instruction per week?

   ______________________min/week

5. Indicate which phrase best describes your elementary school

   ( ) Self-contained classrooms
   ( ) Departmentalized
   ( ) Semi-departmentalized
   ( ) Nongraded
   ( ) Team teaching
   ( ) Other (specify)______________

6. Indicate the present grade level or levels that you are currently teaching.

   ( ) Kindegarten
   ( ) First grade
   ( ) Second grade
   ( ) Third grade
   ( ) Fourth grade
   ( ) Fifth grade
   ( ) Sixth grade

7. What is your feeling concerning the quality of science currently being taught in your school?

   ( ) Excellent
   ( ) Good
   ( ) Average
   ( ) Fair
   ( ) Poor

8. Indicate the type of science program currently being utilized in your building. You may check more than one box.

( ) Science, A Process Approach (SAPA)(AAAS)
( ) Elementary Science Study (ESS)
( ) Science Curriculum Improvement Study (SCIS)
( ) Textbook series (publisher)

____

( ) Locally developed program (describe)

____

( ) Combination of above (specify)

____

( ) None
( ) Other (specify)

____

9. Do you feel that elementary teachers in general are adequately prepared to teach elementary school science.

( ) YES ( ) NO

If no, what would you suggest be changed in their undergraduate preparation?

____

____

____

10. Approximately how many hours of science (not counting methods of science) did you take in college? Please use the appropriate column depending upon whether they were term hours or semester hours.

Term	Semester
( ) 0 - 6 hours	( ) 0 - 4 hours
( ) 7 - 12	( ) 5 - 8
( ) 13 - 18	( ) 9 - 12
( ) more than 18	( ) more than 12

11. Do you feel that the proper emphasis is being placed on the amount of science currently being taught in your school?

( ) YES ( ) NO

If no, what recommendations would you make to improve the situation?

____

____

____

____

12. a. How would you rate your preservice (bachelor's degree) training in the following courses?

________________ institution granting degree

________________ year graduated

	Very Helpful	Moderately Helpful	Helpful	Slightly Helpful	Not Helpful
General science					
Geology or earth science					
Biological science					
Physical science					
Science teaching methods					

b. What should have been done in those classes that you feel could have been more helpful?

____

____

____

13. Do you feel that the science taught in your elementary school is adequately contributing to the development of children for a role in modern society?

( ) definitely
( ) sometimes
( ) seldom
( ) never

14. Do you feel that elementary students should have some input as to what the contents of an elementary science course should be?

( ) Strongly agree
( ) Agree
( ) No opinion
( ) Disagree
( ) Strongly disagree

15. Indicate which kinds of additional training you feel would be most helpful to improve your ability as an elementary science teacher.

( ) Strategies of teaching
( ) Learning psychologies, i.e., Piaget, Gagne, Bruner, etc.
( ) Classroom management
( ) Science courses
( ) Supervised practicum in science
( ) Other (specify)________________

____

16. The following list is a set of goals of science education determined by the National Science Teachers Association. Rank the five most important by placing a number (1) in front of the most important goal, a (2) in front of the next most important goal, etc. Then rank your school according to how well those goals are being taught.

Rank	Goal	Elementary: Good	Ave.	Poor
( )	learning how to learn, how to attack new problems, how to acquire new knowledge	( )	( )	( )
( )	using rational processes	( )	( )	( )
( )	building competence in basic skills	( )	( )	( )
( )	developing intellectual competence	( )	( )	( )
( )	developing vocational competence	( )	( )	( )
( )	exploring values in new experiences	( )	( )	( )
( )	understanding concepts and generalizations	( )	( )	( )
( )	learning to live harmoniously with the biosphere	( )	( )	( )

17. Select <u>five</u> of the areas listed below and rank them in order of greatest concern to you as an elementary science teacher. The problem of greatest concern mark 1, the next in rank mark 2, etc. If some other person teaches science for you, omit this question.

____1. Acquiring and teaching new or modern concepts in science.
____2. Improving my ability to present scientific concepts in an interesting manner.
____3. Securing an adequate textbook.
____4. Supplying supplementary problems material.
____5. Obtaining and using visual aids.
____6. Getting improved library facilities.
____7. Providing career guidance material in science.
____8. Arranging and conducting field trips.
____9. Finding adequate preparation time for experiments and demonstrations.
____10. Improving laboratory experiments and demonstrations.
____11. Improvising simple equipment.
____12. Providing for the superior pupil.
____13. Knowing how to teach problem solving or scientific method.
____14. Finding good science projects.
____15. Finding time for helping individual pupils.
____16. Other (specify)____________________

____

18. What is your feeling concerning the integration of science with other subject areas such as mathematics, social studies, reading, etc.?

( ) Highly favorable
( ) Favorable
( ) Unfavorable
( ) Highly unfavorable
( ) No opinion

19. The following is a list of science-related concerns. Rank them in how you perceive their relative order of importance. Place a number (1) in front of the one which is most important, a number (2) in front of the one next most important, etc.

( ) Population control
( ) Environmental quality
( ) Career education or preparation
( ) Family living
( ) Divine creation of the universe

20. To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?

( ) serious conflict
( ) moderate conflict
( ) little conflict
( ) no conflict

APPENDIX D

SECONDARY SCHOOL SCIENCE QUESTIONNAIRE--I

Instructions for the Secondary Science Teacher

Background

The attached questionnaire is part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with secondary science education and how it relates to what is currently happening in Oregon Public Schools. No attempt is made to evaluate individual science teachers or individual schools. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of science education in Oregon.

You have been randomly selected from a list of all science teachers in Oregon Public Schools to participate in this survey. Anonymity will be maintained throughout the study.

Directions

A. For those questions which are multiple choice, place an (X) in the appropriate blank.

B. For those questions which require snort answers, please write or print legibly.

C. If for any reason you wish to clarify a given response, add your comments in the margin of the questionnaire.

D. If you wish to add additional questions that you feel should have been asked but were not, add them at the end of the questionnaire along with the appropriate response.

E. Please complete and return the questionnaire in the enclosed self-addressed stamped envelope by October 19, 1973.

Your cooperation will be greatly appreciated in seeing that this information can be obtained by the science education community in order to improve the quality of education in Oregon.

1. Sex

MALE ( )　　FEMALE ( )

2. Mark the boxes next to the grades that are taught in your building.

Grade
( ) 7
( ) 8
( ) 9
( ) 10
( ) 11
( ) 12

3. Of those grades taught in your building, circle the number corresponding to the minimum number of yearly science courses required for graduation or for movement to another school.

0 1/2 1 2 3 4 5 6

4. Indicate the number of science teachers in your building who.....

_____teach only science

_____teach science in addition to other subjects

5. Indicate your total number of years experience teaching secondary (7-12) school science. (Count this year)

( ) one　　( ) 10--15
( ) 2--3　　( ) 16--25
( ) 4--9　　( ) 26 or more

6. How much time is provided in the teacher's daily schedule for the preparation of classroom demonstrations and laboratory and field activities.

( ) 0 periods
( ) 1 period
( ) 2 periods
( ) 3 periods

7. Do you perceive the philosophy of the science program to be compatible with the written philosophy of the school?

( ) YES　　( ) NO

If not, explain why there is a discrepancy.

____
____
____

8. Is there any formal articulation between the elementary science program and the secondary science program?

( ) YES ( ) NO

If yes, briefly explain ______________________

____

9. To what degree does the administration encourage and provide the opportunity for science teachers to attend professional meetings and workshops related to science education?

( ) considerable
( ) some
( ) little
( ) none

10. Have you had any post-baccalaureate training in science or science education?

( ) YES ( ) NO

If yes, indicate the type of training.

( ) University courses
( ) Workshop
( ) In-service
( ) NSF Academic Year Institute
( ) NSF Summer Institute
( ) Other (specify)______________________

Indicate with a circle around the box ◯ which type of experience you would describe as being the most beneficial.

11. Describe your familiarity (basic understanding) of the philosophies of the following individuals by checking the appropriate box.

	Familiar	Slightly Familiar	Unfamiliar
Jean Piaget	( )	( )	( )
Jerome Bruner	( )	( )	( )
C. T. Frank	( )	( )	( )
Carl Rogers	( )	( )	( )
William Glasser	( )	( )	( )
Robert Gagne	( )	( )	( )
B. F. Skinner	( )	( )	( )
Abraham Maslow	( )	( )	( )

12. Have you had any special training to help you in teaching such programs as BSCS, PSSC, ESCP, etc?

( ) YES ( ) NO

If yes, indicate the type of training you received.

( ) University courses (specify)

____

( ) in-service (title of person who conducted)

____

( ) Division of Continuing Education course (specify)

____

( ) workshop (title of person who conducted)

____

( ) Other (specify)

____

13. Please give the required information for each science subject you teach.

Subject	Grade Level of Most Students in Class 7 8 9 10 11 12	No. of Sections	Length of Periods	No. of Periods per Week	No. of Weeks of Course	Enrollment Boys	Enrollment Girls
General Science	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Biology	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Chemistry	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Physics	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Earth Science	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Physical Science	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Other (specify)							
____________	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____

14. Indicate the relative percentage of your teaching time devoted to each of the following.

	% of time
Process Skills	______
Values	______
Social Aspects	______
Factual Knowledge	______

15. How often are natural materials such as living things and rocks brought into your classroom and used in science study?

( ) at least once a week
( ) about once every two weeks
( ) about once a month
( ) less than once a month

16. For each science course you teach, check the one box which indicates your present practice.

Practice	Gen Sci	Biol	Chem	Physics	Earth Sci	Other (Specify) ______
More emphasis on student laboratory and less on teacher demonstration.	( )	( )	( )	( )	( )	( )
More emphasis on teacher demonstration and less on student laboratory work.	( )	( )	( )	( )	( )	( )
More emphasis on balance between teacher demonstration and student laboratory work.	( )	( )	( )	( )	( )	( )

17. For each science course you teach, check the one laboratory procedure used most commonly.

Procedure	Gen Sci	Biol	Chem	Physics	Earth Sci	Other (Specify)
Individual laboratory work	( )	( )	( )	( )	( )	( )
Pupils grouped in pairs	( )	( )	( )	( )	( )	( )
Pupils grouped 3 or more to a group	( )	( )	( )	( )	( )	( )
Teacher demonstration	( )	( )	( )	( )	( )	( )
Pupil demonstration	( )	( )	( )	( )	( )	( )
Other (specify)______	( )	( )	( )	( )	( )	( )

18. For each science course you teach, indicate the <u>one method</u> most commonly used for scheduling laboratory work.

Type of Scheduling	Gen Sci	Biol	Chem	Physics	Earth Sci	Other (Specify)
None scheduled	( )	( )	( )	( )	( )	( )
Regular single periods	( )	( )	( )	( )	( )	( )
Regular double periods	( )	( )	( )	( )	( )	( )
A flexible laboratory schedule	( )	( )	( )	( )	( )	( )
Integrated laboratory and recitation	( )	( )	( )	( )	( )	( )
Laboratory optional	( )	( )	( )	( )	( )	( )
Other (specify)______	( )	( )	( )	( )	( )	( )

19. Indicate by checking if the following facilities are available for instruction in most of your classes.

Yes	No	Facility
( )	( )	Water available
( )	( )	Gas outlets
( )	( )	Electrical outlets
( )	( )	Fume hoods
( )	( )	Facilities are old and in need of replacement
( )	( )	Facilities are inadequate in size
( )	( )	Demonstration tables
( )	( )	Equipment storage cases
( )	( )	Exhibit cases
( )	( )	Library of textbooks in the room
( )	( )	Rooms can be darkened for slide and movie projection
( )	( )	Rooms are fitted for television reception
( )	( )	Rooms have classroom libraries and reading tables
( )	( )	Rooms have bulletin boards
( )	( )	Rooms have chalkboards
( )	( )	Rooms have wall and window tables
( )	( )	Animal room
( )	( )	Greenhouse (separate)
( )	( )	Plant growing room
( )	( )	Nature trail
( )	( )	Preparation room
( )	( )	Garden plot
( )	( )	Reforestation area
( )	( )	Project room (separate)
( )	( )	Project areas for individuals
( )	( )	School camp
( )	( )	Radio room or shack
( )	( )	Science museum
( )	( )	School farm
( )	( )	Weather station
( )	( )	Dark room for photography
( )	( )	Demonstration table on wheels
( )	( )	Others (specify)______________

20. List those kinds of activities that students or you as a teacher are doing in the area of career education.

1.______________________________
2.______________________________
3.______________________________
4.______________________________
5.______________________________

21. Have you ever conducted any scientific research at the college level?

( ) YES ( ) NO

Do you currently conduct any scientific research in your school?

( ) YES ( ) NO

Briefly explain______________________

____

22. Do any of your students conduct any scientific research other than that associated with normal classroom activities?

( ) YES ( ) NO

If yes, how many?____________________

23. List those extra curricular activities that you are responsible for. *Circle the number* preceeding the item if it is a voluntary service.

1.______________________________
2.______________________________
3.______________________________
4.______________________________
5.______________________________

24. How would you judge the overall success of the science program in your school?

( ) extremely successful
( ) successful
( ) average
( ) fair
( ) poor

25. Check the one box with the highest number that indicates your participation in the professional organizations.

Pay Dues 1	Attend Meeting 2	Participate in Program 3	Committee Work 4	Past or Present Officer 5	Organization
( )	( )	( )	( )	( )	a. National Education Association
( )	( )	( )	( )	( )	b. Oregon Education Association
( )	( )	( )	( )	( )	c. National Science Teachers Association
( )	( )	( )	( )	( )	d. National Association for Research in Science Teaching
( )	( )	( )	( )	( )	e. Central Association of School Science and Mathematics Teachers
( )	( )	( )	( )	( )	f. National Association of Biology Teachers
( )	( )	( )	( )	( )	g. American Association of Physics Teachers
( )	( )	( )	( )	( )	h. American Association for the Advancement of Science
( )	( )	( )	( )	( )	i. American Chemical Society
( )	( )	( )	( )	( )	j. American Institute of Biological Science
( )	( )	( )	( )	( )	k. Oregon Academy of Science
( )	( )	( )	( )	( )	l. Oregon Science Teachers Association
( )	( )	( )	( )	( )	m. Astronomical League
( )	( )	( )	( )	( )	n. Local Science Teachers Association
( )	( )	( )	( )	( )	o. American Nature Study Association
( )	( )	( )	( )	( )	p. American Federation of Teachers
( )	( )	( )	( )	( )	q. Other (specify)________________

APPENDIX E

SECONDARY SCHOOL SCIENCE QUESTIONNAIRE--II

Instructions for the Secondary Science Teacher

Background

The attached questionnaire is part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with secondary science education and how it relates to what is currently happening in Oregon Public Schools. No attempt is made to evaluate individual science teachers or individual schools. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of science education in Oregon.

You have been randomly selected from a list of all science teachers in Oregon Public Schools to participate in this survey. Anonymity will be maintained throughout the study.

Directions

A. For those questions which are multiple choice, place an (X) in the appropriate blank.

B. For those questions which require short answers, please write or print legibly.

C. If for any reason you wish to clarify a given response, add your comments in the margin of the questionnaire.

D. If you wish to add additional questions that you feel should have been asked but were not, add them at the end of the questionnaire along with the appropriate response.

E. Please complete and return the questionnaire in the enclosed self-addressed stamped envelope by October 19, 1973.

Your cooperation will be greatly appreciated in seeing that this information can be obtained by the science education community in order to improve the quality of education in Oregon.

1. Sex

   MALE ( )   FEMALE ( )

2. Mark the boxes next to the grades that are taught in your building.

   GRADE
   7 ( )
   8 ( )
   9 ( )
   10 ( )
   11 ( )
   12 ( )

3. Of those grades taught in your building, circle the number corresponding to the minimum number of yearly science courses required for graduation or for movement to another school.

   0 1/2 1 2 3 4 5 6

4. Indicate your total number of years experience teaching secondary (7-12) school science. (Count this year)

   ( ) one   ( ) 10-15
   ( ) 2 - 3   ( ) 16-25
   ( ) 4 - 9   ( ) 26 or more

5. Indicate the number of science teachers in your building who....

   ______teach only science

   ______teach science in addition to other subjects

6. Is there any formal articulation between the elementary science program and the secondary science program?

   ( ) YES   ( ) NO

   If yes, briefly explain__________________

   ____

7. Indicate how your science curriculum was selected.

   ( ) by a building principal
   ( ) by a curriculum specialist
   ( ) by a department chairman
   ( ) by a consultant
   ( ) by the board of education
   ( ) by the entire science staff
   ( ) by a committee of science teachers
   ( ) by some other committee (describe)__________________
   ( ) Other (specify)__________________

8. Is there any formal articulation between the junior high science program and the senior high science program?

( ) YES ( ) NO

If yes, briefly explain ____________________

____

9. Describe your familiarity (basic understanding) of the philosophies of the following individuals by checking the appropriate box.

	Familiar	Slightly Familiar	Unfamiliar
Jean Piaget	( )	( )	( )
Jerome Bruner	( )	( )	( )
C. T. Frank	( )	( )	( )
Carl Rogers	( )	( )	( )
William Glasser	( )	( )	( )
Robert Gagne	( )	( )	( )
B. F. Skinner	( )	( )	( )
Abraham Maslow	( )	( )	( )

10. Have you had any post-baccalaureate training in science or science education?

( ) YES ( ) NO

If yes, indicate the type of training.

( ) University courses
( ) Workshop
( ) In-service
( ) NSF Academic Year Institute
( ) NSF Summer Institute
( ) Other (specify) ____________________

Indicate with a circle around the box ( ) which type of experience you would describe as being the most beneficial.

11. Have you had any special training to help you in teaching such programs as BSCS, PSSC, ESCP, etc?

( ) YES ( ) NO

If yes, indicate the type of training you received.

( ) university courses (specify)

____

( ) in-service (title of person who conducted)

____

( ) Division of Continuing Education course

(specify) ____________________

( ) workshop (title of person who conducted)

____

( ) other (specify)

____

12. List and briefly describe those activities that students are doing in the area of ecological concerns.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________

13. Indicate the relative percentage of your teaching time devoted to each of the following.

	% of time
Process skills	______
Values	______
Social aspects	______
Factual knowledge	______

14. Is provision made for students to use the science facilities beyond regularly scheduled class periods on a weekly basis?

( ) YES ( ) NO

15. Do provisions exist for ordering and receiving small amounts of chemicals and expendable materials <u>during</u> the school year, outside the regular budget?

( ) YES ( ) NO

If yes, is the procedure easy and expedient?

( ) YES ( ) NO

16. Are classroom quantities of laboratory materials available for students?

( ) YES ( ) NO

17. Please give the required information for each science subject you teach.

Subject	Grade Level of Most Students in Class 7 8 9 10 11 12	No. of Sections	Length of Periods	No. of Periods per Week	No. of Weeks of Course	Enrollment Boys	Enrollment Girls
General Science	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Biology	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Chemistry	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Physics	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Earth Science	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Physical Science	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____
Other (specify) ________	( )( )( ) ( ) ( ) ( )	____	____	____	____	____	____

18. Please give the following information about textbooks for each science subject you teach. (If no textbook is used, write "None".)

Subject	Title of Textbook(s) Used	Authors	Date of Publication	Your Rating of Text in Meeting Pupil Needs: Excellent	Good	Fair	Poor
General Science	________	________	____	( )	( )	( )	( )
Biology	________	________	____	( )	( )	( )	( )
Chemistry	________	________	____	( )	( )	( )	( )
Physics	________	________	____	( )	( )	( )	( )
Earth Science	________	________	____	( )	( )	( )	( )
Other (specify)	________	________	____	( )	( )	( )	( )

19. For each science course you teach, check "yes" if provision is made in teaching for practicing the listed problem solving abilities. Check "no" if such provision is not made.

Problem Solving Abilities	Gen Sci Yes No	Biology Yes No	Chemistry Yes No	Physics Yes No	Earth Sci Yes No	Other (specify) Yes No
Identifying and stating assumptions	( )( )	( )( )	( )( )	( )( )	( )( )	( )( )
Defining problems	( )( )	( )( )	( )( )	( )( )	( )( )	( )( )
Setting up controlled experiments	( )( )	( )( )	( )( )	( )( )	( )( )	( )( )
Interpreting evidence	( )( )	( )( )	( )( )	( )( )	( )( )	( )( )
Making applications of generalizations	( )( )	( )( )	( )( )	( )( )	( )( )	( )( )
Formulating conclusions and generalizations from evidence	( )( )	( )( )	( )( )	( )( )	( )( )	( )( )
Proposing and testing hypotheses	( )( )	( )( )	( )( )	( )( )	( )( )	( )( )
Other (specify) ________	( )( )	( )( )	( )( )	( )( )	( )( )	( )( )

20. Please indicate by checking the appropriate boxes, the extent to which you use the following methods in providing for the rapid learner.

Procedure	Often	Sometimes	Seldom	Never
Encourage students to compete for superior scholarship awards	( )	( )	( )	( )
Individual encouragement and personal guidance	( )	( )	( )	( )
Participation in science fairs with projects	( )	( )	( )	( )
Encourage study of the applications of science and mathematics	( )	( )	( )	( )
Encourage each pupil to work at his own rate but require the student to continue regular class work	( )	( )	( )	( )
Encourage student self-evaluation	( )	( )	( )	( )
Encourage pupil to set up special experiments and demonstrations	( )	( )	( )	( )
Provide opportunities to work as laboratory assistant	( )	( )	( )	( )
Provide opportunity for enrichment with advanced study	( )	( )	( )	( )
Encourage students to make aids to instruction	( )	( )	( )	( )
Provide special science seminars	( )	( )	( )	( )
Encourage enrichment through advanced reading	( )	( )	( )	( )
Work experiences off campus in the area of science	( )	( )	( )	( )
Other (specify)____________________	( )	( )	( )	( )

21. For each magazine you read, indicate the frequency by writing in a 1, a 2, or a 3 on the line next to the magazine after the following plan.
1 means - read thoroughly
2 means - read about one article per issue
3 means - do not read

Magazines

____a. American Biology Teacher
____b. Journal of Chemical Education
____c. School Science and Mathematics
____d. Science Education
____e. School Science Review
____f. Science and Children
____g. The Science Teacher
____h. Earth Science
____i. National Geographic
____j. Science
____k. Science News
____l. National Wildlife
____m. Physics Today
____n. Science Digest
____o. Popular Mechanics
____p. Scientific American
____q. Science World
____r. Journal of Research in Science Teaching
____s. Chemistry
____t. Physics Teacher
____u. Environmental Education
____v. Other (specify)________________

22. Is any provision made for evaluating the total science program in your school?

( ) YES ( ) NO

If yes, briefly describe the procedure for making such an evaluation.

____
____
____

23. Would you describe your evaluation of students as being individualized or group evaluated?
( ) individualized
( ) group
( ) a combination of the above
( ) none of the above

24. How would you judge the overall success of the science program in your school?
( ) extremely successful
( ) successful
( ) average
( ) fair
( ) poor

APPENDIX F

SECONDARY SCIENCE TEACHER QUESTIONNAIRE--III

Instructions for the Secondary Science Teacher

Background

The attached questionnaire is part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with secondary science education and how it relates to what is currently happening in Oregon public schools. No attempt is made to evaluate individual science teachers or individual schools. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of science education in Oregon.

You have been randomly selected from a list of all science teachers in Oregon public schools to participate in this survey. Anonymity will be maintained throughout the study.

Directions

A. For those questions which are multiple choice, place an (X) in the appropriate blank.

B. For those questions which require short answers, please write or print legibly.

C. If for any reason you wish to clarify a given response, add your comments in the margin of the questionnaire.

D. If you wish to add additional questions that you feel should have been asked but were not, add them at the end of the questionnaire, along with the appropriate response.

E. Please complete and return the questionnaire in the enclosed self-addressed, stamped envelope by October 19, 1973.

Your cooperation will be greatly appreciated in seeing that this information can be obtained by the science education community in order to improve the quality of education in Oregon.

1. SEX:

   MALE ( ) FEMALE ( )

2. AGE:

   ( ) 21-30
   ( ) 31-40
   ( ) 41-50
   ( ) 51-60
   ( ) 61-70

3. Highest Degree Earned:

   ( ) Bachelor's
   ( ) Master's
   ( ) Doctorate
   ( ) Other________________

4. Subject area of undergraduate preparation:

   ( ) Biology
   ( ) Chemistry
   ( ) General Science
   ( ) Mathematics
   ( ) Physical Science
   ( ) Physics
   ( ) Other________________

5. What is your feeling concerning the quality of science currently being taught in your school?

   ( ) Excellent
   ( ) Good
   ( ) Average
   ( ) Fair
   ( ) Poor

6. Do you feel that secondary science teachers in general are adequately prepared to teach secondary school science?

   ( ) YES ( ) NO

7. Do you feel that the proper emphasis is being placed on the amount of science currently being taught in your school?

   ( ) YES ( ) NO

   If no, what recommendations would you make to improve the situation?

   ____
   ____
   ____
   ____

8. Do you feel that the science taught in your secondary school is adequately contributing to the development of young adults for a role in modern society?

YES ( )   NO ( )

If no, what recommendations would you suggest to improve their preparation?

____

____

____

____

9. Check those boxes that you feel would improve the science program in your school.

( ) Fewer required science courses
( ) More required science courses
( ) More field trip experiences
( ) Guest appearances by persons employed in science related fields
( ) More science activities
( ) Easier reading materials
( ) More reading materials
( ) More interesting science courses (can you offer some suggestions?)

____

____

____

( ) More laboratory materials
( ) An elective system with mini-courses
( ) Longer class periods
( ) Shorter class periods
( ) Less emphasis on facts
( ) More emphasis on facts
( ) Less emphasis on concepts or ideas
( ) More emphasis on concepts or ideas

10. What is your feeling concerning the integration of science with other subject areas such as mathematics, social studies, vocational education, etc.

( ) Highly Favorable
( ) Favorable
( ) Unfavorable
( ) Highly Unfavorable
( ) No Opinion

11. What is your opinion of the "fairness" of the grading system in science classes compared with other subjects?

( ) Fair
( ) Unfair
( ) Same

If unfair, list those things that should be done to make it fair.

____

____

____

____

12. Do you feel that ten credits of science should be equated with ten credits of business, music, art or physical education?

YES ( )   NO ( )

If no, explain your reason.

____

____

____

____

13. Do you feel that students should have some input as to what the contents of a science course should be?

( ) Strongly Agree
( ) Agree
( ) No Opinion
( ) Disagree
( ) Strongly Disagree

14. Rank those kinds of additional training you feel would be most helpful to improve your competence as a secondary science teacher by placing a (1) in front of the item most important, a (2) in front of the item next important, etc.

( ) Strategies of teaching
( ) Learning psychologies; e.g., Piaget, Bruner, etc.
( ) Classroom management
( ) Science Courses
( ) Advanced science methods
( ) Other (specify)__________________

____

15. The following list is a set of goals of science education determined by the National Science Teachers Association. Rank the five most important by placing a number (1) in front of the most important goal, a (2) in front of the next most important goal, etc. Then rank your school according to how well you think those goals are being taught.

	Junior High			Senior High		
	Good	Average	Poor	Good	Average	Poor
( ) Learning how to learn, how to attack new problems, how to acquire new knowledge..........	( )	( )	( )	( )	( )	( )
( ) Using rational processes........................	( )	( )	( )	( )	( )	( )
( ) Building competence in basic skills.............	( )	( )	( )	( )	( )	( )
( ) Developing intellectual competence..............	( )	( )	( )	( )	( )	( )
( ) Developing vocational competence................	( )	( )	( )	( )	( )	( )
( ) Exploring values in new experiences.............	( )	( )	( )	( )	( )	( )
( ) Understanding concepts and generalizations......	( )	( )	( )	( )	( )	( )
( ) Learning to live harmoniously with the biosphere......................................	( )	( )	( )	( )	( )	( )

16. The following is a list of science-related concerns. *Rank them in how you perceive* their relative order of importance. Place a number (1) in front of the one which is most important, a number (2) in front of the one next most important, etc.

( ) Population Control
( ) Environmental Quality
( ) Career Education or Preparation
( ) Family Living
( ) Divine Creation of the Universe

17. Indicate by checking those areas listed below which you feel the need for further work in to improve as a science teacher.

YES	NO	
( )	( )	Astronomy
( )	( )	Botany
( )	( )	Zoology
( )	( )	Psychology
( )	( )	Geology
( )	( )	Genetics
( )	( )	General Physics
( )	( )	General Chemistry
( )	( )	Bio-Chemistry
( )	( )	Nuclear Physics
( )	( )	Nuclear Chemistry
( )	( )	Sociology
( )	( )	Mathematics
( )	( )	Ecology
( )	( )	Meteorology
( )	( )	Organic Chemistry
( )	( )	Computer Science
( )	( )	Other (specify)

____

____

18. Select five of the areas listed below and rank them in order of greatest concern to you as an elementary science teacher. The problem of greatest concern mark 1, the next in rank mark 2, etc.

____1. Acquiring and teaching new or modern concepts in science.
____2. Improving my ability to present scientific concepts in an interesting manner.
____3. Securing an adequate textbook.
____4. Supplying supplementary problems material.
____5. Obtaining and using visual aids.
____6. Getting improved library facilities.
____7. Providing career guidance material in science.
____8. Arranging and conducting field trips.
____9. Finding adequate preparation time for experiments and demonstrations.
____10. Improving laboratory experiments and demonstrations.
____11. Improvising simple equipment.
____12. Providing for the superior pupil.
____13. Knowing how to teach problem-solving or scientific method.
____14. Finding good science projects.
____15. Finding time for helping individual pupils.
____16. Other (specify)____________________

19. To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?

( ) Serious Conflict
( ) Moderate Conflict
( ) Little Conflict
( ) No Conflict

APPENDIX G

STUDENT QUESTIONNAIRE

Instructions for the Secondary Social Studies Student

Directions

A. For those questions which are multiple choice, place an (X) in the appropriate blank.

B. For those questions which require short answers, please write or print legibly using either a pen or pencil.

C. If for any reason you wish to clarify a given response, add your comments in the margin of the questionnaire.

D. If you wish to add additional questions that you feel should have been asked but were not, add them at the end of the questionnaire along with the appropriate response.

1. Grade in School

( ) 7
( ) 8
( ) 9
( ) 10
( ) 11
( ) 12

2. Sex

( ) MALE ( ) FEMALE

3. Type of major:

( ) College prep
( ) Vocational
( ) General

4. Indicate the highest amount of education for each parent or guardian.

	Mother	Father
Grade School		
Junior High School		
Senior High School		
Junior College		
Bachelor's Degree		
Master's Degree		
Doctor's Degree		

5. If you had to rate your overall performance in science classes since grade seven, what grade would you assign yourself?

( ) A ( ) B ( ) C ( ) D ( ) F

6. List any science club or related extra curricular activity in which you are currently participating:

____

____

____

____

7.a. Indicate by checking the appropriate boxes which science course or courses you have taken since the seventh grade. (Include any science course in which you are currently enrolled.)

( ) ISCS - Intermediate Science Curriculum Study
( ) IPS - Introductory Physical Science
( ) ESCP - Earth Science Curriculum Project
( ) BSCS - Biological Science Curriculum Study
( ) CHEM Study
( ) PSSC - Physical Science Study Committee
( ) HPP - Harvard Project Physics
( ) Other (specify)__________
( ) Other (specify)__________
( ) Other (specify)__________

b. Of those courses that you have checked, would you recommend any one to a friend?

( ) YES ( ) NO

c. If yes, which ones would you recommend.

( ) ISCS ( ) PSSC
( ) IPS ( ) HPP
( ) ESCP ( ) Other________
( ) BSCS ( ) Other________
( ) CHEM Study ( ) Other________

8. Do you feel that enough emphasis is placed on the importance of science by teachers, administrators and students in your school?

( ) YES ( ) NO

9. What is your opinion concerning the science course offerings in your school?

( ) No opinion
( ) The perfect courses for me
( ) Wish there were some new courses (include suggestions for new courses)

____

____

____

10. Check those boxes that you feel would improve the science program in your school.

( ) fewer required science courses
( ) more required science courses
( ) more field trip experiences
( ) guest appearances by persons employed in science related fields
( ) more science activities
( ) easier reading materials
( ) more reading materials
( ) more interesting science courses (can you offer some suggestions)

____

____

____

( ) more laboratory materials
( ) an elective system with mini courses
( ) longer class periods
( ) shorter class periods
( ) less emphasis on facts
( ) more emphasis on facts
( ) less emphasis on concepts or ideas
( ) more emphasis on concepts or ideas

11. What is your feeling concerning the integration of science with other subject areas such as social studies, mathematics, humanities, vocational education, etc.

( ) highly favorable
( ) favorable
( ) unfavorable
( ) highly unfavorable
( ) no opinion

12. What is your opinion of the "fairness" of the grading system in science classes compared with other subjects?

( ) fair
( ) unfair
( ) same

If unfair, list those things that should be done to make it fair.

____

____

____

13. Do you feel that ten credits of science should be considered equal to ten credits of business, music, art or physical education?

( ) YES ( ) NO

If no, explain your reason____________

____

____

____

14. Are you planning on a career in a science related field (e.g., engineering, medicine, etc.)

( ) YES ( ) NO

If yes, indicate which field

____

15. Have you received any instruction in your science classes related to career education in the field of science?

( ) YES ( ) NO

If yes, briefly describe

____

____

____

16. Do you feel that students should have some input as to what the contents of a science course should be?

( ) strongly agree
( ) agree
( ) no opinion
( ) disagree
( ) strongly disagree

17. The following is a list of science-related concerns. Rank them in how you perceive their order of importance. (Place a number (1) in front of the one which is most important, a number (2) in front of the one next most important, etc.

( ) population control
( ) environmental quality
( ) career education or preparation
( ) family living
( ) divine creation of the universe

18. Which one word best describes the degree to which you "like" science?

( ) exciting
( ) enjoyable
( ) tolerable
( ) boring
( ) no opinion

19. To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?

( ) serious conflict
( ) moderate conflict
( ) little conflict
( ) no conflict

20. The following list is a set of goals of science education determined by the National Science Teachers Association. Rank the five most important by placing a number (1) in front of the most important goal, a (2) in front of the next most important goal, etc. Then rank your school according to how well those goals are being taught.

Rank	Goal	Senior High: Good	Ave.	Poor
( )	learning how to learn, how to attack new problems, how to acquire new knowledge	( )	( )	( )
( )	using rational processes	( )	( )	( )
( )	building competence in basic skills	( )	( )	( )
( )	developing intellectual competence	( )	( )	( )
( )	developing vocational competence	( )	( )	( )
( )	exploring values in new experiences	( )	( )	( )
( )	understanding concepts and generalizations	( )	( )	( )
( )	learning to live harmoniously with the biosphere	( )	( )	( )

APPENDIX H

P. T. A. QUESTIONNAIRE

Directions

A. For those questions which are multiple choice, place an (X) in the appropriate blank.

B. For those questions which require short answers, please write or print legibly using either a pen or pencil.

C. If for any given reason you wish to clarify a given response, add your comments in the margin of the questionnaire.

If you wish to add additional questions that you feel should have been asked but were not, add them at the end of the questionnaire along with the appropriate response.

1. Age

( ) 20 - 30
( ) 31 - 40
( ) 41 - 50
( ) 51 - 60
( ) 61 - 70

2. Sex

( ) MALE ( ) FEMALE

3. Number of children currently in public school.

( ) 0
( ) 1
( ) 2
( ) 3
( ) 4
( ) more than 4

4. Indicate which office you currently hold in your local P. T. A.

( ) President
( ) Vice President
( ) Secretary
( ) Treasurer
( ) Other________________________

5. Indicate the highest amount of education for each parent or guardian.

	Mother	Father
Grade school		
Junior high school		
Senior high school		
Junior college		
Bachelor's degree		
Master's degree		
Doctor's degree		

6. Indicate the grades your children are currently enrolled in.

( ) Kindergarten
( ) First Grade
( ) Second
( ) Third
( ) Fourth
( ) Fifth
( ) Sixth
( ) Seventh
( ) Eighth
( ) Ninth
( ) Tenth
( ) Eleventh
( ) Twelfth

7. Do you feel that your children's schools are adequately contributing to the development of children for a role in modern society?

	Yes	No
Elementary School		
Junior high or Middle school		
Senior high school		

8. Do you feel that your children's schools are educating children better today than compared to when you went to school?

	Better	Same	Poorer
Elementary School			
Junior high or Middle school			
Senior high school			

9. Do you feel that the science being taught in your children's schools is adequately contributing to the development of children for a role in modern society?

	Yes	No
Elementary school		
Junior high or Middle school		
Senior high school		

10. Do you feel that your children's schools are placing the proper emphasis on the amount of science currently being taught?

	Yes	No
Elementary school		
Junior high or Middle school		
Senior high school		

11. Do you feel that enough emphasis is placed on the importance of science by teachers, administrators, and students in your school district?

Elementary School	Junior High or Middle School	Senior High School
( ) YES ( ) NO	( ) YES ( ) NO	( ) YES ( ) NO

12. Do you feel that students should have some input as to what the contents of a science course should be?

Elementary School	Junior High or Middle School	Senior High School
( ) strongly agree	( ) strongly agree	( ) strongly agree
( ) agree	( ) agree	( ) agree
( ) no opinion	( ) no opinion	( ) no opinion
( ) disagree	( ) disagree	( ) disagree
( ) strongly disagree	( ) strongly disagree	( ) strongly disagree

13. How would you compare the quality of science teaching today with that which you received when attending schools?

Elementary School	Junior High or Middle School	Senior High School
( ) much better	( ) much better	( ) much better
( ) better	( ) better	( ) better
( ) the same	( ) the same	( ) the same
( ) worse	( ) worse	( ) worse
( ) much worse	( ) much worse	( ) much worse

14. Do you feel that teachers in general are adequately trained to teach science to children in the.....

Elementary School	Junior High or Middle School	Senior High School
( ) YES ( ) NO	( ) YES ( ) NO	( ) YES ( ) NO

15. What is your opinion of the adequacy of the science facilities found in your local school district?

Elementary School	Junior High or Middle School	Senior High School
( ) more than adequate	( ) more than adequate	( ) more than adequate
( ) adequate	( ) adequate	( ) adequate
( ) inadequate	( ) inadequate	( ) inadequate
( ) no opinion	( ) no opinion	( ) no opinion

16. The following list is a set of goals of science education determined by the National Science Teachers Association. Rank the five most important by placing a number (1) in front of the most important goal, a (2) in front of the next most important goal, etc. Then rank your children's schools according to how well those goals are taught.

Rank	Goal	Elementary Good	Elementary Ave.	Elementary Poor	Junior High Good	Junior High Ave.	Junior High Poor	Senior High Good	Senior High Ave.	Senior High Poor
( )	learning how to learn, how to attack new problems, how to acquire new knowledge	( )	( )	( )	( )	( )	( )	( )	( )	( )
( )	using rational processes	( )	( )	( )	( )	( )	( )	( )	( )	( )
( )	building competence in basic skills	( )	( )	( )	( )	( )	( )	( )	( )	( )
( )	developing intellectual competence	( )	( )	( )	( )	( )	( )	( )	( )	( )
( )	developing vocational competence	( )	( )	( )	( )	( )	( )	( )	( )	( )
( )	exploring values in new experiences	( )	( )	( )	( )	( )	( )	( )	( )	( )
( )	understanding concepts and generalizations	( )	( )	( )	( )	( )	( )	( )	( )	( )
( )	learning to live harmoniously with the biosphere	( )	( )	( )	( )	( )	( )	( )	( )	( )

17. Do you feel that ten credits of science should be equated with ten credits of business, music, art or physical education?

( ) YES ( ) NO

If no, explain your reason.

____
____
____
____

18. What is your feeling concerning the integration of science with other subject areas such as social studies, mathematics, humanities, vocational education, etc.

( ) highly favorable
( ) favorable
( ) unfavorable
( ) highly unfavorable
( ) no opinion

19. The following is a list of science related concerns. Rank them in how you perceive their order of importance. (Place a number (1) in front of the one which is most important, a number (2) in front of the one next most important, etc.

( ) population control
( ) environmental quality
( ) career education or preparation
( ) family living
( ) divine creation of the universe

20. To what degree do you perceive any conflict between science and religion in their explanations of the origin of man?

( ) serious conflict
( ) moderate conflict
( ) little conflict
( ) no conflict

APPENDIX I

SCIENCE OPINION QUESTIONNAIRE

1. Age

( ) 20-30
( ) 31-40
( ) 41-50
( ) 51-60
( ) 61-70

2. Sex

( ) MALE ( ) FEMALE

3. What is your academic specialty?

____

____

4. Indicate the number of children you currently have in public schools?

( ) 0
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5 or more

5. Do you feel that public schools in Oregon are generally contributing to the development of children for a role in modern society?

	YES	NO
Elementary School		
Junior High or Middle School		
Senior High School		
Community College		

6. Do you feel that the science being taught in Oregon public schools is adequately contributing to the development of children for a role in modern society?

	YES	NO
Elementary School		
Junior High or Middle School		
Senior High School		

7. Do you feel that Oregon public schools are placing the proper emphasis on the amount of science currently being taught?

	YES	NO
Elementary School		
Junior High or Middle School		
Senior High School		

8. Compare present science education in Oregon public schools with the science education that you received.

	Better	Same	Poorer
Elementary Schools			
Junior High or Middle School			
Senior High School			

9. Do you feel that enough emphasis is placed on the importance of science by teachers, administrators, and students in Oregon public schools?

Elementary school
( ) YES ( ) NO

Junior high or Middle school
( ) YES ( ) NO

Senior high school
( ) YES ( ) NO

10. Do you feel that teachers in general are adequately trained to teach science to children in the. . . .

Elementary school
( ) YES ( ) NO

Junior high or Middle school
( ) YES ( ) NO

Senior high school
( ) YES ( ) NO

11. Do you agree that students should have some input as to what the contents of a science course should be in the. . . . .

Elementary school
( ) strongly agree
( ) agree
( ) no opinion
( ) disagree
( ) strongly disagree

Junior high or Middle school
( ) strongly agree
( ) agree
( ) no opinion
( ) disagree
( ) strongly disagree

Senior high school
( ) strongly agree
( ) agree
( ) no opinion
( ) disagree
( ) strongly disagree

12. Compare the quality of <u>science teaching</u> in Oregon public schools today with that which you received when attending . . . . .

Elementary school	Junior high or Middle school	Senior high school
( ) much better	( ) much better	( ) much better
( ) better	( ) better	( ) better
( ) the same	( ) the same	( ) the same
( ) worse	( ) worse	( ) worse
( ) much worse	( ) much worse	( ) much worse

13. If you had to identify the one major weakness in the science preparation of incoming freshmen, it would be:

( ) poor mathematical training
( ) inability to think critically
( ) inability to identify and analyze a problem
( ) poor development of major concepts and principles in the sciences
( ) poor laboratory skills
( ) inability to use language to express ideas
( ) other (specify)______________________________

14. What kinds of academic training do you feel would best help improve the quality of secondary science teachers in Oregon? (you may check more than one)

( ) more required science courses
( ) more courses in educational strategies and techniques
( ) more mathematics courses
( ) more laboratory courses
( ) independent science related research projects
( ) courses focused on the proper use of scientific instruments
( ) science courses geared for science teachers as opposed to courses for science majors in a particular field
( ) courses in the philosophy of science
( ) other (specify)______________________________
( ) other (specify)______________________________

15. Identify one single change that you would like to be made at the university undergraduate level that you feel would improve the scientific literacy of college students in general.

____
____
____

16. The following list is a set of goals of science education determined by the National Science Teachers Association. Rank what you believe to be the five most important by placing a number (1) in front of the most important goal, a (2) in front of the next most important goal, etc. Then rank Oregon public schools according to how well those goals appear to be taught.

	Elementary			Junior High			Senior High		
	Good	Ave.	Poor	Good	Ave.	Poor	Good	Ave.	Poor
( ) learning how to learn, how to attack new problems, how to acquire new knowledge....	( )	( )	( )	( )	( )	( )	( )	( )	( )
( ) using rational processes..................	( )	( )	( )	( )	( )	( )	( )	( )	( )
( ) building competence in basic skills.......	( )	( )	( )	( )	( )	( )	( )	( )	( )
( ) developing intellectual competence........	( )	( )	( )	( )	( )	( )	( )	( )	( )
( ) developing vocational competence..........	( )	( )	( )	( )	( )	( )	( )	( )	( )
( ) exploring values in new experiences.......	( )	( )	( )	( )	( )	( )	( )	( )	( )
( ) understanding concepts and generalizations	( )	( )	( )	( )	( )	( )	( )	( )	( )
( ) learning to live harmoniously with the biosphere................................	( )	( )	( )	( )	( )	( )	( )	( )	( )

17. What kinds of academic training do you feel would best help improve the quality of elementary teacher's ability to teach science to elementary children?

( ) more required science courses
( ) more courses in educational strategies and techniques
( ) more mathematics courses
( ) more laboratory courses
( ) independent science related research projects
( ) courses focused around proper laboratory techniques
( ) science courses geared for elementary teachers as opposed to science courses for science majors
( ) courses in elementary science education
( ) other (specify)__________
( ) other (specify)__________

18. Do you feel that ten credits of science should be equated with ten credits of business, music, art or physical education in Oregon public schools?

( ) YES ( ) NO

If no, explain your reason

____
____
____

19. What is your response to the suggestion to integrate science with other subject areas such as social studies, mathematics, humanities, vocational education, etc. in Oregon public schools?

( ) highly favorable
( ) favorable
( ) unfavorable
( ) highly unfavorable
( ) no opinion

20. The following is a list of science-related concerns. Rank them in their order of importance. (place a number (1) in front of the one which is most important, a number (2) in front of the one next most important, etc.)

( ) population control
( ) environmental quality
( ) career education or preparation
( ) family living
( ) divine creation of the universe

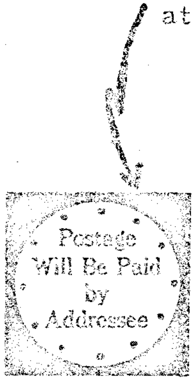
21. Do you perceive any conflict between science and religion in their explanations of the origin of man?

( ) serious conflict
( ) moderate conflict
( ) little conflict
( ) no conflict

APPENDIX J

Technique used for coding the return questionnaires.

Each of the 12 dots represented a particular cell in the matrix. e.g. A dot at the one o'clock position represented Stratum 1 for Eastern Oregon.



No
Postage Stamp
Necessary
If Mailed in the
United States

BUSINESS REPLY MAIL

First Class Permit No. 1 Corvallis, Oregon

Thomas Thompson
Department of Science Education
Corvallis, OR 97331

APPENDIX K

Instructions for the Elementary Principal

Background

The enclosed questionnaires are part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with elementary science education and how it relates to what is currently happening in elementary schools throughout Oregon. No attempt is being made to evaluate individual schools, teachers or administrators. The information sought will be used by the state department of education and state institutions of higher education to improve the quality of science education in Oregon.

Your school has been randomly selected to participate in this study. Anonymity will be maintained throughout the survey.

Directions

a. Selection of partipating teachers:
Alphabetically list all your teachers who have taught one or more years in your school, excluding this current school year. Next count down the list until you come to the third teacher. If you have fewer than three teachers, resume your count back at the beginning of your alphabetical list until you reach number three.

Example using two teachers:

Adams	1	3
Moore	2	

Adams would be the third teacher on an alphabetical list of two.

b. Give the questionnaire and self-addressed stamped envelope to the teacher.

c. The questionnaire should be completed and returned in the self-addressed stamped envelope by October 19, 1973.

Your cooperation will be gratefully appreciated in seeing that this information can be obtained in order to improve the quality of education in Oregon.

Instructions for the Elementary Principal

Background

The enclosed questionnaires are part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with elementary science education and how it relates to what is currently happening in elementary schools throughout Oregon. No attempt is being made to evaluate individual schools, teachers or administrators. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of science education in Oregon.

Your school has been randomly selected to participate in this study. Anonymity will be maintained throughout the survey.

Directions

a. Selection of participating teachers:
Alphabetically list all your teachers who have taught one or more years in your school, excluding the current school year. Next count down the list until you come to the third and eighth teachers. If you have fewer than eight teachers, resume your count back at the beginning of your alphabetical list until you reach number eight.

Example using five teachers:

Adams	1	6
Jones	2	7
Moore	3	
Smith	4	8
Young	5	

Moore and Smith would be the third and eighth teachers respectively who would be chosen to respond to the questionnaires.

b. Give both teachers a questionnaire along with a self-addressed stamped envelope.

c. The questionnaires should be completed and returned in the self-addressed stamped envelopes by October 19, 1973.

Your cooperation will be gratefully appreciated in seeing that this information can be obtained in order to improve the quality of education in Oregon.

Instructions for the Elementary Principal

Background

The enclosed questionnaires are part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with elementary science education and how it relates to what is currently happening in elementary schools throughout Oregon. No attempt is being made to evaluate individual schools, teachers or administrators. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of science education in Oregon.

Your school has been randomly selected to participate in this study. Anonymity will be maintained throughout the survey.

Directions

a. Selection of participating teachers:
Alphabetically list all your teachers who have taught one or more years in your school, excluding this current school year. Next count down the list until you come to the third, fifth, sixth, and eighth teachers. If you have fewer than eight teachers, resume your count back at the beginning of your alphabetical list until you reach number eight.

Example using seven teachers:

Adams	1	8
Foster	2	
Jones	3	
Moore	4	
Smith	5	
Wilson	6	
Young	7	

Jones, Smith, Wilson and Adams would be the third, fifth, sixth, and eighth teachers respectively, who would be selected to participate.

b. Give each teacher a questionnaire along with a self-addressed stamped envelope.

c. The questionnaires should be completed and returned in the self-addressed stamped envelope by October 19, 1973.

Your cooperation will be gratefully appreciated in seeing that this information can be obtained in order to improve the quality of education in Oregon.

Instructions for the Elementary Principal

Background

The enclosed questionnaires are part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with elementary science education and how it relates to what is currently happening in elementary schools throughout Oregon. No attempt is being made to evaluate individual schools, teachers or administrators. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of science education in Oregon.

Your school has been randomly selected to participate in this study. Anonymity will be maintained throughout the survey.

Directions

a. Selection of participating teachers:
Alphabetically list all your teachers who have taught one or more years in your school, excluding this current school year. Next count down the list until you come to the third, fifth, sixth, seventeenth and twenty-second teachers. If you have fewer than 22 teachers, resume your count back at the beginning of your alphabetical list until you reach number 22.

Example using eleven teachers:

Adams	1	12	20
Carlson	2	13	21
Evans	3		
Foster	4	14	22
Jones	5		
Moore	6		
Nelson	7	15	
Smith	8	16	
Thomas	9	17	
Wilson	10	18	
Young	11	19	

Evans, Jones, Moore, Thomas and Foster would be the third, fifth, sixth, seventeenth and twenty-second teachers respectively, who would be selected to participate.

b. Give each teacher a questionnaire and self-addressed stamped envelope.

c. The questionnaires should be completed and returned in the self-addressed stamped envelope by October 19, 1973.

Instructions for the Elementary Principal - 2

Your cooperation will be gratefully appreciated in seeing that this information can be obtained in order to improve the quality of education in Oregon.

APPENDIX L

Instructions for the Secondary Principal

Background

The enclosed questionnaires are part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with secondary science education and how it relates to what is currently happening in Oregon public schools. No attempt is being made to evaluate individual students, schools, teachers or administrators. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of science education in Oregon.

Even though the survey is concerned with science education, we are seeking to get input from a cross section of high school students. Therefore we have arbitrarily selected social studies students in grades 10-12 as our population. Anonymity will be maintained throughout the survey.

Directions

a. Selection of participating teachers:
   Alphabetically list all your teachers who teach social studies to students in grades 10-12. Next count down the list until you come to the seventh teacher on the list. If you have fewer than seven social studies teachers, resume your count back at the beginning of your alphabetical list until you reach number seven.

   Example:

Adams	1	6
Jones	2	7
Moore	3	
Smith	4	
Young	5	

   Jones would be the seventh teacher who would be chosen to administer the questionnaires.

b. Give the teacher the questionnaires along with the enclosed instructions and self-addressed stamped folder.

c. The questionnaires should be completed and returned in the self-addressed stamped folder by October 19, 1973.

Your cooperation will be gratefully apprecitaed in seeing that this information can be obtained in order to improve the quality of education in Oregon.

Instructions for the Secondary Social Studies Teacher

Background

The enclosed questionnaires are part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with secondary science education and how it relates to what is currently happening in Oregon Public Schools. No attempt is being made to evaluate individual students, schools, or teachers. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of education in Oregon.

Even though the survey is concerned with science education, we are seeking to obtain input from an unbiased cross section of high school students. Therefore we have chosen to use high school social studies students in grades 10-12 as the representative population. Anonymity will be maintained throughout the survey.

Directions

a. Selection of participating students:

Alphabetically list all the students in your first social studies class that you normally meet with on Tuesdays. Count down the list until you come to the eleventh student. If you have fewer than eleven students, resume your count back at the beginning of your alphabetical list until you reach number eleven.

Example--a class of nine students:

Adams	1	10
Carlson	2	11
Foster	3	
Jones	4	
Nelson	5	
Peters	6	
Smith	7	
Thomas	8	
Wilson	9	

Carlson would be the eleventh person selected from a class of nine students.

b. Give the student a copy of the questionnaire to complete. Collect and return it in the self-addressed stamped envelope by October 19, 1973.

Your cooperation will be gratefully appreciated in seeing that this information can be obtained in order to improve the quality of education in Oregon.

Instructions for the Secondary Social Studies Teacher

Background

The enclosed questionnaires are part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with secondary science education and how it relates to what is currently happening in Oregon Public Schools. No attempt is being made to evaluate individual students, schools, or teachers. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of education in Oregon.

Even though the survey is concerned with science education, we are seeking to obtain input from an unbiased cross section of high school students. Therefore we have chosen to use high school social studies students in grades 10-12 as the representative population. Anonymity will be maintained throughout the survey.

Directions

a. Selection of participating students:
Alphabetically list all the students in your first social studies class that you normally meet with on Tuesdays. Count down the list until you come to the 5th, 11th and 14th students. If you have fewer than 14 students, resume your count back at the beginning of your alphabetical list until you reach number 14.

Example--class of ten students

Adams	1	11
Carlson	2	12
Foster	3	13
Jones	4	14
Moore	5	
Nelson	6	
Peters	7	
Smith	8	
Thomas	9	
Wilson	10	

Moore, Adams and Jones would be the 5th, 11th, and 14th students respectively selected from a class of ten students.

b. Give the three students copies of the questionnaire to complete. Collect and return them in the self-addressed stamped envelope by October 19, 1973.

Your cooperation will be gratefully appreciated in seeing that this information can be obtained in order to improve the quality of education in Oregon.

Instructions for the Secondary Social Studies Teacher

Background

The enclosed questionnaires are part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with secondary science education and how it relates to what is currently happening in Oregon Public Schools. No attempt is being made to evaluate individual students, schools, or teachers. The information sought will be used by the State Department of Education and the state institutions of higher education to improve the quality of education in Oregon.

Even though the survey is concerned with science education, we are seeking to obtain input from an unbiased cross section of high school students. Therefore we have chosen to use high school social studies students in grades 10-12 as the representative population. Anonymity will be maintained throughout the survey.

Directions

a. Selection of participating students:

Alphabetically list all the students in your first social stu studies class that you normally meet with on Tuesdays. Count down the list until you come to the 3rd, 5th, 6th, 11th, 14th and 22nd students. If you have fewer than 22 students, resume your count back at the beginning of your alphabetical list until you reach number 22.

Example--a class of 15 students:

Adams	1	16
Carlson	2	17
Evans	3	
Foster	4	18
Jones	5	
Moore	6	
Nelson	7	19
Peters	8	20
Roberts	9	21
Smith	10	22
Thomas	11	
Thompson	12	
Weber	13	
Wilson	14	
Young	15	

Evans, Jones, Moore, Thomas, Wilson and Smith would be the 3rd, 5th, 6th, 11th, 14th and 22nd students respectively selected from a class of fifteen students.

b. Give the six students copies of the questionnaire to complete. Collect and return them in the self-addressed stamped folder by October 19, 1973.

Your cooperation will be gratefully appreciated in seeing that this information can be obtained in order to improve the quality of education in Oregon.

APPENDIX M

Instructions to the P. T. A. President

Background

The enclosed questionnaires are part of a survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with science education for grades K-12 and how it relates to what is currently happening in Oregon Public Schools. No attempt is being made to evaluate individual P. T. A. members or affiliated schools. The information sought will be used by the State Department of Education and state institutions of higher education to improve the quality of science education in Oregon.

You have been randomly selected from other local P. T. A. officers throughout Oregon. Anonymity will be maintained throughout the study.

Directions

a. Selection of participants:
   Two questionnaires are included. One is to be completed by you, president of your local P. T. A. The second questionnaire should be given to another office holder such as vice president, secretary or treasurer.

b. Two self-addressed envelopes are included for the return of the questionnaires. Each participant should return his/her questionnaire separately to insure anonymity.

c. The questionnaires should be completed and returned in the self-addressed stamped envelopes by October 19, 1973.

Your cooperation will be gratefully appreciated in seeing that this information can be obtained in order to improve the quality of education in Oregon.

APPENDIX N

Instructions for the OSU scientist

To Selected Faculty Science Members:

Enclosed you will find an opinion survey which is being distributed to selected science faculty members on the Oregon State campus. The questionnaire is part of a statewide survey which is being conducted by the Oregon Mathematics Education Council in cooperation with the Oregon State Department of Education. The requested information is concerned with science education and how it relates to what is currently happening in Oregon public schools. No attempt is being made to evaluate individual faculty members, departments or local schools. The information sought will be used by the State Department of Education and institutions of higher learning in an effort to improve the quality of science education in Oregon. Anonymity will be maintained throughout the study.

Would you please return the completed questionnaire in the campus mail. It should be sent to:

Thomas Thompson
Department of Science Education

Your cooperation in completing and returning the questionnaire by November 9, 1973 will be gratefully appreciated.

Thomas Thompson
Department of Science Education
Oregon State University

APPENDIX O

Responses to question #8d. of ETQ-I which asked "What do you think that person could do to improve his effectiveness?".

Frequency	Response
53	not sure
22	needs more time
9	nothing
3	be available
3	workshops
3	give demonstrations
3	better organized
2	adopt new program
2	concerned with unimportant details
2	keep up to date on new materials
2	meetings to discuss problems
2	stick with beginning plans
1	teach the value of science
1	resign
1	could do better if teachers were happier
1	make assignments of material covered
1	get live materials faster
1	coordinate SAPA with other science
1	use more student materials
1	draw on outside resources
1	push for science to be taught more
1	by teaching all the sciences
1	be more definite
3	no reply

APPENDIX P

Fifty-two science-related field trips taken by elementary students.

Frequency	Field Trip
68	nature walk
51	none
34	Oregon Museum of Science
21	forestry
11	ocean
11	OSU Marine Science Center
9	outdoor school
9	fish hatchery
8	zoo
7	planetarium
6	geology
6	dairy
5	farm
5	weather station
4	museum
3	outdoor planet study
3	mountains
3	job opportunities
2	Undersea gardens
2	arboretum
2	wildlife refuge
2	4-H
2	pet shop
2	field study
2	Portland public Docks
1	Wildlife Safari
1	Enchanted Forest
1	paper mill
1	Columbia Gorge
1	gas shortage
1	chicken hatchery
1	nuclear reactor
1	can company
1	photography
1	fire department
1	Portland International Exhibit
1	art collecting

APPENDIX P (continued)

Frequency	Field Trip
1	sailing ship
1	Audubon Society
1	radio station
1	electric shop
1	air port
1	ecology
1	park
1	greenhouse
1	airplane ride
1	contact lens manufacturer
1	woolen mill
1	stream exploration
1	T. V. studio
1	cricket hunt
1	Deer Park
55	no reply

APPENDIX Q

Responses to the question - "Describe the procedure for making a program evaluation" - ETQ-I.

Frequency	Evaluation procedure
15	Science committee from school
10	No reply
9	Don't know
6	Principal's observation
5	Teacher written evaluation
4	Science coordinator
4	Area goals
4	Standardized tests
3	SAPA checklist
3	Number of units checked out in a school year
2	Subjective
2	Based on performance objectives
2	Brainstorming & building coordinator
2	Checklist & short answer questionnaire
2	Questionnaire and group discussion
2	Achievement test
1	Previous science fairs
1	Forms from administration
1	In-service
1	Pupil evaluation
1	Check list by teachers
1	County elementary supervisor's observation
1	Grade level meetings
1	Teacher evaluates each lesson after they teach it
1	Pilot program for evaluation

APPENDIX R

Responses to the question - "Explain why there is a discrepancy between the school's philosophy and the philosophy of the science program.".

Frequency	Response
2	No written philosophy for the science department.
2	Inadequate science laboratories.
2	No reply
1	A course was dropped without regard for the curriculum.
1	Class size makes it impossible.
1	No continuity from the lower grades.
1	Don't know what philosophy is.
1	Need two years to teach physical science
1	Science is more progressive than school philosophy
1	Science courses don't provide a broad enough base for varied interests.
1	BSCS green version is taught in vocational school
1	Not exploratory enough in science.
1	Not enough time for science.
1	Administration won't invest in student activities for science.
1	My view & school's view don't agree.

APPENDIX S

Responses to the question describing the formal articulation between elementary and secondary school science programs.

Frequency	Response
8	District science coordinator
5	No reply
5	District curriculum for grades 1-12
3	Coordinated SAPA program
3	District wide science committee
2	District meetings
2	Meet once a month
1	Curriculum planning - but not teaching
1	Communication is limited
1	Host elementary teachers at junior high school
1	Secondary program builds on elementary program
1	SAPA precedes ISCS
1	Coordinate program
1	Visits all other school programs
1	Very sporatic
1	Very little
1	They try to correlate programs
1	Elementary & secondary are both laboratory approaches
1	Programs were selected with similar philosophies
1	Progressive process in books read
1	Department heads meet
1	7-12 picks up where K-6 leaves off
1	Junior high and senior high staffs meet
1	Placement into general science of biology

APPENDIX T

Responses to the "other" category of the question asking which source of training did the teacher receive for such courses as BSCS, PSSC, ESCP, etc. - SSSQ-I.

Frequency	Responses
2	NSF Summer Institute
2	CBA
2	Portland project
1	BSCS grant
1	NSF Conference
1	ESCP seminar
1	ESCP summer institute
1	Student teaching
1	Academic Year Institute
1	NSF
1	BSCS
1	IPS
1	BSCS second year
1	ECCP
1	HPP
1	ISIS writer
1	Laboratory instructor for ESCP

APPENDIX U

Responses to the kinds of science-related activities that are related to career education at the secondary level.

Frequency	Response
32	none
18	Speakers
14	Films
8	Field trips
8	Discussion
5	Career education classes
4	Pamphlets
4	Individual projects
4	Bulletin material
4	Health occupations
3	Teaching units
3	Science careers
3	Forestry
3	Variety of things (skill building, communication, problem solving)
3	Oceanography careers
2	School counselor
2	Relevance of science for careers
2	Cluster mods
2	Research on individual jobs
2	Laboratory aids
2	Horticulture
2	Conservation
2	College preparation
2	Agriculture
1	Work experience
1	Small engines class
1	Awareness
1	Nursing
1	Counseling individuals
1	Correlating subject with vocational area
1	Future Teachers of America
1	Giving inspiration
1	Shop courses
1	Career terminal in class
1	Students with jobs
1	Work experience program
1	Economic geology

APPENDIX U (continued)

Frequency	Response
1	Meteorology
1	Great scientists
1	Job availability
1	Heavy equipment
1	Engine theory
1	Advance science courses
1	Science club
1	Science program for career cluster
1	Photography
1	Engineering careers
1	Computer career information
1	Rocks and minerals
1	Scientific field survey
1	Job variety
1	Health service literature
1	Teacher aids
1	Aids at hospital
1	Reading
1	Summer programs
1	Visitations
1	Integration with courses
1	Career education research center
1	Skills for medical school
1	Aids at veterinary clinic
1	Social studies class on understanding through occupational exploration
1	Introduction to careers in subject matter
1	Individual reports
1	Volunteer work
1	Counseling center
1	Library files
1	Visitations
60	No reply

APPENDIX V

Responses to the question asking for a brief description of the scientific research that the teacher is currently engaged in.

Frequency	Response
4	No reply
2	Water analysis
2	Use of laser in measuring and in holograms
2	Small projects
2	Marine aquarium
2	Geological in nature
1	Chemistry research
1	Doubling chromosomes on plants
1	Analysis of creek
1	Limnological studies on a river
1	Ecological studies - Biology II class
1	Dissection of mammalia
1	Use of science magazines
1	Culturing protozoa
1	Greenway & open space of city
1	Mouse breeding
1	Interaction between animals & chemicals
1	Individual study
1	Astrophotography and cosmic ray study
1	Field research
1	Beach ecology
1	Genetics, breeding guppies
1	Wave studies
1	Ecological studies
1	Westinghouse Talent Search
1	Natural history
1	Effects of X-rays on drosophila

APPENDIX W

Responses to those organizations which science teachers belong other than those listed in Table 68.

Frequency	Organization
18	Local Teachers' Association
3	Oregon Council of Teachers of Mathematics
1	Phi Delta Kappa
1	American Museum of Natural History
1	Portland Federation of Teachers
1	Geology Society
1	Oregon Nurses Association
1	Audubon Society
1	Izzack Walton League
1	Oceanography Association
1	Sigma Xi
1	Atronomical Society of the Pacific
1	Environmental Education Council

APPENDIX X

Responses explaining the type of articulation between the elementary schools and secondary school.

Frequency	Response
7	Informal
4	A curriculum guide
2	District committee
2	Science department meeting
2	Rather vague
2	Through meetings
2	Science teachers assist elementary teachers
2	Science coordinator
1	Between grades 6-12
1	ISCS → BSCS
1	Planning
1	Through science goals for district
1	Teachers do deminstrations
1	Committee meets in summer and throughout year
1	A curriculum guide
1	Have a K-12 program
1	EIS → ISCS
1	Trying to adapt
1	Vertical curriculum study
1	Elementary and secondary coordinators
5	No reply

APPENDIX X (page 2)

Responses explaining the type of articulation between the junior high science and the senior high science program.

Frequency	Response
13	Science department meets
10	Informal
6	Rather vague
6	Through meetings
6	Sequences
5	A curriculum guide
5	Science coordinator
2	Through science goals for district
2	Have a K-12 program
2	Vertical curriculum study
1	Between grades 6-12
1	District committee
1	Planning
1	Between SAPA, ISCS, BSCS, etc.
1	IPS → Physical science
1	Meets twice a year
1	Meetings for developing common goals
1	ISCS (I & II) in junior high and ISCS (III) in senior high school
1	Biology department
1	Junior high biology → senior high biology

APPENDIX Y

Responses to the "some other committee" and "other" categories of the question asking the secondary science teacher how the science curriculum was selected.

"Some other committee"

Frequency	Reponse
2	Citizen and Teacher
2	Teachers, students and citizens
1	Board member, superintendent, principal, teacher and department chairman
1	By accident
1	Teachers and curriculum specialist
1	State guidelines
1	Board and teacher committee
1	Principal, guidance counselor and teachers
1	School curriculum committee

"Other"

10	Picked by self
7	Picked by individual teacher
2	By tradition
2	Student and teacher
1	Student interest
1	Science staff and other teachers
1	Don't know
1	Central administration
1	District curriculum committee
1	Adopted before coming

APPENDIX Z

Responses to the "other" category of the question asking which source of training did the teacher receive for such courses as BSCS, PSSC, ESCP, etc. - SSSQ-II.

Frequency	Response
5	NSF Summer courses
2	Shell Fellowship
2	Practical experience
1	Portland State University Department Chairman
1	NSF Summer course - IPS
1	Teacher
1	NSF Summer Institute - PSSC
1	ISCP
1	ESCP
1	Academic Year Institute

APPENDIX AA

Responses to the "other" category of periodicals read by science teachers not listed in Table 87.

Frequency	Periodical
8	Natural History
5	Oregon Bin
4	Environment
4	Bulletin of Atomic Scientist
3	Bio Science
3	Smithsonian
3	Pacific Search
3	The Oregon Science Teacher
2	American Journal of Physics
2	Popular Science
2	Nature
2	Conservationist
2	Search
2	Mathematics Teacher
2	Geo Times
2	Audubon
2	Sea Frontier
2	Carolina Printout
1	Air Progress Pilots
1	Aviation News
1	Science and Mechanics
1	Earth Science
1	Today's Health
1	Journal of Mammology
1	Current Science
1	Journal of Geological Education
1	Oceans
1	Earthwatch Oregon
1	National Fisherman
1	Popular Electronics
1	California Geology
1	National Rules and Conservation
1	California Department of Geology Publications
1	Ecological Journal
1	Mining Engineering

APPENDIX BB

Responses to the question, "Describe the procedure for making a program evaluation." - SSSQ-II.

Frequency	Evaluation Procedure
12	Informal
11	Science department
6	Group - teachers and administrators
6	Outside evaluation
5	Evaluation of competencies of students
4	Currently developing a process
4	Student's performance in high school
3	Student evaluation instrument
3	Department chairman
3	Student's performance in college
2	Random sample of students given a test each month
2	Department chairman evaluates teachers
2	Administration
2	Curriculum committee
2	Evaluation forms for teachers to fill
2	Science committee
2	Curriculum days
1	Very difficult
1	Science in-service in building
1	Pre and post tests
1	Surveys of student attitudes
1	Self
1	Summer curriculum committee
1	District wide evaluation
1	Subject area specialists
1	Survey
1	Total school evaluations
1	Curriculum consultant
1	Evaluative Criteria
1	Achievement Tests

APPENDIX CC

Recommendations by elementary teachers for improving the undergraduate preparation of elementary teachers.

Frequency	Response
19	More science courses
13	Methods course in elementary science
11	More science methods in new approaches
10	Supervised practicum in science
5	Update courses to meet ESS, etc.
5	Science courses for elementary teachers rather than for science majors
4	Do more pupil oriented activities
3	Simple explanations of science concepts
3	How to teach at primary grades
3	Practical application of unit material
3	More laboratory work
2	Discovery methods of teaching
2	Teacher's attitude must be changed
2	More "hands on" workshop training
1	In depth course in newer programs
1	Drop methods course - only have content
1	In-service for district
1	Develop more teaching units
1	Focus on value of science for society
1	Two years preparation of science background, then develop units
1	Too textbook oriented
1	Teaching techniques for science
1	A science textbook
1	Relevant science background
1	Basic fundamentals rather than process
1	Departmentalize
1	Need a stronger program or someone to help teach the course
1	Process skill training
1	Less science and more reading and math
1	More life sciences
1	Preparation in post-baccalaureate work
1	Outdoor education
1	Physical science
1	Stress science in the environment, less common sense
1	More research
18	No reply

APPENDIX DD

Elementary teachers' responses to the question, "What should have been done in those classes that you feel could have been more helpful?"

Frequency	Response
17	Less lecture, more participation
14	More practical activities
14	Teach methods of science
11	Relate to elementary school situations
9	Actual teaching experience with children
7	More practical application
5	Relate to student needs
5	More observation
4	Basic science courses
4	Work with students during methods course
4	More emphasis on new programs
3	More outdoor experiments
3	Not sure
3	Use student materials
3	More demonstrations
3	Experiments at class level
2	Longer time for course (2 years)
2	Gear to primary level
2	More background for those with little experience
2	Training by teachers, not professors
2	Correlation between what is taught and what happens in schools
2	Discovery learning
1	More teaching ideas
1	Small group studies
1	Doing SAPA lessons
1	Classes especially for elementary children
1	More A-V presented materials
1	More field trip experiences in undergraduate preparation
1	Methods should have been more specific
1	General science should have been required
1	Game projects
1	Make unisort cards

APPENDIX EE

Responses given by elementary teachers for recommending what should be done to place the proper emphasis on science in the elementary school

Frequency	Response
8	Lack of equipment
6	In-service (tips on how to teach)
5	A person to teach all the science
3	Get a better program
3	Need more time to teach science
3	None
2	Better textbooks
2	Familiarity with new system
2	Currently under investigation by a committee
2	Tie science in with other subjects
2	Use science laboratories
1	Don't teach science in the primary grades
1	More student activities
1	More life science
1	Need a definite program
1	Force the teachers to follow a curriculum
1	Get a program and its equipment
1	Make it more self discovery
1	In-service for S-APA
1	Necessary materials
1	A more flexible program
1	Fewer concepts for the primary grades
1	Discuss with group at meeting
1	In-service something narrow in scope
1	District should give more support to old programs
1	In-service (district) followed by grade level meeting
1	In own room - yes, in whole school - no
1	Relate science to every day experiences
1	Tie science in with environmental and career education
1	None
1	Seventh & eighth grades need more
1	Too much emphasis on fact
1	Teachers should use all the units
1	More science on a less esoteric level
13	No reply

APPENDIX FF

Secondary science teachers responses for recommending what could be done to place the proper emphasis on science in their school

Frequency	Response
8	Two years of required science
4	More course offerings
4	One year of required science for seventh and eighth grades and one year of science for ninth grade
4	Not enough budgeted funds
3	More field trips and related field-laboratory experiences
3	Environmental science courses
3	More practical application
2	Coherent sequence for grades 7-12
2	More advanced courses
2	Three years of science
2	Counsel more students into chemistry and physics
2	Student ability should be considered for scheduling
2	Poor facilities limit the program
1	Mathematics as a tool of science
1	Science related to careers
1	Back to basic fundamentals
1	Two hour laboratories
1	More freedom of choice
1	Reduce competition with athletics
1	Change from two years of required science to one year required plus 1 year elective
1	Integrate science with other subjects
1	One teacher shouldn't be required to teach everything
1	Physical science for seniors who don't take chemistry or physics
1	Fewer required courses
1	New graduation requirements will indicate the proper amount
1	Require more than one year of laboratory science
1	Teachers should teach in their subject matter specialty
1	Courses are too watered down
1	No physical science course
1	Differing levels of difficulty
1	Remove biology as a required course
5	No reply

APPENDIX GG

Secondary science teachers responses for recommending what could be done in the science training of young adults to improve their development for a role in modern society.

Frequency	Response
5	More practical application
3	More student involvement in science issues
2	Terminal high school student needs more science
2	Currently revising the curriculum
2	Too many students not taking science
2	Limited scope of course offerings
2	Limited course offerings
2	More mathematics and reading skills
2	Better facilities
2	Integrate science with other areas
1	Schools are too traditional
1	Students are not receptive to new ideas
1	BSCS is too difficult for most students
1	More information on computer science
1	Better preparation in the elementary grades
1	Biology is the only required course
1	Students don't devote the necessary time and effort to science
1	Schools operate on the theory that students won't go on to college
1	Better multi-grade curriculum development
1	More laboratories
1	Some is not relevant
1	More field experiences
1	Consumer science
1	Environmental emphasis
1	More student enrollment in science
1	Challenge students - make them think
1	More students in advanced courses
4	No reply

APPENDIX HH

Secondary science teachers' responses to suggestions for more interesting science courses.

Frequency	Response
4	Offer mini courses
4	Advanced science courses
3	Community preparation
3	Environmental science
3	Oceanography
2	Ecology
2	Space science
2	Consumer chemistry
2	Life science
2	Individualized project course
1	Pre-nursing
1	More science projects
1	Science for fun and recreation
1	Let students pick areas of interest
1	Adapt concepts to fit in with life experiences of students
1	Earth science elective
1	Horticulture
1	Science for high ability students
1	Field studies in earth science
1	Problem solving
1	Teachers should use market courses
1	Integrate science
1	Applied science courses
1	Better reading materials
1	Meteorology
18	No reply

APPENDIX II

Responses by secondary science teachers explaining their responses to why ten credits of science shouldn't be equated with ten credits of other subjects.

Frequency	Response
16	Nature of science requires more study and work
11	Science is more difficult
7	Because of laboratory work
7	Only on physical education, physical education shouldn't be graded
6	Use the amount of work involved to determine credit, i.e. college work
2	Science should be more demanding and result in greater reward
2	Comparisons are difficult to equate
2	Science has required objectives, rather than exposure to subject
2	Because students avoid science because it lowers their G.P.A.
2	Only for music, art and physical education
1	Science courses are more demanding - physically and mentally
1	Science is a pursuit different from other subjects
1	Different value
1	A case can be made pro and con - hasn't made up mind yet
1	Science requires more understanding than "fuzzy" subjects
1	Only for those going on in science
1	All people are not science students
5	No reply

APPENDIX JJ

"Other" responses to the type of science course taken in secondary school by high school students.

Frequency	Response
6	Oceanography
6	Biology II
4	General science
3	Ecology
2	Animal science
2	Geology
2	Biology III
2	Integrated science
2	Conservation
2	Life science
1	Photography
1	Physics, anatomy and physiology
1	Botany and water ecology
1	Consumer chemistry
1	Environmental biology
1	Man's environment
1	Aerospace
1	Basic chemistry
1	Astronomy and geology
1	Physiology
1	Genetics
1	Horticulture
1	Physical science II
1	Space science
1	Human anatomy
1	Advanced chemistry
1	Mini courses
1	Alcohol, tobacco and drugs
1	Astrology

APPENDIX KK

Students' suggestions for new science course offerings.

Frequency	Response
6	Biology II
5	Environmental education
5	Astronomy
4	Wildlife observation
4	Oceanography
2	More practical application
2	Microbiology
2	Ecology
2	Space sciences
2	Zoology
2	Geology
2	Organic chemistry
2	Science with less mathematics
2	More advanced biology
2	Animal science
2	Astronomy and geology
1	Computer programming
1	Forestry and wildlife
1	Short courses
1	Topology
1	Advanced earth science
1	Advanced chemistry and advanced biology
1	Nursing
1	Medical and dental science
1	Industrial chemistry
1	Horticulture
1	Advanced anatomy and physiology
1	More diversity
1	Ones on one certain subject
1	Anatomy
1	Embryology
18	No reply

APPENDIX LL

Students' suggestions for improving the fairness of the grading system in science.

Frequency	Response
4	Grade on individual ability
2	Grade on a curve
2	Grade on participation, not on tests
2	Grade on effort
2	Less emphasis on grades
2	Don't make exceptions
1	More explaining in class
1	More credit should be given
1	Classes should be made easier
1	"Objectional" labs should be optional
1	Too much emphasis on lab reports
1	Teachers should be more fair
1	Grade easier
1	Should not be competitive
1	Get rid of grades
1	Teacher was unjust
1	Science is hard, therefore grade it easier
1	Graded on what you learn, not on projects
1	Science is not necessary, art expresses feelings
1	Make science a pass-fail course
1	Grade on attitude towards science
1	Don't go on without understanding
1	Science can't be graded fair

APPENDIX MM

Students' explanations for not equating ten credits of science with ten credits of other subject areas.

Frequency	Response
21	Science is harder
8	Science requires more work
4	Get more credits for science
4	Science requires more thinking
3	Science is more in depth
2	Advanced science should get more
2	Science is a brain course
2	Science has more value
2	Science is worth more
2	Worth more because of labs
1	There is more to learn about science
1	Science is different
1	Physical education and art are useless
1	Music is an art
1	Science is more complex
1	No comparison with other subjects
1	Science requires more time

APPENDIX NN

Students' responses to the type of career they are pursuing in science.

Frequency	Response
19	Medicine
11	Engineering
9	Veterinary medicine
8	Forestry
5	Dentistry
4	Not sure
4	Mechanical engineering
3	Nursing
3	Pharmacy
3	Dental hygienist
3	Oceanography
2	Chemistry
1	Aeronautics
1	Speech therapy
1	Aerodynamics
1	Psychology
1	Physical therapy
1	Astronomy
1	Water biology
1	Lab technician
1	Animal science
1	Marine biology
1	Environmental
1	Nursing, doctorate
1	Aerospace
1	Photogrammetry
1	Machine work
1	Astronautical engineer
1	Archeology
1	Photography
1	Science teacher
1	Agriculture
1	Zoology
1	Structural geology
1	Anthropology

APPENDIX OO

Students' description of the kinds of career education instruction they are receiving in science classes.

Frequency	Response
6	Biology
4	Books and pamphlets
3	Anatomy
2	Can't remember
1	Study of light and its properties
1	Teacher recommended readings
1	Keep in mind to be a researcher or a nurse
1	Advanced placement in chemistry
1	Took career interest tests
1	Different courses
1	Forestry
1	Conservation
1	Brief career goals for science
1	Stars in earth science
1	Counseling
1	Medical fields
1	Geology and forestry jobs
1	Biochemistry
1	Work as a scientist
1	Little discussion
1	Speaker invited

APPENDIX PP

PTA officers' explanations for not equating ten credits of science with ten credits of other subject areas.

Frequency	Response
7	Science is more difficult
6	Business-yes, art, P.E. and music-no
6	Science is more important
5	Science should be worth more credits
4	More time is needed for science classes
2	Only for those wishing a career in science
1	Aptitude should be considered
1	Children need extra science
1	Science isn't something you use in everyday living
1	Unless you're majoring in P.E.
1	Most are interested in science, only a few are interested in other subjects
1	Others are electives
1	Because they are equated, students select easier route
1	Depends on individual interest of the child
1	Science needs to be made more interesting
1	Science needs to be integrated with other subjects
1	Ten credits of science are worth fifteen of others
1	Science is far greater in scope
1	Science gives children much more
1	Science should be an elective
10	No reply

APPENDIX QQ

Frequency distribution of the academic specialties of the OSU scientists.

Frequency	Academic specialty
28	Engineering
22	Chemistry
18	Botany
15	Zoology
13	Oceanography
12	Forestry
9	Mathematics
8	Pharmacy
7	Biochemistry and biophysics
7	Physics
6	Ecology
6	Genetics
5	Food science
5	Geology
4	Agriculture
4	General science
3	Horticulture
3	Veterinary medicine
3	Meteorology
2	Economics
2	Crop science
2	Microbiology
2	Health
2	Statistics
2	Computer science
1	Soil science
1	Antrhopology
1	Dairy
1	Radiation biology

APPENDIX RR

"Other" responses to the OSU scientists' opinion about the kinds of academic training that would best improve the quality of secondary science teachers in Oregon.

Frequency	Responses
5	Relate to practical needs of people
3	Better grammar and communication skills
3	Apprentice teaching with proper scientists
2	Humanities and liberal arts
2	More homework at all levels
1	Experience working in science
1	Find scientists who can teach, not teachers who sample science
1	Hire science teachers rather than education types
1	Courses in engineering as well as science
1	Fusion of science with sociology
1	Methods where emphasis is on methods not on lesson plan preparation
1	Science courses related to professional fields
1	Straight and crooked thinking (excitement of science)
1	More rigorous training and testing of students
1	Require courses emphasizing quantitative aspects for all students
1	Learn ability to analyze
1	How to teach science
1	Higher standards in science courses
1	Scientific writing
1	History of science courses
1	Should complete an academic major
1	B.S. in science and a M.S. in science education

APPENDIX SS

OSU Scientists' suggestions for improving the scientific literacy of university undergraduate students.

Frequency	Responses
23	Encourage themes for English (critical writing)
11	Require individual research projects
7	Require one year of biological and physical science as a part of general education
6	Higher admission requirements for college
5	Require more solid science courses
5	Additional mathematics training
4	Require substantial science for general education
4	Science courses should be taught by the "best" members of the department
4	Training in using the scientific section of the library
4	Study of ecology
3	Appreciation of science courses
3	Emphasis on practical application
3	History of science and philosophy of science
3	Emphasis on the interdisciplinary aspects of science
3	Develop ability to think critically
3	More funds
3	Reduce class size of introductory courses
2	Concentrate on approach to solving problems
2	Better mathematics application
2	Critically evaluate papers by scientists
2	Ability to think clearly
2	Better teachers
2	Replace general chemistry with integrated chemistry
2	Science seminars
1	Satisfactory as is
1	Each course - student learns basic information - then synthesizes solution
1	Nothing, it should be done before college
1	Require a general chemistry course for everyone
1	Independent reading
1	Removal of "lab sci" requirements with substitution of thoughtful humanistic survey courses
1	5 year program
1	Stimulate intellectual curiosity
1	One year of chemistry and one year of physics, one year of elective

APPENDIX SS (continued)

Frequency	Response
1	Abolish honoring credit for high school courses
1	Integrate math with sciences
1	For science teachers to concentrate on subject, not how to teach
1	General biology for all non-science majors
1	To allow certain courses in professional schools
1	Fail incompetent students
1	Require a science sequence outside of major field
1	Lab projects (tied to practical aspects)
1	More flexibility
1	More math courses
1	One year of philosophy of science
1	Abolish introductory survey courses
1	Require chemistry, zoology, botany, and genetics
1	More awareness of student needs
1	Promote interest in learning rather than grades
1	Courses in science appreciation
1	Better teaching in low level math courses
1	Student must master calculus, physics, chemistry and biology
1	Increase number of science courses for science teachers
1	Higher standards of performance
1	Broad liberal arts education to know man
1	Better math teaching
1	Establish minimum competence in math & science
1	Study cause-effect relationship
1	More rigor
1	Improve ethics, logic, & esthetics
1	Critical evaluation of course by professor & students
1	Re-group undergraduate education students into different subject areas (cross discipline)
1	General courses rather than technical
1	Teach them to become independent learners
1	Improved concept of higher education
1	A senior thesis
1	Better system of advisors
1	Combine science with communication skills and cultural values
1	One year chemistry, one year physics

APPENDIX SS (continued)

Frequency	Response
1	Encourage students to take technical courses like agriculture & forestry
1	Courses in science terminology & science communication (not necessarily report writing)
1	Upgrade upper division courses
1	Present material based on facts, not opinion
1	Fewer education courses for science education majors
1	Eliminate the school of Education & Physical Education majors
1	Better "school" (O.S.U. recognition of student success)
1	Development of discipline oriented course for non-science majors by members of particular discipline
1	Math is weak point of all science education
1	More freedom of direction & expression
1	Less pre-requisite constraints
1	Advantages of science approach in thought & action
1	Better training for college teachers
1	Integrate math with science
39	No reply

APPENDIX TT

"Other" responses to the OSU scientists' opinion about the kinds of academic training that would best improve the quality of elementary teachers' ability to teach science.

Frequency	Response
3	Better communication skills
2	Courses in the philosophy of science
2	Humanities and liberal arts
2	Applied science courses
1	Courses exploring the inquisitive mind of the elementary education major
1	Science refresher courses geared to elementary school teaching
1	Engineering science
1	No more required
1	Better methods courses
1	Provide them with realistic teaching

APPENDIX UU

OSU scientists' explanations for not equating ten credits of science with ten credits of other subject areas.

Frequency	Response
16	More time and effort for science
12	To equate is like adding horses and cows together (not equivalent)
6	Science intellectual development exceeds others
4	Science is more valuable in life
4	No credit for physical education
3	More credit hours should be given for sciences
3	Ten credits of science are more valuable to a college student
1	Student should have some music and art
1	Business and physical education dull student's rational processes
1	Credits have little bearing on person's performance
1	Too thin training
1	Science can be best taught in school, others elsewhere
1	Not with P. E., but with business
1	Do not have to think in other courses
1	Ten credits of science equal 15 credits or 20 credits for P. E.
1	Science should be required not an elective
1	Science is learned, not native talent
1	Music and art require practice
1	Education courses should be separated from "fun" courses