A STUDY OF SCIENCE PROGRAMS IN GRADES SEVEN, EIGHT AND NINE OF MICHIGAN PUBLIC SCHOOLS

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ABSTRACT

A STUDY OF SCIENCE PROGRAMS
IN GRADES SEVEN, EIGHT AND NINE
OF MICHIGAN PUBLIC SCHOOLS

by Joseph Esmond Bowles

The purpose of this study was to elucidate the status of science programs in grades seven, eight, and nine of Michigan Public Schools, and to develop recommendations which would contribute to further improvement of science education at these grade levels as well as to the K-12 program. Primary consideration was given to certain of those school provisions and practices which give general indication of current procedures and the bases on which programs are conducted.

The data for the study were obtained by questionnaire from a disproportionately stratified sample consisting of 140 of the 1101 schools which contained one or more of grades seven, eight, and nine in the K-12 Public School Districts of Michigan. The schools were classified as elementary, junior high, or senior high schools.

The study revealed that all of the elementary schools in the sample studied offered a general science course in each of the three grades. However, at least 13% and 10% of the junior and

senior high schools, respectively, did not offer a course at one or more of the grade levels. A variety of courses and sequences were offered by the junior and senior high schools and the number of different courses increased from the seventh through the ninth grade.

At least 50% of the science teachers in each type of school were full-time science and/or mathematics teachers. Less than 5% of the teachers reported having physical education or administrative responsibilities.

About as many departmental plans as self-contained classroom plans were reported by the elementary schools. The departmental plan predominated in junior and senior high schools. Science was most frequently taught as a separate subject. A few teachers reported integrating science with other subjects.

The content of science courses was most frequently determined at the school or district level in elementary and junior high schools, although in a considerable number of schools the individual teacher made these determinations. About one-third of the senior high schools reported school or district-level plans. A single textbook was most frequently used to determine the content taught in elementary and senior high schools, whereas the curriculum guide most frequently served this purpose in junior high schools. Teachers in junior high schools were more prone to utilize pupil suggestions than were the teachers in elementary and senior high schools.

The use of class time for laboratory instruction was reported by approximately one-half of the senior high school teachers, one-fourth of the teachers in junior high schools and one-third of the elementary teachers. In most schools the acquisition and utilization of science teaching equipment and supplies were handled on an individual teacher basis. Approximately 53% of all teachers had a petty cash fund for local purchases of incidental supplies.

District curriculum committees which were actively concerned with science programs at these grade levels served 60%, 47%, and 21% of the elementary, junior high, and senior high schools, respectively. A science curriculum guide which provided for these grades was available to 52%, 41%, and 12% of the elementary, junior high, and senior high schools, respectively.

Science consultant/supervisory services and in-service education programs were available in less than one-half of the schools. Comparing types of schools, consultant services were most frequently available in junior high schools while in-service education programs were most frequently provided in elementary schools. Less than one-fourth of the senior high schools made either provision.

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. More senior

high school teachers considered insufficient knowledge of science as an obstacle than did teachers in the other types of schools.

The recommendations which were made included activation of science curriculum committees, increased science supervisory-consultant service at the state and local levels, and increased provision of in-service education programs which are directly related to science education.

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Joseph Esmond Bowles

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CHAPTER I

INTRODUCTION TO THE STUDY

The advent and aftermath of World War II produced a new urgency in the minds of many peoples in the United States to re-examine the goals, purposes, procedures and outcomes of public education in America. That part of the educational program concerned with science and mathematics has received unprecedented attention on a nation-wide basis for over a decade. Greatest attention and progress in improving science education so far has occurred at the secondary school level. There has also been an increased concern about the lower levels of science programs, particularly in terms of continuous and sequential programs from kindergarten through the twelfth grade.

The relationship of grades seven, eight, and nine to the upper and lower grade levels of pre-college instruction has been a topic of concern since around 1900. With a changing school population, educators recognized that the curriculum offerings and techniques of instruction at the elementary and secondary levels were not meeting the needs of the pupils. The recognition of these conditions together with such factors as increased understanding of the nature of the child and the need for better articulation between grades resulted in the establishment of the junior high school.

Somewhat paralleling the reorganization movement which lead to the establishment of the junior high school, changes were occurring in science instruction. The earlier programs stressed object teaching. Nature study programs succeeded the object teaching approach and these were subsequently supplanted by General Science courses in the junior high school. Currently, a variety of courses exist with varying degrees of emphasis on the several major science fields. It is evident from current literature that some of these trial courses are being developed within the context of previous and subsequent science experiences and that others are not. There appears to be, at the present time, an interest in the development of materials which will make for unification of the content to be taught at all grade levels. Likewise, there is a desire to find approaches that have the potential of increasing understanding of and facility with the processes of science.

Conant focuses attention upon the importance of science education to the individual and society:

> Science has become increasingly an activity in which government must play a constructive role. This means in a free society each citizen to some degree is involved in scientific decisions and needs some appreciation for the methods of science. . . . And every American citizen, if he is sufficiently youthful and ambitious, is a potential leader of his community and may ultimately be responsible for decisions and expenditures. In public health and medicine, or in business as a manager or labor leader, he may be hard pressed in determining policy involving science or its application; or just as a plain man on the street, a voter, he may have to register his opinion on matters of high material import which concern research and development projects financed by public funds . . . Whether we like it or not, we are all

> immersed in an age in which the products of scientific inquiries confront us at every turn. . . . Therefore every citizen would be well advised to try to understand both science and the scientists as best he can.[1]

I. THE PROBLEM

Statement of the problem. The purpose of this study was twofold: (1) to elucidate the status of science programs in grades seven, eight, and nine of Michigan Public Schools, and (2) to develop a set of recommendations which could contribute to further improvement of science education at the seventh, eighth, and ninth grade levels and, directly or indirectly, the K-12 program.

The investigation was concerned with the following aspects of science programs:

1. Science course offerings, requirements, and related activities.
2. Teaching assignments.
3. Organizational patterns for science instruction.
4. Modes of structuring the science curriculum and the factors influencing course content.
5. Professional practices related to the utilization of supplementary literature, teaching aids, and laboratory activities.
6. Availability of facilities for science instruction and the bases for the requisition, control, and utilization of equipment and supplies.
7. Provisions for curriculum implementation.
8. Evaluation practices.

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[1]James B. Conant, Science and Common Sense. New Haven: Yale University Press, 1951, pp. 7-25.

9. In-service education opportunities available to the teacher of science through administrative provisions.

10. Changes in science programs during the past three years.

11. Major obstacles to teacher effectiveness and the improvement of science programs.

Basic to this study was the belief that it would be more fruitful to consider the general structure or sets of procedures within schools or school systems than to conduct a detailed analysis of such facets of programs as the specifics of course content, laboratory activities, and the like. For this reason, primary consideration was given to certain of those school provisions and/or practices which give general indication of current practices and the bases on which programs are conducted.

Need for the study. The expenditure of human and financial resources which has been made in science education at the pre-college level since World War II and the rationale for such nation-wide attention are well known to the professional educator. The National Science Foundation, by the end of 1962, had spent or committed some thirty million dollars for the development of modern high school science courses, mainly in biology, chemistry, and physics. The Foundation had also expended in excess of two hundred million dollars in Institute programs for up-grading the science subject-matter backgrounds of science teachers.[2]

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[2]Ralph W. Tyler. "Forces Redirecting Science Teaching." The Science Teacher 30:22; October 1962.

Only initial steps have been taken for similar developments at the elementary and junior high school levels. One initial approach to bring about improvement at these levels on a national basis was through a series of activities conducted by the American Association for the Advancement of Science (AAAS).[3]

To explore ways to affect this improvement, three independent conferences were conducted by the AAAS, each of which included about fifty participants representing elementary and junior high school teachers, science supervisors, science educators, scientists from various disciplines, representatives of one or more of the senior high school course-content-improvement programs, and educational psychologists. As a result of the conferences, a Commission on Science Education was established by the AAAS. Funds are being provided by the National Science Foundation for the work of this Commission. The Commission's program appears to be similar in purpose to the course-content-improvement programs at the senior high school level. It was recommended that new materials be developed independently by several centers. No single science curriculum is envisaged by the Commission. The Commission itself has sponsored one such writing conference at Stanford University and has planned a second conference for the summer of 1964.

The National Science Teachers Association, also with support from the National Science Foundation, has been concerned

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[3]American Association for the Advancement of Science. "Science Teaching in Elementary and Junior High Schools," Science 133: 2019-24; June 23, 1961.

with the problem of ways to improve science instruction at the junior high school level. It conducted a work conference of fifty specialists in education, science, and science teaching in November 1959. In the report of the Conference the uniqueness of junior high school science is recognized:

> . . . Although all levels of science instruction are important, a reasonable argument can be made that in many respects junior high school science occupies what is truly a key position in the K-12 sequence. On a national basis, a larger fraction of enrolled students take junior high school science than any other science course. For some it is terminal science, and this enhances its significance. The fact that junior high school science occurs during the highly formative years of early adolescence places it in an unusually strategic position. The scientific literacy of the average citizen of the future is determined largely during these years. It can well be said that at these levels, more than at any other, youngsters become oriented toward, or away from the product and process of science, either as prospective science specialists or lay citizens. . .[4]

A review of the literature also indicates that studies are needed relative to science education in the junior high school. Anderson and Brown comment on the dearth of studies at this level:

> The junior high school in general and junior high science in particular, have not received their share of study in recent years. There were more than twenty-five major books published on the junior high prior to 1930 and only two from 1931 - 1947. This trend has continued to the present time. . . . Research evidence indicates continuance of internal school reorganization leading to the establishment of more junior high schools. . .[5]

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[4]National Science Teachers Association, Planning for Excellence in High School Science. Washington, D.C.: 1961. p. 39.

[5]N. D. Anderson and W. R. Brown. "What Does the Future Hold for Junior High Science." School Science and Mathematics 61: 239-41; April 1961.

Reporting on several aspects of science teaching in Michigan, Mallinson[6] notes that with the emphasis being placed on K-12 science programs it becomes very important to have more information about existing programs at the junior high school level.

Thus, it has been indicated briefly that individuals and groups, with representation from all major specialties having bearing on science education, noted the need for examination and improvement of the science curricula. Some progress has been made toward designing programs for the junior high school by national groups. However, there is still the point of view that curriculum improvement within the school and classroom is unavoidably the responsibility of the science educators at local levels. This means that curriculum improvement should involve intimately those who ultimately have responsibility for its implementation. Furthermore, it is held that curriculum improvement is a dynamic process which, if adequate educational programs are to be developed and maintained, should be one of continuous revision conducted in close relationship to other curriculum areas in the school.

In the above framework, it seems reasonable that insight with regard to the status of science education at all levels in Michigan and the structure within which science programs are being conducted should be gained in order to formulate a basis for the rational development of courses of action which might have promise of efficient and fruitful efforts leading to the improvement of science instruction.

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[6]George Mallinson. "The Status of Science Teaching in Michigan." Newsletter of the Michigan Science Teachers Association 3: June 1955.

Limitations of the study. The present study was concerned with science programs in grades seven, eight, and nine in the public schools of the K-12 districts within the State of Michigan. Data from the Department of Research Services, Michigan Department of Public Instruction, indicates that the number of K-12 districts is approximately 40% of the total number of public school districts in Michigan but that ninety-three percent (93%) of the public school population is served by K-12 districts.

This study has the same limitations that characterize any survey that is made by the questionnaire method. The accuracy of such a study is dependent upon the accuracy of respondents. Judgments are made, opinions are offered, information based on memory is given, and in some cases items are not answered. Such inherent limitation may have been reduced in some degree through information gained by the investigator as a result of discussions with science educators of the public schools and science education centers at Michigan State and Western Michigan Universities. The study is further limited by the nature of the instrument used and the number of teacher returns.

II. DEFINITION OF TERMS

The K-12 Districts are those public school administrative units which provide instruction from the kindergarten through grade twelve, inclusive.

A science teacher is a school faculty member who has responsibility for the conduct of one or more science courses. A full-time science teacher is assigned to science and/or mathematics instruction for more than half the school day. Less-than-full-time science teachers are identified as half-time or less-than-half-time science teachers plus three other areas of responsibility:

1. Half-time science-math plus social studies, languages, and other academic subjects.
2. Less-than-half-time science-math plus social studies, languages, and other academic subjects.
3. Half-time science-math plus physical education and/or coaching.
4. Less than half-time science-math plus physical education and/or coaching.
5. Half-time plus administration.
6. Less-than-half-time plus administration.

Science program is an all-inclusive term referring to all those courses and activities engaged in by students, faculty, staff, and special resource persons who are involved in science instruction.

The junior high school level refers to grades seven through nine whether or not any one or more of these grades is included in a school specifically designated as a junior high school. A junior high school is one which includes one or more of the grades seven, eight, or nine (usually two or more) and is designated as a junior high or intermediate school in the Michigan Education and Buyer's Guide, 1962-1963, or as may be supplemented by the Michigan Education

Association's publication, Teacher Salary Schedule Study, 1962-1963.[7]

An elementary school organization includes one or more of the seventh, eighth, or ninth grades and lower grades, whereas a secondary school organization is one which includes one or more of the seventh, eighth, or ninth grades with higher grades through the twelfth.

Science supervisor, consultant, coordinator, and specialist are used synonymously and include those faculty or staff members having special competence and assignment in science education beyond class instruction. General supervisor or helping teacher is a faculty or staff member of a school having responsibility in several curriculum areas.

The conventional definition of principal as the administrative head of a school is used.

In-service education programs refers to those activities provided by the school or district for its teachers for the purposes of teacher orientation to the philosophy of the school and its instructional program, increased professional competence of its staff, and for the development of curricula.

III. GENERAL PROCEDURES

Preparatory to initiation of the study discussions were held with several science educators representing local administrative units,

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[7] Stanley E. Hecker and Thomas J. Northey. Teacher Salary Schedule Study, 1962-1963, Michigan: The Michigan Education Association, 1962.

institutions of higher education concerned with the preparation of science teachers, and the Science Curriculum Committee of the Michigan Department of Public Instruction concerning the value of such an investigation. The consensus of these educators was that such a study would be of value to those groups within the State which were or would be planning to assume a role in the improvement of science education at various grade levels in the State of Michigan.

Subsequently, an extensive review was made of the literature pertinent to the proposed study. The historical development of the junior high schools, the history and philosophy of science education at this level, current trends and developments in K-12 science programs, methods of conducting the study, related research, and others were studied.

In view of the limitations imposed by available resources, the questionnaire technique was employed. Using these resources and in view of the purposes of the study, an instrument was devised and validated by jury. A preliminary form of the instrument was tried out by participants in the Michigan State University Academic Year Institute for General Science Teachers and reviewed by the directors of science education in two of the larger school systems in the State. Recognized ambiguities were corrected and other refinements incorporated into the final form.

A stratified random sampling procedure was employed to select an adequate number of schools to be studied which, on the basis of

information available at the time would ensure an adequate sample at the .05 confidence level. The basis used for calculating the sample size was type of school organization (elementary, junior high, or senior high) and the student enrollments of these schools. The sample, population, and statistical procedures are described in greater detail in Chapters III and IV.

To identify and determine the size and structure of public schools in the State of Michigan, the Michigan Education Directory and Buyer's Guide, 1962-1963[8] was used.

The school was the sampling unit. After selection of the schools to be studied, the superintendents of the districts were contacted and names of all science teachers in each school within the sample groups were supplied by this administrator. Subsequently, a questionnaire form was mailed to each teacher. A copy of the letter to superintendents, the questionnaire, and covering letter to teachers are included as Appendices B, C, and D.

Upon receipt of the completed questionnaires, a notation was made and the data were transformed for International Business Machine (IBM) punch-card work sheets. Facilities and personnel of the Michigan State University's Computer Center were utilized as a means of handling the data by punch-card sorting processes. Following tabulation of the data, they were tabled and analyzed as presented in Chapter IV.

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[8]Since the Michigan Department of Public Instruction does not publish a comparable official publication, "The Directory" enjoys quasi-official status in the State.

IV. ORGANIZATION OF THE THESIS

The thesis consists of five chapters. Chapter I presents an introduction to the study, need for the study, limitations of the study, definition of terms, a general description of the procedures employed, an orientation to the organization of the thesis, and a summary.

Chapter II provides additional background pertinent to the investigation. The historical development of the junior high school which was briefly noted in Chapter I and the agreements and recommendations of the AAAS Conferences on elementary and junior high school science education are presented in greater detail. Objectives of science instruction and their origins are discussed. The chapter also includes an overview of recent efforts directed toward the improvement of science education, as well as a review of related research.

Chapter III consists of a detailed discussion of the methodology employed in the study.

Chapter IV presents the organization and interpretation of the data collected by administration of the questionnaire.

Chapter V gives the conclusions and offers some recommendations for improvement of science education programs in the public schools of Michigan.

V. SUMMARY

The purpose of the first Chapter has been to provide a brief introduction to the total thesis. The junior high school movement

in respect to meeting the needs of pupils was reviewed as were some of the changes in science instruction. Justification for the need for the study was established and the procedures used to implement the study were cited.

CHAPTER II

A REVIEW OF CERTAIN DEVELOPMENTS PERTINENT TO THE STUDY

In the early years of the American twelve-year program of public education, the eight-year elementary and four-year secondary schools (8-4 plan) were the prevailing patterns of grade organization employed in American schools. As to the bases for such division of grades, Gruhn and Douglas[1] conclude:

> First, there is no evidence that the eight-year elementary school and the four-year high school were influenced in their origin and early development by any recognition of the nature of the physical, social, and psychological growth of children. Second, the elementary and the secondary schools began as two entirely separate institutions; furthermore, throughout much of their early history there was little or no attempt to bring about satisfactory articulation between them.

Ultimately, these two aspects of educational programs, the nature of the pupil including such things as needs and interests, and articulation between levels of instruction, constituted the bases for reorganization of the grades which culminated in the formation of junior high schools. These factors continue to be fundamental to curriculum development in the junior high schools.

One of the first criticisms of the organizational structure of American schools mas made by President Charles W. Eliot of

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[1]William T. Gruhn and Harl R. Douglas. The Modern Junior High School. New York: The Ronald Press, 1956. p. 5.

Harvard. Eliot's dissatisfaction was voiced around 1872-73 in statements to the effect that the pre-college years of education were too long. Subsequent proposals by Eliot initiated the appointment of a series of committees, principally by the National Education Association, whose recommendations resulted in what has come to be known as the "reorganization movement".[2] Influential in the changes that occurred were the recommendations of the well-known Committee of Ten, the Committee of Fifteen, the Committee on College Entrance, and the Committee on Economy of Time. Gradually recognition was given to the special nature of early adolescence, the need for smooth transition from elementary to secondary school, and the problem of pupil retention in the upper-elementary and high school grades.[3]

The junior high school movement is generally considered to have begun in the school year 1909-1910. At that time, Columbus, Ohio and Berkeley, California introduced the 6-3-3 plan of organization.[4] Since then variants of the 6-6

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[2]Harl R. Douglas and Calvin Greider. American Public Education. New York: The Ronald Press, 1948. pp. 41-2.

[3]Reviews, condensations, and excerpts of the reports mentioned can be located in most books on the history of American education.

[4]Frank F. Bunker. The Junior High School Movement: Its Beginnings. Washington, D. C.: F. W. Roberts Co., 1935.

organization (including junior and junior-senior high schools) have increased to the point that by 1952 they were the predominant types of schools.[5]

Science instruction in grades 7-9 has undergone changes which somewhat parallel the reorganization movement. Under the early 8-4 plan of organization grades seven and eight were placed in the elementary school and grade nine was the first year of the secondary school. Differences in science instruction are to be expected as it appears in an elementary school setting, a senior high school setting, in a junior high school setting, and as educational theory and practice evolve.

Underhill's extensive study of elementary-school science[6] characterizes the elementary science instruction of the period 1860-1880 as object teaching and that of the later 1800's and early 1900's as nature study.

In brief, object teaching was a highly formalized method of instruction which emphasized the mere description of animate and inanimate objects at the expense of the interpretation and understanding of natural events and phenomena. Based on faculty psychology, object teaching was found to be unrealistic and failed to provide for the educational needs of an industrial democracy.

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[5]Walter H. Gauminitz and J. Dan Hull. "Junior High Schools versus Traditional (8-4) High School Organizations." Bulletin of the National Association of Secondary-Principals 38: 112-21; March 1954.

[6]Orra E. Underhill. The Origins and Developments of Elementary School Science. New York: Scott, Forsman and Company, 1941.

As interest in object teaching decreased emphasis was placed on the nature of the subject-matter of science. Craig[7] points out that attempts to design an elementary science curriculum met with opposing points of view. Social and economic changes were tending to influence the purposes of the educational program and developments in the field of psychology were affecting conceptions of the nature of the learning process.

Colonel Francis W. Parker provided a general philosophy of education which supported the study of nature. Wilber S. Jackman, working under Parker at the Cook County Normal School (later the School of Education at the University of Chicago), developed a course of study for elementary science which has been analyzed as an approach in which generalizations of science were utilized as unifying principles and emphasized scientific techniques as a method of problem solving. The beginnings of modern elementary science instruction are marked by the works of Jackman and others which were developed under the influence of Colonel Parker.[8] Craig[9] credits Jackman with the distinction of being the father of modern elementary science noting that "his point of view in regard to both children and science corresponds remarkably to our recent conceptions".

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[7]Gerald S. Craig. "Elementary School Science in the Past Century." Science Teacher 24: 13-14; February 1957.

[8]Underhill, op. cit., pp. 101-105.

[9]Craig, op. cit., p. 13.

About the same time that Parker and his associates were active in developing elementary science programs, the nature study movement emanating from Cornell University under the direction of Professor Liberty Hyde Bailey laid stress upon different objectives than those held by Jackman. The main purpose of this movement was to improve agriculture and to stop the migration of farmer's children to cities. Underhill[10] describes Bailey's thesis thusly:

> . . . the accomplishment of the aims of this program was to be not by a study of agriculture, but through making the children so sympathetic with nature that they would enjoy rural life and be happy on the farm. Bailey insisted that no good farming is possible without sympathy and love of nature, and that it is incorrect practice to begin with a study of the principles of agriculture, emphasizing the utility of knowledge.

The movement as exemplified by the Cornell approach gained momentum and became a leading form of elementary school science by 1900. However the nature of Nature-Study, particularly as it was science, was debatable to the degree that symposia were held for the purpose of defining the term. A prominent figure in the movement, Edward F. Bigelow, gave his definition of the term after a satirical analysis of the differences of opinion:[11]

> If you know what the thing is (Nature-Study) you do not need the definition; if you do not know, or rather, do not feel, it is beyond the power of words to convey the thought.

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[10] Underhill, op. cit., p. 162.

[11] Ibid., pp. 166-167.

Underhill summarizes major criticisms of Nature-Study as it became to be practiced:

> Emphasis almost wholly upon biological materials.
> Anthropomorphic explanations.
> Culture-epoch theories as a basis of organization.
> A study of isolated and unrelated phenomena which lacks organization.
> Emphasis on poetry and myth.
> Work incidental to that of some other subject.
> Methodology based on the assumption that children cannot reason in the early grades.
> Extravagant claims for emotional and aesthetic outcomes.
> Emphasis on identification and the learning of isolated bits of fact.[12]

By the 1920s, Nature-Study was viewed as unsuccessful in the elementary school and a return to the development of elementary science as viewed earlier by Jackman was begun.

With recognition of the need for reorganization of secondary schools and the establishment of the first junior high schools in the school year 1909-1910 came recognition that a different science program also was needed. Neither the Nature-Study of the elementary school nor the specialized courses of the secondary schools were appropriate. About this time a committee of the Central Association of Science and Mathematics Teachers was investigating a program of unified science for the high school. The report[13] of this committee recommended:

> The first year science course of the high school should be organized upon a broad basis involving

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[12] Ibid., p. 170

[13] O. W. Caldwell (Chairman). "Preliminary Report of the Committee on Unified High School Science Course." School Science and Mathematics 16: 778-82; December 1914.

> fundamental principles of the various sciences and using materials from all, if needed. Certain large topics should be selected for study. These should have coherence in themselves; they should be so chosen as to allow of the scientific interpretation of the more common experiences of the pupils, and to lead to new experiences with common phenomena. Use should be made of materials from any of the sciences as may be needed for the study of the topics selected. Such a use of topics upon which various sciences are focused will introduce the pupils to the differentiated subjects. . . .

Commenting upon this approach, Shinn[14] clarified the meaning of "unified science":

> . . . by "unified science" is not meant a uniform, standardized, "cut and dried" course for all teachers, all classes, and all localities, but a science, the parts of which are not integers but fractions; not isolated subjects taught by trained specialists but are portions of a broad (or deep) subject, science, taught by men who specialize in the general education of youth.

Such was the general science which around 1910 was beginning to develop in grade nine. By 1920 the Science Committee on Reorganization of Secondary Education made specific recommendations for the teaching of general science in the seventh, eighth, and ninth grades.[15]

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[14] H. B. Shinn. "The Movement Towards a Unified Science Course in Secondary Schools." School Science and Mathematics 16: 778-82; December 1914.

[15] O. W. Caldwell (Chairman). Reorganization of Science in Secondary Schools. United States Bureau of Education, Washington, D. C.: Government Printing Office, 1920, Bulletin No. 26.

CHARACTERISTICS OF EARLY ADOLESCENCE

The junior high school pupils are generally in the twelve-fifteen year age group. Characteristically, this age is one of rapid growth and maturation, and of extreme heterogeneity with respect to the physical, emotional, social, and intellectual being. Cole,[16] Hurlock,[17] and others present detailed descriptions of the characteristics of junior high school students.

Although there is a degree of homogeneity in age, there are numerous factors that produce a variety of differences. Only a brief overview of several important aspects of this stage of maturation are feasible at this point. The important considerations lie in the wide range of maturity in physical, psychological, mental, emotional, and sexual traits of students at this stage of development. The complexity of the situation is summarized by Gruhn,[18] "Psychologists seem agreed that the predominate characteristic of early adolescents is that at no other age are children so different from each other."

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[16]Luella Cole. Psychology of Adolescence. New York: Holt, Rinehart and Winston, Inc., 1959.

[17]Elizabeth B. Hurlock. Adolescent Development. New York: McGraw-Hill Book Company, Inc., 1949.

[18]William T. Gruhn. "Reaffirming the Role of the Junior High School in the American High School System." Bulletin of the National Association of Secondary School Principals, Vol. 44, No. 259. Washington, D. C.: November 1960. p. 7.

Indicative of the characteristics of early adolescents that must be taken into account by teachers, planners, and administrators of educational programs at the junior high school level are the following:[19] with regard to physical development, boys mature more slowly than girls; girls experience the greatest rate of growth at an age of twelve to thirteen years and boys from fourteen to fifteen years of age; and the physical changes of early adolescents occur rapidly. As a result the individual often presents symptoms of tiredness and may exhibit poor muscular co-ordination. The junior high school student usually has high interest in all forms of physical activity coupled with intense team spirit. He desires activity as a member of a team.

As the individual approaches puberty he begins to desire independence. He has a strong desire for friendship, and needs membership in groups and acceptance by his peers. The most outstanding emotional change is, perhaps, an awakened interest in the opposite sex. Early adolescents, further, are super-critical and often moody and uncooperative. During this period of maturation, mental development is often disrupted, reaching a plateau, and the heterogeneity of mental development is extreme.

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[19]Data for this portion of the chapter are taken from studies of the adolescent reported by Cole, op.cit., Hurlock, op. cit., and by Lawrence K. Frank and Mary Frank, Your Adolescent at Home and in the School, New York: The Vicking Press, Inc., 1956.

Arising from the characteristics of junior high school youth, Buell identifies seven needs:

1. A need to acquire and maintain functional knowledge, attitudes, appreciations and skills.
2. A need to develop satisfying relations with boys and girls of their own age.
3. A need to attain social skills needed in a democracy.
4. A need to adjust to physical, emotional, and social changes.
5. A need to become realistic about their own strengths and weaknesses.
6. A need to plan and prepare for a career.
7. A need to build a personal system of standards and values.[20]

Brimm notes that the transitional function of the junior high is evident due to the wide variation in the degree and rate of physical and sexual maturity. Emphasizing the transitory nature of adolescence, he identifies the following unique functions of the junior high school:

1. Transition from the self-contained classroom of the elementary school to the highly departmentalized classes of the senior high school.
2. Transition from the emphasis on the basic skills of the elementary school to the content courses of the senior high school.
3. Transition from the program of all required courses to the elective program of the senior high school.
4. Transition from the childhood activities of the pre-adolescent to the accepted activities of the young adult.
5. Transition from the pre-adolescent set of values to the more serious adult values of our modern, complex economy.

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[20]Clayton E. Buell. "Functions of the Junior High School," Clearing House 32: 97-100; October 1957.

6. Transition from the social patterns of childhood to the social life of the adult which draws a definite distinction between the activities of the sexes.[21]

Commenting on Conant's[22] study of the junior high school Brimm[23] says, "The investigation shows that many schools have ignored the real functions of the junior high school and are, in fact, operating a 'little high school' patterned after the senior high school. Such a plan violates the basic principles of the junior high school and serves no real purpose in our educational program. The highly departmentalized content courses of the junior high school do not provide for a transition. . . . The school that does not provide for a transition period is violating one of the basic principles of psychology."

RELATED STUDIES

The paucity of recently conducted studies relative to junior high school science programs has been noted previously. In a study of the historical background of science teaching in junior high schools, Haupt[24] concluded that there was less

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[21]R. P. Brimm. The Junior High School. Washington, D. C.: The Center for Applied Research in Education, Inc., 1963. p. 13.

[22]James B. Conant. Education in the Junior High School Years. Princeton, New Jersey: Educational Testing Service, 1960.

[23]Brimm, op. cit., pp. 9-10.

[24]Walter N. Haupt. The Historical Background of Science Teaching in the Junior High Schools Since 1920. Doctor's thesis. Boston: Boston University, 1954.

agreement as to methods and purposes of science education in 1954 than earlier. The trend appeared to be toward exploration, differentiation, socialization, and articulation, with more emphasis on individual and social integration and less emphasis on college or vocational preparation.

Dameron[25] studied the relationship of pupil achievement to the organization pattern for teaching eighth-grade science in seven Middle West high schools. The organizational patterns included a core curriculum in which science, social studies and English were taught in a three-hour time block in both grade seven and eight, a two semester eighth-grade course with no science in grade seven, and a one-semester science course in grades seven and eight. There was no significant difference in achievement of the pupils in any one of the organizational patterns when mean scores were compared through the use of analysis of variance and covariance. However, the investigator admitted that the influence of other variables such as teacher preparation, qualifications and teaching methods were unknown.

The relative achievement in science and mathematics at the eighth grade level in relation to school organization, enrollment, and pupil ability was studied by McCutcheon.[26]

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[25]Joseph D. Dameron. A Study of the Science Achievement Test Scores of Eighth-Grade Pupils in Selected Junior High Schools. Doctor's thesis. Lawrence: University of Kansas, 1959.

[26]George J. McCutcheon. An Analytical Study of Achievement in Grade Eight General Science and Grade Eight Mathematics in Minnesota Public Schools. Doctor's thesis. Minneapolis: University of Minnesota, 1957.

A stratified random sample of seventy-four Minnesota schools, involving six thousand pupils were included in the study. Statistically significant differences at the one percent (1%) level were found between schools in achievement in science and mathematics.

Smith[27] made a study of trends in junior high school general science. All grades showed an increase in the number of minutes per period. The seventh grade had the greatest amount of increase in time allotted and the ninth grade the least. No significant pattern appears with regard to the subject matter included in general science courses. The content areas of biology, physical science, health, and earth science appear in the program, but emphasis on specific content differed from school to school.

Flannagan[28] undertook to determine the status of general education science in the public high schools of the United States. He found that such courses are increasing in the public high schools. Since the majority of these courses are developed for the junior and senior years, it appears that many schools are fairly well satisfied with freshman general science and sophomore biology and are trying to form a four-year science sequence for general education. He found that laboratory work was included

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[27]Keith F. Smith. "Trends in Junior High School Science." Science Teacher 23: 86-88; March 1956.

[28]Norman Anthony Flannagan. A Study of High School Courses in Grades 9-12 Designed for General Education. Doctor's thesis. Ithaca: Cornell University, 1954.

in three of every four of the general education courses studied; in seven of every ten laboratory courses, students work individually or in pairs; and that no general agreement has been reached as to specific topics to be included in such courses.

To determine the relative importance of principles of science deemed desirable in general science, Smith[29] identified two-hundred fifty-three from an initial list of three-hundred two as most appropriate for general science courses. Of the two-hundred fifty-three principles, one-hundred forty-one were from the physical sciences and one-hundred twelve from the biological sciences. In a related study, Smith[30] undertook to determine the relative values of experiments desirable for inclusion in a general science course at the junior high school level; to determine whether each would be performed more appropriately as an individual laboratory experiment or as a demonstration; and to determine whether each experiment would be more appropriately performed inductively or deductively. From the study of forty-six texts and workbooks, two-hundred forty-six experiments were selected and assigned to one-hundred nine principles of the list established in the former study. A large number of the experiments were judged to be suitable

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[29]Herbert F. A. Smith. "A Determination of Experiments Desirable for a Course of General Science at the High School Level: I." Science Education 35: 279-84; December 1951.

[30]Ibid.

for use with the inductive method and most of the experiments could be performed with simple apparatus. The importance of both demonstration and individual laboratory experiments was indicated. The findings indicate that all experiments do not lead directly to principles of science. Further studies to determine the extent to which these materials contribute to objectives other than the development of principles were suggested.

Fischler[31] reported an analysis of eight series of general science textbooks for grades seven, eight, and nine in which little uniformity as to grade placement of subject matter was found.

Studies of general science textbooks for grades seven, eight, and nine reported by Pettit,[32] Novak,[33] and others reveal a lack of uniformity in the choice of units, topics used in the units, in concepts used in the development of the topics, and in the amount of space devoted to the various topics.

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[31]Abraham S. Fischler. Modern Junior High School Science. New York: Bureau of Publications, Teachers College, Columbia University, 1961.

[32]Donald D. Pettit. "The Content of Junior High Science." School Science and Mathematics 40: 643-654, October; 763-777, November 1940.

[33]Benjamin J. Novak. "Variation Among General Science Textbooks." School Science and Mathematics 43: 23-26, January 1943.

In a study to determine types and numbers of questions demanding reflective thinking found in general science textbooks, Curtis[34] found that in the textbooks, eighty-four percent of the thought questions were those involving explanation, recall, decision for or against, discussion, and cause and effect relationship. The investigator concluded that insufficient use is made of many types of questions that stimulate reflective thinking in texts written for junior high school science.

A status study conducted by the National Education Association Research Division[35] revealed that less curriculum revision was being conducted at the junior high level than at the senior high level.

Chompa[36] investigated the effectiveness of telecasts in helping ninth grade students learn science and in motivating them to further study in science. The pupils studied were placed in three groups: a conventionally taught group, a group taught

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[34]Francis D. Curtis. "Types of Thought Questions in Textbooks of Science." Science Education 27: 6-67, September-October 1943.

[35]National Education Association Research Division. Mathematics and Science. National Education Association Research Bulletin 36. Washington, D. C.: October 1958.

[36]V. Anthony Chompa. Television: Its Effectiveness in Ninth Grade Science Classroom Teaching. Doctor's thesis. University Park: Pennsylvania State University, 1957.

the same course supplemented twice weekly by fifteen-minute telecasts, and a group taught the same course supplemented by a half-hour of the motion picture films viewed each week by the television group. While all three groups made significant gains, it was not stated whether significant differences existed among the three groups.

In an effort to determine the effect of teaching current events in science on the development of attitudes of seventh and eighth grade boys, Kahn[37] found significant improvement of scientific attitudes on the part of those boys taught by the current-event technique.

The effect of supervision on pupils ability to use the scientific method of problem solving, and to develop and maintain scientific attitudes was studied by Frasier[38] who found seventh grade pupils do not naturally have scientific attitudes nor do they know how to apply the scientific method. Statistically significant progress is made when these outcomes are specifically

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[37]Paul Kahn. An Experimental Study to Determine the Effect of a Selected Teaching Procedure for Teaching the Scientific Attitudes to Seventh and Eighth Grade Boys through the Use of Current Events in Science. Doctor's thesis. New York: New York University, 1955.

[38]James Edwin Frazier. A Supervisory Program for the Improvement of Instruction of Selected Areas of Junior High School Science. Doctor's thesis. Greeley: Colorado State College of Education, 1954.

taught for. The experimental and control groups did equally well in subject-matter achievement.

Obourn[39] studied the role of assumptions. The general science teachers studied were observed to be naive to this aspect of forming conclusions. The suggestion was made that writers of teaching materials, teachers and administrators needed to develop a clearer understanding of the significance and place of assumptions in the acceptance of conclusions.

Studies of the comparative performance of ninth-grade biology students with tenth-grade biology students were made by Mathes and Blanc[40] and by Heigerd.[41] The results were inconclusive. The Mathes-Blanc study concluded that the experimental group of ninth-graders (selected on the basis of ability, science interest, and teacher recommendations) did considerably better than unselected tenth graders. The conclusions reached through the more complex study by Heigerd in general were negative to a plan of ninth grade biology and tenth-grade physical science.

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[39]Ellsworth S. Obourn. "The Role of Assumptions in Ninth Grade General Science." Science Education 40: 87-91; March 1956.

[40]George E. Mathes and Sam Blanc. "Biology Achievement in Grades 9 and 10." The Science Teacher 27: 23-26; March 1960.

[41]Lloyd H. Heigerd. "More on Ninth Grade Biology." The Science Teacher 27: 27-30; March 1960.

Gladieux[42] studied extra-class science activity in the public secondary schools of New York State. The most important single factor involved in the success of a science club or other extra-class science activity appeared to be the availability and willingness of the science teacher to assume responsibility of sponsorship. Being assigned too many non-teaching, non-science duties was identified as a factor which reduced the effectiveness of science teachers in directing these activities.

In studying the pre-service and in-service education in science of Iowa secondary school science teachers, Droullard[43] discovered that only seventeen of two-hundred eighty-one science teachers reported in-service education programs in their schools.

Mallinson[44] investigated trends in science education in Michigan. The data indicated that the majority of teachers in Class A, B, and C schools teach more than one science; ninety percent of the combinations fall into four categories: (1) Biology and General Science (2) Biology, General Science, and Physical

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[42]Rolland J. Gladieux. A Study of the Extra-Class Science Activity in the Public Secondary Schools of New York State Exclusive of New York City. Doctor's thesis. Buffalo: University of Buffalo, 1954.

[43]Clayton Arthur Droullard. Pre-Service and In-Service Science Education of Iowa Secondary School Science Teachers. Doctor's thesis. Boulder: University of Colorada, 1954.

[44]George Mallinson. "The Status of Science Teaching in Michigan." Newsletter of the Michigan Science Teachers Association 3: June 1955.

Education (3) Chemistry, Physics, and Mathematics (4) Chemistry, Physics, Biology, and General Science. In some instances as many as four different science courses were taught by one teacher. In most cases, the courses other than science which were taught by a science teacher, were mathematics or physical education. Many teachers who are teaching only one science do not have a major or a minor preparation in the subject taught. Few teachers of general science have the desired breadth of training.

In a study of the permanence of seventh, eighth, and ninth grade teachers in Michigan, Budde[45] found that teachers of these grades were less permanent than teachers in all other grades, except grade ten. Considered as a grade group, these teachers were less permanent than teachers in any other grade group. Men teaching these grades were less permanent than women teaching the same grades and these men were less permanent than their counterparts in senior high schools. Seventh, eighth, and ninth grade teachers were younger and had fewer years teaching experience than did teachers in other grades. Professional and salary advancement and the desire to teach more challenging subject matter were the two most frequently given reasons for changing from these grade levels.

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[45]Ray Budde. A Study of Permanence of Seventh, Eighth, and Ninth Grade Teachers in Michigan. Doctor's thesis. East Lansing: Michigan State University, 1959.

Rasmussen[46] studied the administrative organization for improvement of instruction in Michigan Public Schools. He found that no common organizational procedures were employed; that there was definite indication of lack of understanding of principles of administrative organization on the part of superintendents of school systems; that the superintendents are not the instructional leaders in many cases, but rather the building principals appear to serve this function; and, that there was positive evidence of overlapping and vaguely defined functions of administrators and committees in the public schools.

A 1963 memorandum[47] from the Michigan Science Curriculum Committee summarized responses to a questionnaire concerned with science teaching in grades seven, eight, and nine received from four-hundred twenty-four teachers in Michigan. Among the findings of this pilot study were the following:

> Ability grouping was the most frequently reported provision for individual differences. The second largest number of respondents reported no provision for individual differences.
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> Many responses indicated that science was offered for five hours per week. Few schools required laboratory activities, especially in grades seven and eight.

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[46] Gerald Raymon Rasmussen. A Study of Administrative Organization for the Improvement of Instruction in the Public Schools of the State of Michigan, Exclusive of the Upper Peninsula and the City of Detroit. Doctor's thesis. East Lansing: Michigan State University, 1962.

[47] Mimeographed memorandum to educators who cooperated with the State Science Curriculum Committee by responding to the Committee's questionnaire. Lansing, Michigan: 1963.

> Of those responding, the greatest number reported a policy of using a single textbook; the second greatest number used multiple texts and the use of reference books in lieu of texts was the third most frequently reported practice.
>
> Approximately 66% of the four-hundred twenty-four respondents had five years or less teaching experience, 47% had three years or less, and only 15% had ten or more years teaching experience.
>
> With regard to organization for curriculum development twenty-eight (6.6%) reported having a K-12 science curriculum committee, fourteen (3.3%) reported having a junior high school committee, and five (1%) elementary committees were reported.

A more recent study concerning current activities in junior high school science was conducted by Matala.[48] The study was made for the previously mentioned AAAS feasibility study in an effort to find the new ideas and approaches developing in various areas of the country. Data for this report were obtained from about one-half of all State Departments of Public Instruction. From these responses, it appeared to the investigator that what was occurring in Iowa was fairly representative of what was happening elsewhere; hence, activity in Iowa was reported in detail.

With respect to curriculum development at the state level, a K-12 curriculum outline was being developed. A Science Area Committee had responsibility for planning, policy decisions, and coordination-integration of seven production committees: primary intermediate grades, junior high (7-9), biology, chemistry, physics,

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[48] Dorothy C. Matala. "Current Activities in Elementary and Junior High School Science." School Science and Mathematics 61: 339-367; May 1961.

and advanced science. Through a "block and gap" approach, it was hoped to reduce repetition from grade to grade and the number of areas that are taught in each grade. Similar organization and effort were occurring on the local level. In Iowa some schools have moved biology to the ninth grade. However, more schools favored the development of a physical science course for the ninth grade.

Throughout the states there was a great amount of curriculum revision underway but with a question of strong doubt as to whether the right thing was being done. Teachers were asking for guidance in what a total program should aim for.

A variety of special projects in science were identified. Among these were seminars for special students, summer science-math programs for the student of high interest and ability, and educational television programs in science.

In recognition of the inadequate backgrounds in science of elementary and junior high school teachers, consultative services and in-service education programs in science were being provided by colleges and universities as well as by state and local education agencies. Most states and an increasing number of local systems employed full or part-time science consultants.

In summary, there seemed to be no question that, for the states responding, general science is on the way out for ninth grade and possibly, also, for the seventh and eighth grades. The indication is that the trend for the seventh, eighth, and ninth

grades is biological science, earth science, and physical science, respectively. There is indication in a few experimental studies that thought concerning how children learn (concept development) has entered the planning. However, what is known about children's learning and thinking is not evidenced in the planning which has taken place.

OBJECTIVES FOR SCIENCE INSTRUCTION

That planning is a requisite to the development and continued improvement of effective and efficient educational programs is axiomatic. As a first step in the process of planning, it is essential that the goals or objectives be identified. The objectives to be sought through educational programs then become the reference points or standards by which the major facets of instructional programs are developed, implemented, and evaluated.

To ensure that the objectives (value judgements) selected have sound rational bases (i.e. are defendable), they must be consistent with one's social and educational philosophy and further derived from such pertinent kinds of knowledge as relate to the present and foreseeable future needs of the learner and society. Sources of knowledge out of which objectives may be derived include studies of the learner: his physical, social, and philosophical needs; studies of contemporary society: its structure, critical problems, and needs; and, the major subject fields of knowledge: their content, structure, and modes of thought. Past

experience strongly suggests that no single source of information is sufficient as a basis for sound decisions about the objectives of educational programs.

Allegations by critics of public education and rebuttals by educators and their supporters leave little doubt that serious differences exist between, even in some cases within, the principal groups. If for no other reason, it behooves those actively engaged in the educational enterprise to re-examine their objectives, the bases on which these objectives were derived, and the consistencies of current polices and practices to this base.

Many competent and dedicated groups of individuals have from time to time addressed themselves to the task of setting goals for education. Statements of objectives issued by these groups have varied widely in approach, mode of presentation, length, and elaboration; however, taken as a group of statements, attention is focused on the development of effective thinking, the ability to make wise value judgements, and general intellectual resourcefulness. In general, agreement has been reached that the goal of American education is the optimum development of the individual through acquisition of the knowledge, skills, and attitudes which are of inherent value to the individual and which lead to patterns of behavior which foster the goals of our democratic society.

The development of objectives for science education has a long history. It has been undertaken as a component of deliberations

on the objectives of general education, as well as an exclusive area of importance in its own right.

In 1920 the Science Committee of the Commission on Reorganization of Secondary Education attempted to relate science instruction to the attainment of the famous seven cardinal principles or objectives of secondary education that had been developed by the Commission.[49]

The importance of scientific method as an objective of science instruction was set forth by a special committee of the American Association for the Advancement of Science in a report which was published in 1927.[50]

The Thirty-first Yearbook of the National Society for the Study of Education, published in 1932,[51] has probably influenced science education in the United States more strongly than any other single publication. Through this yearbook a comprehensive science program was offered which included organized science instruction for all grades, one through twelve. It proposed that

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[49]Commission on Reorganization of Secondary Education. Report of Subcommittee on the Teaching of Science. United States Bureau of Education, Bulletin, No. 36. Washington, D. C.: Government Printing Office, 1920.

[50]American Association for the Advancement of Science. "Committee Report on the Place of Science in Education." School Science and Mathematics 28: June 1928.

[51]National Society for the Study of Education. Program for Teaching Science. Thirty-first Yearbook, Part I. Chicago: University of Chicago Press, 1932.

instruction be organized about broad generalizations. The purpose of science teaching was held to be the development of understandings of the major generalizations and of associated attitudes.

With respect to science instruction as a facet of general education, a 1945 report of the Harvard Committee on General Education advocated that science instruction should be developed about such broad integrative elements as the comparison of scientific with other modes of thought, the comparison and contrast of the individual sciences with one another, the relations of science with its own part and with general human history, and of science with problems of human society.

A report of the Educational Policies Commission in 1944[52] recognized the role of science instruction in attainment of the goals of general education for American students. These purposes are to:

> (1) Equip him to enter an occupation suited to his abilities and offering reasonable opportunity for personal growth and social usefulness; (2) prepare him to assume the full responsibilities of American citizenship; (3) give him a fair chance to exercise his right to the pursuit of happiness; (4) stimulate intellectual curiosity, engender satisfaction in intellectual achievement, and cultivate the ability to think rationally; and (5) help him develop an appreciation of the ethical values which should undergird all life in a democratic society.

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[52] Educational Policies Commission. Education for All American Youth. Washington, D. C.: National Education Association, 1944.

The Forty-sixth Yearbook of the National Society for the study of Education[53] has also been influential in shaping science education in America. Justification for singling out the objectives set forth in this publication as exemplars to be considered for adoption is in part based on the following statement:

> To state objectives for science instruction involves the risk of forgetting or disregarding the dominant purposes of science education. This error must be avoided. The objectives listed . . . do not lessen the emphasis throughout this yearbook on the function of science in modern education . . . The Committee's objectives for science teaching and the explanatory content are intended to provide a working philosophy to pervade and unify the entire report. An attempt has been made to incorporate the best elements of other statements, particularly those emphasizing a social viewpoint for science teaching.[54]

Preliminary to formulating the objectives given, the following criteria were established:

> (1) . . . the statement should be practicable for the classroom teacher. It must be usable; when properly used, it should lead logically from one step to the next; and, if carefully followed, it should result in progress toward the objectives ultimately sought.
>
> (2) . . . the statement of objectives should be psychologically sound. It should be based on generally accepted principles of learning and should be as little subject as possible to the conflicting postulates of various theories of the psychology of learning.

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[53] National Society for the Study of Education. Science Education in American Schools. Forty-sixth Yearbook, Part I. Chicago: University of Chicago Press, 1947.

[54] Ibid., p. 24.

> (3) . . . the objectives should be possible of attainment under reasonably favorable circumstances and to a measureable degree . . .
>
> (4) . . . the objectives should be universal in a democratic society . . .
>
> (5) . . . the statement of objectives and the explanatory context should indicate, directly or by clear implication, the relationship of classroom activity to desired changes in human behavior. Too often objectives are stated either in overly broad, general terms, and hence are vague, or in terms of specific subject-matter content.[55]

The committee further sets forth its position on the objectives of science instruction to the effect that objectives represent directions of growth and not final outcomes to be completely and perfectly attained. Furthermore, the Committee's position is that learning outcomes in science education shall function in changed behavior. That is to say, that what is learned -- the facts, concepts, and principles of the sciences, physical and mental skills, attitudes, and all the rest -- results in changed thinking and behavior.

The following are types of objectives recommended for science instruction by the Committee.

Science instruction should result in growth toward patterns of behavior which reflect attainment of:

1. Functional facts, concepts, and principles of the major fields of science. The acquisition of facts should be approached, not as an end in itself, rather as a means of gaining understanding of concepts and principles, of developing scientific attitudes, and in gaining an understanding of and skill in the use of the intellectual processes of science.

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[55] Ibid., p. 25.

2. Instrumental skills related to the ability to read and understand science content, perform fundamental operations of mathematics with accuracy, read and interpret maps, graphs, charts, tables and the like, manipulate science equipment and to make accurate measurements.

3. Problem-solving skills which include the ability to sense and define problems, recognize and procure available information pertinent to the problems, develop, select, and test hypotheses, and draw valid conclusions.

4. Attitudes such as open-mindedness, intellectual honesty, inquisitiveness, and suspended judgement.

5. Appreciations of the scientific enterprise and members of its community.

6. Interests in some phase(s) of science as vocational or avocational pursuits.[56]

A listing of the objectives like the above should not be construed to mean that the list is exhaustive, final, thoroughly explanatory, or that the components are mutually exclusive. Rather, the list is in harmony with the goals of general education and needs for specialization, it provides for both individual and societal needs, and, at the same time, provides for efficient instruction through the interrelatedness of its components. Further, the objectives are practicable, psychologically sound, possible of attainment, reflect the product and processes of science, the relationship and importance of science to the individual and society, and they are operationally definable.

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[56] Ibid., pp. 28-29.

RECENT DEVELOPMENTS FOR THE IMPROVEMENT OF SCIENCE INSTRUCTION

On the national level, the use of Federal funds for further education of secondary-school science teachers in the content of science and mathematics through National Science Foundation Institutes programs has been noted. Sizable sums of Federal, state, and philanthropic foundation monies, also, have been applied to support (1) special studies and conferences relative to science education, (2) curriculum content improvement projects, (3)improvement of science facilities and related instructional materials, (4) science consultant and supervisory services, and (5) other aspects of the educational enterprise. The amount and value of the time and effort expended by countless individuals in the interest of improved science instruction in the last decade alone is inestimable. The total effort applied at this point is without precedent and appears to be just gathering momentum.

Descriptions of the major curriculum content improvement programs can be readily located in the literature. The most notable of these are, perhaps, the upper secondary level courses produced by the Physical Science Study Committee (Physics), the Biological Sciences Curriculum Study, the Chemical Education Materials Study, and the Chemical Bond Approach Project. In parallel with these efforts on the upper secondary school levels, which have as their goals reflection of modern science -- its content, structure, and intellectual processes -- and development

of appropriate instructional procedures and materials, are a number of perhaps less well known but similar projects on lower educational levels. Among these are the Elementary School Science Projects of the University of California and of the University of Illinois. These new curriculum materials represent such departures from the heretofore conventional course materials in content, structure, and rationale for science instruction that they have implications for junior high school science and the development of K-12 programs that are consonant with those that have been proposed in this chapter.

The approach to be made at the national level to improve science teaching in elementary and junior high schools seems to have been established through the three independent conferences conducted by the American Association for the Advancement of Science, briefly alluded to in Chapter I. Of major significance were the points of substantial agreement reached by participants in the three conferences. The points of agreement were:

1. Science should be a basic part of general education for all students at the elementary and junior high school levels.

2. Instruction at the elementary levels should deal in an organized way with science as a whole.

3. There must be a clear progression in the study of science from grade to grade.

4. There should be no single, national curriculum in science.

5. Science teaching should stress the spirit of discovery characteristic of science itself.

6. New instructional materials must be prepared for in-service and pre-service programs for science teachers.

7. The preparation of instructional materials will require the combined efforts of scientists, classroom teachers, and specialists in learning and teacher preparation.

8. There is great urgency to get started on the preparation of improved instructional materials for science.[57]

In Michigan several major developments have occurred within the past decade at the state level which are of importance to the improvement of science programs. For many years the policy of the Department of Public Instruction has been to provide educational leadership through the sponsorship of some twenty curriculum advisory committees. In 1955 the Curriculum Planning Committee of the State Department of Public Instruction was presented with the proposal that a state level committee on science education be established. In 1956, this committee was established.

During 1958 the State Science Committee prepared and published the following statement of philosophy:

> Although there is ample evidence to indicate that there is today a dearth of persons adequately prepared in science and mathematics to meet the demands of teaching, industry, and research, the state committee on science education in Michigan considers its chief concern to be the design of well-balanced educational programs which will meet the long range needs of individuals and society.

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[57] American Association for the Advancement of Science. Science. Vol. 133, No. 3469: 2019-2024; June 23, 1961.

> We conceive of two types of needs: (1) the general educational needs of all students, (2) the more extensive and additional needs of those who may become specialists.
>
> An understanding and appreciation of the forces at work in our modern culture has become so dependent upon a citizen's having some insight into the fundamental concepts of science and mathematics that today, more than ever before, every student must have adequate experience in these areas as a part of his general education.
>
> The students who are potentially specialists in science and technology have a further need -- enough experience of a sound and rigorous nature that they may judge whether or not their own interests lie in this direction. Further, for the sake of those who do decide to specialize in this area, it is important that their instructional programs have been such that they may proceed to further study without loss of time and effort.
>
> The committee is confident that, with an allotment of time and effort in grades kindergarten through fourteen comparable with that given to other major areas of the curriculum, programs can be designed which will meet these educational needs, and will, in the long run, supply increased numbers of scientists, mathematicians, and technicians for teaching, industry, and research. The committee further believes that these increased numbers can be obtained without siphoning away from equally important non-science areas a disproportionate number of those persons with superior abilities and broad training who are so necessary in all areas such as public service, religion, and the professions.[58]

Following an initial attempt to identify and attack specific instructional problems which resulted in recurring doubts that committee proposals were in line with the overall objectives of the parent committee (Curriculum Planning Committee), its statement

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[58] Bruce R. Nelson. "A State Level Approach Toward Improving Science Education." School Science and Mathematics: 257-258; April 1958.

of philosophy was expanded by a statement of the following broad objectives:

I. All science experiences should be designed as a quest or search in which the student should:
   A. Grow in his understanding of the basic ideas and information in significant areas of science and his consideration of the inter-relationships in science and non-science areas.
   B. Learn to:
      1. Observe his environment and report accurately what he has observed.
      2. Develop and use functional skills.
      3. Make comparisons of likenesses and differences.
      4. Evaluate the importance of information.
      5. Determine the kinds of information he still needs to realize the goal.
      6. Identify and use the most efficient way to gain the information.
      7. Apply the information obtained.
   C. Recognize the contributions and social implications of science to daily living and use them in his thinking and in his actions.

II. In science instruction the teacher should attempt to do the following:
   A. Provide a well balanced distribution of experiences in the significant areas of science.
   B. Stimulate the student's curiosity about this environment and encourage him to become interested in and concerned about the "why" of his enviroment.
   C. Provide opportunities for the student to identify himself with and enjoy elements of his biological and physical environment.[59]

In 1961 the Committee on Science Education of the Michigan Curriculum Program[60] "developed a set of criteria which teachers and administrators could use to evaluate the developments in their science programs as well as to identify areas that need further emphasis."

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[59] Ibid., p. 259.

[60] State Department of Public Instruction. Guidelines for the K-12 Science Program. Michigan Department of Public Instruction, Bulletin, No. NDEA-309, Lansing, Michigan: 1961.

SUMMARY

A reorganization of the early American eight-year elementary and four-year secondary school division of grade levels resulted in the development of junior high schools which generally include grades seven, eight, and nine. The nature of the early adolescent student and articulation between levels of instruction constitute the bases for formation of this division of instruction and continue to this day to be fundamental to curriculum development in the junior high school.

The period of early adolescence is characterized as one of rapid growth and maturation, and of extreme heterogeneity in terms of physical, emotional, social, and intellectual development. Certain special needs of junior high school youth are derivable from the physical-mental-social characteristics of the group. Similarly, unique functions relating to the transitional needs of this age are identifiable for junior high schools.

There is a paucity of recently conducted studies on junior high school science programs. Among the results of related studies described were identification of: a trend toward objectives of exploration, differentiation, socialization, and articulation; an increase in the amount of time for science; a prevalence of general science courses and an increased amount of laboratory work; a list of general principles and related experiments of importance to general science courses; a lack of uniformity of

texts with respect to content; the role of assumptions in science instruction; findings negative to placement of biology in the ninth grade and physical science in the tenth; a lack of in-service education programs in schools; lack of permanence on the part of junior high teachers.

Research studies about Michigan schools revealed lack of a pattern of organization procedures at the local level; lack of understanding of principles of administrative organization; over-lapping and vaguely defined functions of administrators and committees.

Results of a survey of State Departments of Public Instruction to identify new ideas and approaches to elementary and junior high school science were reported. Among the findings was a trend toward K-12 curriculum development at state and local levels, provision of consultant services and in-service education programs.

Backgrounds and origins of objectives for science education were discussed and the statement of objectives proposed by a committee of the National Society for the Study of Education in 1947 were defended.

Major developments for the improvement of science instruction which have occurred in the last decade were discussed. In Michigan a State Science Curriculum Committee was formed in 1958. Subsequently the Committee published a statement of philosophy

and objectives for science instruction which was supplemented by a publication in 1961 which set forth criteria for the evaluation of K-12 science programs.

CHAPTER III

METHODOLOGY OF THE STUDY

In order to secure data relative to the issues cited in Chapter I, a survey was made to determine the general character of existant science programs in grades seven, eight, and nine and to discover any trends which might be discernible.

Construction of the instrument. Consideration of the various techniques for conducting a normative survey indicated the questionnaire to be the most feasible one for obtaining the information desired in this investigation. An extensive set of questions which might be used to obtain a detailed characterization of science programs was developed. In recognition of the fact that the length, amount of detail, and time required for completion of the instrument are major causes for non-respondence, considerable restatement, combination, and selection of areas for examination ensued. The preliminary form was reviewed by the guidance committee, a member of the College's Bureau of Educational Research, science teachers who were then participating in the Academic Year Institute for General Science Teachers at the University, and directors of science education for the cities of Lansing and Detroit, Michigan. Incorporation of suggestions made

by these science educators completed development of the instrument into final form.

Selection of the sample. The school was selected as the sampling unit. According to the Michigan Department of Public Instruction, approximately five-hundred and fifty K-12 Public School Districts accommodate over 93% of the public school population in Michigan. Schools in these districts which included one or more of the seventh, eighth, and ninth grades constituted the universe studied. Examination of the Michigan Education Directory and Buyers Guide (1962-63) revealed a variety of organizational schemes employed by school districts with respect to the relation of the three grades under consideration to upper and lower grades. Additionally a wide range of student populations within schools was observed.

Conant[1] observed that the elementary, junior high school, and senior high school place differing emphases on some aspects of education (e.g. the pupil, the subject matter, and the guidance function) and are staffed with teachers having somewhat different academic and professional backgrounds. In terms of the student population of a school, restrictions are frequently placed on the number and kind of specialized teachers, services, facilities, teaching aids, and extra-class activities. In light of these

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[1]James B. Conant. Education in the Junior High School Years. Princeton, New Jersey: Educational Testing Service, 1960.

considerations, and to provide efficient sampling procedures, a disproportionate stratified sampling design was employed. On the bases of (1) the organizational relationships of grades seven, eight, and nine to upper and lower grades, and (2) student populations the following twelve strata were established:

Stratum	Organization-Population Characteristics
I	Elementary: 0 - 300
II	Elementary: 301 - 500
III	Elementary: 501 - 700
IV	Elementary: 701 - above
V	Junior High School: 0 - 300
VI	Junior High School: 301 - 500
VII	Junior High School: 501 - 700
VIII	Junior High School: 701 - above
IX	Senior High School: 0 - 300
X	Senior High School: 301 - 500
XI	Senior High School: 501 - 700
XII	Senior High School: 701 - above

The Michigan Education Directory and the Teacher Salary Schedule Study 1962-1963[2] were used to classify all schools in K-12 districts which included one or more of grades seven, eight, and nine in terms of the strata described above. Statistical procedures described by Cochran[3] were used to determine the sample size needed to obtain a confidence level of .05. On the basis of the established strata, calculations indicated that a sample size of forty-one was adequate. However, following consultation with the Department of Statistics of the University and with the

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[2] Stanley E. Hecker and Thomas J. Northey. Teacher Salary Schedule 1962-1963. Lansing: Michigan Education Association, 1963.

[3] W. G. Cochran. Sampling Techniques. New York: John Wiley and Sons, 1953.

Bureau of Educational Research a sample size of one-hundred fifty was adopted. All schools in the population studied were assigned consecutive numbers and the table of random numbers included in Dixon and Massey[4] was utilized to select a random sample of schools to be studied. As a means of alleviating potential difficulty resulting from non-respondent cases, alternate sample groups were developed in like manner. Adhering to this procedure, usable questionnaires were returned representing one-hundred forty schools. Table I of Chapter IV, page 61, summarizes the proportions of schools in the population and sample when assigned to the strata. Appendix A, page 133, identifies the sample studied.

Following identification of schools in the primary and alternate sample groups, a letter was sent to the superintendents of systems that included these schools. The letter described the the study, listed the pertinent schools, and requested the names of all teachers in each school who were responsible for the conduct of one or more science classes at one or more of the grades under investigation. Upon receipt of the names of teachers from their superintendents, the questionnaire, an addressed business-reply (pre-paid postage) envelope and a covering letter which introduced the study were mailed to each teacher. Schools in the Detroit system were studied somewhat differently. At the

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[4]Wilfrid J. Dixon and Frank J. Massey. Introduction to Statistical Analysis. New York: McGraw-Hill Book Co., Inc., 1957.

suggestion of the Director of Exact Sciences for Detroit Public Schools, the chairman of the science department in each sample school was supplied with a questionnaire to be completed as representative of the program and practices within the school. At a general meeting of science department chairmen, the Director of Exact Sciences described the study and the desired approach to completion of the instrument. It was assumed that this procedure was adequately comparable to that used for other schools. Copies of the questionnaire, letter to superintendents, and letter to teachers appear as Appendices B, C, and D, respectively.

Upon receipt of the completed questionnaire, a check-list notation was made for record keeping purposes and the data were transformed to IBM punch-card work sheets. Subsequently, the facilities and personnel of the Michigan State University's Computer Center were utilized to handle the data by punch-card sorting processes. The cards then were arranged to obtain data for three strata: elementary schools, junior high schools, and senior high schools. Usable questionnaires representing one-hundred forty different schools (12.7% of the population) were used in the study. Tables I and II of Chapter IV, pages 61 and 62, compare the sample used to the population under study.

During card-sort runs to obtain data pertaining to provisions and practices on a school basis (rather than individual teacher practices) a few discrepancies were encountered due to differences in reporting by teachers in the same school. In all

cases, these were resolved by examination of the original forms. There were no difficulties encountered in resolving the differences.

Summary. In this chapter the methodology employed in the study has been described in detail. Since it was desired to obtain data on the entire State and due to limitations of time and financial resources the questionnaire and survey sampling techniques were used.

The stratification scheme used to determine sample size proved to be highly efficient; however, to increase confidence in and precision of the data, a larger sample size was utilized. A table of random numbers was used to select a group of sample schools. An alternate group was selected in like manner to match those in the first group. In the event that a response was not obtained from a school in the first group, the alternate matchmate was selected for study. Such a procedure ensured an adequately large sample to obtain a high confidence level (greater than 0.05) in the representativeness of the sample with respect to the population. The data on individual teacher practices are based on a 71.3% return of questionnaires from teachers. The extent to which non-responding teachers may have biased this set of data (e.g. pertaining to individual teacher practices: Tables V, VII, XII, XIII, XVI, XXI, XXII, XXIV of Chapter IV) is not clear. However, one may assume that the extent to which the group of respondents was not typical of the "average" teacher it tended to represent the better educated and more professionally committed teachers.

CHAPTER IV

DATA: ORGANIZATION AND INTERPRETATION

This chapter presents the results of the study. The data are listed in twenty-four tables supplemented by appropriate interpretations and elaborations.

The distribution of schools in the population by type of school and student enrollment is shown in Table I. About one-third (33.1%) of the population of schools studied were designated as junior high schools. Nearly 45% of the schools were senior high schools and the remaining 22% were elementary schools.

With respect to student enrollment, about 52% of all schools enrolled five-hundred or more students, while about 25% enrolled three-hundred or fewer students.

Comparing types of schools and student enrollment, senior high schools having an enrollment of 0-300 and 301-500 comprised 12.9% and 12.7%, respectively, of all schools in the population, while 19.1% of all schools were senior high schools having enrollments of 501 or more. Junior high schools having enrollments of 0-300 and 301-500 comprised 6.5% and 6.0%, respectively, of the population, while 20.6% of the population were junior high schools having an enrollment of 501 or more. Elementary schools having a population of 0-300 and 301-500 comprised 4.7% and 4.8%, respectively,

of the population, and 12.7% of the population were elementary schools with enrollments of 501 or more.

The data show that the distribution of elementary schools among the four categories of enrollment is rather even throughout. The distribution of junior high schools is heavier in the larger enrollment categories, and the distribution of senior high schools is slightly heavier in the smaller enrollment categories.

Table II gives similar information for schools included in the sample. The sampling procedures used and percentage of usable returns resulted in sample deviations from population proportions of less than 5% in the totals. Within sample points, deviation of the sample from the population was less than a maximum of 4%. In seven of twelve sample points the deviation was less than 1% and in only two of twelve sample points did the deviation lie between as great as 2.2% to 3.9%. Thus, the sample is shown to closely approximate the distribution of schools in the population studied.

Table I. Number of schools in the population by student enrollment

Student Enrollment	Elementary		Junior High		Senior High		Totals	
	No.	%	No.	%	No.	%	No.	%
0-300	52	4.7	72	6.5	142	12.9	266	24.1
301-500	53	4.8	66	6.0	140	12.7	259	23.5
501-700	56	5.1	60	5.6	95	8.6	211	19.2
701-above	84	7.6	166	15.0	115	10.5	365	33.2
TOTALS	245	22.2	364	33.1	492	44.7	1101	100.0

Table II. Number of schools in the sample by student enrollment

Student Enrollment	Elementary No.	%	Junior High No.	%	Senior High No.	%	Totals No.	%
0-300	5	3.6	10	7.1	17	12.1	32	22.8
301-500	4	2.9	8	5.7	19	13.6	31	22.2
501-700	5	3.6	7	5.0	13	9.3	25	17.9
701-above	11	7.8	24	17.2	17	12.1	52	37.1
TOTALS	25	17.9	49	35.0	66	47.1	140	100.0

Table III presents the number of schools in the sample studied by type of school, the number of different schools of each type, and the total number of schools having each of the three grades with which the study was concerned (the latter are not mutually exclusive).

Most of the elementary schools in the sample include grades seven and eight, while only 20% include the ninth grade. Only 4% of junior high schools do not include seventh or eighth grades, while approximately 26% of the junior high schools do not include the ninth grade. Fewer senior high schools include the seventh and eighth grades and more include the ninth grade than do elementary and senior high schools.

Thus, it is shown that a greater percentage of junior high schools include all three grades than do the elementary and senior high schools.

Table IV shows the total number of different teachers represented in the sample by type of school, and the total number of teachers who taught science in each of the grade levels by type of school (the latter are not mutually exclusive).

Table III. Number of schools in the sample with grades 7, 8, 9

Type of School	Number Schools Having Grades 7	8	9	Total Number Diff. Schools Represented
ELEM	24	19	5	25
JHS	47	47	36	49
SHS	42	49	66	66
TOTALS	113	115	107	140

Table IV. Number of teachers in the sample teaching grades 7, 8, 9

Type of School	Number of Teachers Teaching in Grades 7	8	9	Total Number diff. Teachers Represented
ELEM	25	18	5	27
JHS	59	64	42	106
SHS	30	35	67	96
TOTALS	114	117	114	229

From Table V it is noted that over one-half of all teachers of science in each type of school taught only science and mathematics. Comparing types of schools, the junior high schools had the greatest percentage of full-time science and mathematics teachers, and the percentage of teachers in this class of assignments in elementary schools exceeded that in the senior high schools.

Of the half-time or less teachers of science in senior high and junior high schools, there was a greater percentage who taught science less than half-time than there were of those classified as half-time science teachers. An equal percent (22%) of elementary teachers were half-time or less than half-time science teachers.

In elementary schools the greater percentage of part-time teachers taught other academic subjects than had non-academic teaching assignments. No coaches and only a small percent (4%) of administrative staff were identified as also teaching science although the additional responsibilities of 11% of teachers in this group were not identified. In junior high schools at least 3% of the teachers were half-time coaches/physical education teachers and at least 4% had half-time administrative responsibilities. At least 5% of the part-time science teachers in the senior high schools had coaching or physical education responsibilities.

Combining the three strata, 57% of the science teachers had full-time science and mathematics assignments, 17% had half-time science assignments, and 25% of the teachers had less than half-time science responsibility. Thus, it is shown that only slight differences occur in percentages of full-time science teachers between the three types of schools, as well as in the remaining categories of teaching assignments.

Table V. Teaching assignments

Type of School	Grade	Full-time Sci/Math		Half-time Sci. and other Acad. Subjects		Half-time Sci. and Coach Phys. Ed.		Half-time Sci. and Admin.		Half-time Sci. and Unknown		Less than half-time Sci. and other Acad. subjects		Less than half time Sci. and Coach Phys. Ed.		Less than half-time Sci. and Admin.		Less than half-time Sci. and Unknown	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEM	7,8,9	15	56	2	7	0	0	1	4	3	11	6	22	0	0	0	0	0	0
JHS	7,8,9	65	61	0	0	3	3	0	0	13	12	4	4	0	0	0	0	21	20
SHS	7,8,9	51	53	5	5	3	3	0	0	10	10	4	4	2	2	0	0	21	22

NOTE: Percentages calculated on basis of number of teachers in each type school. Percentages may not total to 100 due to rounding.

Table VI presents the extent of course offerings and requirements by type of school and grade level. Although all elementary schools offered a science course at each of the three grade levels, at least 13% of the junior high schools and 10% of the senior high schools did not offer a course in at least one of the three grades. The percentage of junior and senior high schools which did not offer a science course at the seventh grade level was larger than those which did not offer a course at the other two grade levels.

In all types of schools and at all grade levels General Science was the course offered and required by the greatest proportion of schools. General Science was the only required course in elementary and junior high schools, and in the seventh grade of senior high schools.

Of the senior high schools which had an eighth grade, 2% required Earth Science at this level (0.9% of all schools having an eighth grade). Earth Science was offered as a ninth grade subject by 6% of junior high schools having the grade and as an eighth and ninth grade subject by 2% and 5%, respectively, of senior high schools which had these grades.

In the junior high schools, Biology was offered as a seventh and ninth grade course by 4% and 14%, respectively, of these schools which had the grade. It was required by none. Biology was offered in the ninth grade by 29% of the senior high schools which had the grade and was a required course in 12% of these schools.

In terms of different science courses, the number increased from the seventh to the eighth to the ninth grades, except in the elementary schools; however, the proportion of schools which offered each of the courses other than General Science was quite small in general (2%-9% except for ninth grade Project Science in junior high schools, 28%, and ninth grade Biology in senior high schools, 29%).

In the elementary school groups, the science course offerings were all titled General Science. All schools offered science at each of the seventh, eighth, and ninth grades included in the school. Of the twenty-four elementary schools having a seventh grade, 75% required science; 74% which had an eighth grade required science; and, 80% which included a ninth grade required science.

Not all junior high schools offered science in each of the three grades: 87% which had a seventh grade offered science; 94% which had an eighth grade offered science; and, 94% which had a ninth grade offered science. In 85% of the junior high schools which had a seventh grade science was required at this level, as it was in 83% of the schools which had an eighth grade and in 25% of those schools which included the ninth grade.

In the senior high schools which had the grades, 79% offered science and 60% required science at the seventh grade level; 82% offered eighth grade science and 71% required it; and, 76% offered science in the ninth grade and 33% required science at this level. Science at all three grade levels was more frequently offered in the elementary schools, next in junior high, and least in senior high schools.

At the seventh and eighth grade levels science was more frequently required in the junior high schools than it was in elementary and senior high schools, and least frequently required in the senior high schools. At the ninth grade level science was most frequently required by the elementary schools and least frequently required in the junior high schools.

The major differences of importance to this study to be noted in Table VI are (1) while all elementary schools offered science in each grade, 13% of junior high schools and 10% of senior high schools did not offer a course in at least one of the three grades; science in the seventh grade was most frequently omitted; (2) general science was the only course offered in elementary schools and was the course most frequently offered and required in the junior and senior high schools; (3) project science was the second most frequently offered course in junior high schools, as was Biology in the senior high schools. Both project science and Biology were designated as ninth grade courses; (4) to the extent that course titles are meaningful, the data indicate that the variety of course offerings increases from the seventh to the eighth to the ninth grades and that a few junior and senior high schools are offering earth science and physical science in lieu of the traditional general science courses.

Table VI. Science course offerings and requirements

Type of School	Grade Level	Total* Schools	Courses Offered	Schools Offering		Schools Requiring		Schools Not Offering Course		Schools Not Responding	
				No.	%	No.	%	No.	%	No.	%
ELEMENTARY	7	24	Gen.Sci.	24	100	17	70				
	8	19	Gen.Sci.	19	100	14	74	0	0	0	0
	9	5	Gen.Sci.	5	100	4	80				
JUNIOR HIGH	7		Gen.Sci.	36	77	34	72				
	7	47	Nat.Stu.	2	4	0	0	6	13	1	2
	7		Health/Bio.	2	4	0	0				
	8		Gen.Sci.	42	89	39	83				
	8	47	Ad.Gen.Sci.	2	4	0	0	1	2	1	2
	8		Health	1	2	0	0				
	9		Gen.Sci.	16	44	9	25				
	9		Biology	5	14	0	0				
	9	36	Phy.Sci.	1	3	0	0	0	0	0	0
	9		Earth Sci.	2	6	0	0				
	9		Proj.Sci.	10	28	0	0				
	9		Nat.Sci.	2	6	0	0				
SENIOR HIGH	7		Gen.Sci.	27	64	25	60				
	7	42	Health	3	7	0	0	4	10	5	12
	7		Nat.Sci.	3	7	0	0				
	8		Gen.Sci.	33	67	33	67				
	8	49	Earth Sci.	1	2	1	2	1	2	13	26
	8		Nat.Sci.	1	2	0	0				
	9		Gen.Sci.	19	29	13	20				
	9		Biology	19	29	8	12				
	9	66	Phy.Sci.	3	5	0	0	1	2	15	23
	9		Earth Sci.	3	5	0	0				
	9		Other**	6	9	0	0				

NOTE: Percentages calculated on the basis of the number of schools which include the grade (Total schools column).
Percentages may not total to 100 due to rounding.

* Gives the total number of schools in the sample which include these grades.

** Includes six schools each offering one of the following: Human Physiology, Geography, Advanced General Science, Advanced Physical Science, Natural Science, Electronics.

Table VII shows that at least 48% of elementary teachers devoted less class time for science instruction than they did for other academic subjects. The same was true for at least 16% and 5% for junior high and senior high teachers, respectively.

A slightly higher percentage of senior high teachers (6%) reported that greater class time and effort were devoted to science compared to other subjects than did junior high (5%) and elementary teachers (4%).

The greatest percentage of teachers who reported equal time for science and other subjects were in the senior high schools (88%), while 76% of junior high school teachers reported equal time, and the smallest percentage of teachers who reported equal time for all subjects were in the elementary school group (44%).

Table VII. Allotment of time and effort for science compared to other academic subjects

Type of School	Amount of Time for Science Relative to that for Other Subjects							
	Equal		Less		Greater		No Response	
	No.	%	No.	%	No.	%	No.	%
ELEM.	12	44	13	48	1	4	1	4
JHS	81	76	17	16	5	5	3	3
SHS	84	88	5	5	6	6	1	1

NOTE: Percentages calculated on basis of number of teachers in the type of school.

Table VIII contrasts sequences of courses offered by those elementary, junior high, and senior high schools having all three of the grades seven, eight, and nine.

Four of the twenty-five (16%) elementary schools included all three grades. The science course offered in all grades was titled General Science. Three of the schools required one full year of science in each grade. One school required one year in either the seventh or eighth grade plus one year in the ninth grade.

Twenty-seven of the forty-nine (55%) junior high schools included all three grades. Of these twenty-seven, nine (33%) required science each year. Two schools (4%) required only one-half year of science in the ninth grade and one (2%) required one-half year in the seventh grade. One full year of science is offered in these schools at these grade levels.

With regard to course titles and requirements in junior high schools, fourteen different sequences were reported. General Science required in all three grades was the sequence which occurred most frequently. Eight of these schools offered only two years of science but all schools offered a science course in the ninth grade. All science offered in the seventh and eighth grades is required; however, only thirteen of the twenty-seven schools required that science be taken in the ninth grade.

In junior high schools a variety of course titles was reported for the ninth grade. Biology was offered by nine schools and required in none. Earth Science was offered in five schools

(one-half year in one) and required by two. Physical Science was specified as a course by two schools and required by none. Natural Science and Project Science for poor students was reported by one school each; presumably, this is the required course in the ninth grade for those students.

Thirty-four of the sixty-six senior high schools included all three grades. Of these, twenty required science each year; however, two schools offered one-half year courses in the ninth grade, two schools offered one-half year courses in the seventh and eighth grades and one school offered a one-half year course in the seventh grade.

In terms of course titles and requirements, twenty-one sequences were reported by the senior high school group. Eleven of the thirty-four schools offered less than three years of science; nine offered two years of science and two offered only one year. The seventh grade is the one that a science most frequently is not offered (six schools); four schools reported no science offered for the ninth grade, and three schools reported science was not offered at the eighth grade level.

The greatest variety of courses offered in the senior high schools was reported for the ninth grade level: sixteen schools offered General Science (ten required it); eleven offered Biology (included Human Physiology) with two schools that required it; three schools offered Physical Science (required by one).

Very few senior high schools offered Earth Science; for example, one school offered one-half year at the eighth grade

level and two schools offered a one-year elective course at the ninth grade.

In general, fewer course titles were reported from the elementary schools (General Science only) and the greater number of electives (all grades) was reported by the junior high schools. An approximately equal percentage of junior and senior high schools offered Biology. Physical Science and Earth Science were offered by a greater percentage of junior high schools than senior high schools.

Of major importance to this study are the observations that 92% of elementary schools, 45% of junior high schools, and 48% of senior high schools did not include all three grades. Only a course titled General Science was offered in elementary schools having all three grades. Of those schools which included all three grades, 25% of the elementary, 63% of the junior high, and 20% of the senior high schools required less than three years of science instruction.

Fourteen different sequences were offered in the junior high school group, twenty-one sequences were offered in the senior high school group, and two sequences were offered in the elementary school group. With only five exceptions, the three year sequences of courses included General Science for the seventh and eighth grades. In the main, the ninth grade courses were General Science (55%), Biology (31%), Earth Science (11%), Physical Science (9%), Project Science (1%), Natural Science (1%), and Human Physiology (1%). (The percentages given are not mutually exclusive due to multiple course offerings in the ninth grade.) Ten percent (10%) of these schools offer more than one ninth-grade course.

Table VIII. Course sequences in schools having all three grades

Type of School	Number of Schools	Courses		
		Seventh Grade	Eighth Grade	Ninth Grade
ELEM.	3	Gen.Sci.	Gen.Sci.	Gen.Sci.
	1	Gen.Sci.(2)	Gen.Sci.(2)	Gen.Sci.
JUNIOR HIGH SCHOOL	6	Gen.Sci.	Gen.Sci.	Gen.Sci.
	4	Gen.Sci.	Gen.Sci.	Gen.Sci.(3)
	1	Gen.Sci.	Gen.Sci.	Earth Sci.(3)
	2	Gen.Sci.	Gen.Sci.	Biology(3)
	2	Gen.Sci.	None	Earth Sci.
	2	None	Gen.Sci.	Gen.Sci.(3)
	2	None	Gen.Sci.	Biology(3)
	2	Gen.Sci.	Gen.Sci.	Gen.Sci.(3) Biology(3)
	1	Gen.Sci.½yr. Biology(3)-½yr	Gen.Sci. Gen.Sci.-Accel.(3)	Gen.Sci. Biology(3)
	1	Gen.Sci.	None	Gen.Sci.½yr. Gen.Sci.(3)-½yr.
	1	Gen.Sci.	None	Gen.Sci.½yr. Earth Sci.(3)-½yr.
	1	Gen.Sci.	Gen.Sci.	Phys.Sci.(3)
	1	Gen.Sci.	Gen.Sci.	Phys.Sci.(4) Project Sci.(5) Biology
	1	Gen.Sci.	Gen.Sci.	Nat.Sci.(6) Biology Earth Sci.
SENIOR HIGH SCHOOL	4	Gen.Sci.	Gen.Sci.	Gen.Sci.
	1	Gen.Sci.	Gen.Sci.	Gen.Sci.½yr.
	3	Gen.Sci.	Gen.Sci.	None
	5	Gen.Sci.	Gen.Sci.	Biology
	1	Gen.Sci.	Gen.Sci.	Biology(3)
	2	Gen.Sci.	None	Gen.Sci.
	1	Gen.Sci.	Gen.Sci.(3)	Gen.Sci.(7)
	1	None	Gen.Sci.	Gen.Sci.(3)
	1	None	None	Gen.Sci.
	1	None	Gen.Sci.	None
	1	Gen.Sci.	Gen.Sci.	Phys.Sci.
	1	Gen.Sci.	Gen.Sci.	Phys.Sci.(3)
	2	Gen.Sci.	Gen.Sci.	Earth Sci.(3)

Table VIII. Continued

Type of School	Number of Schools	Courses		
		Seventh Grade	Eighth Grade	Ninth Grade
SENIOR HIGH	2	None	Gen. Sci.	Biology
	1	Gen. Sci.	Gen. Sci.	Human Physio.-½yr.
	1	None	Nat. Sci.	Gen. Sci.
	1	Gen. Sci. (Bio.)-½yr.	Gen. Sci. (Prep Sci.) ½yr.	Phys. Sci. (3)
	1	Nat. Sci. ½yr.	Earth Sci. ½yr.	Gen. Sci.-Biology
	2	Gen. Sci.	Gen. Sci.	Gen. Sci.-Biology
	1	Gen. Sci.	Gen. Sci.	Gen. Sci.-Phys. Sci.
	1	Health ½yr.	Gen. Sci.	Gen. Sci.

(1) One-year courses and required unless otherwise noted.
(2) One year required in either seventh or eighth.
(3) Not required.
(4) Any one of the three required.
(5) For slow learners.
(6) Better students (A or B grades) may elect tenth grade Biology; Average to better students may elect Earth science in ninth grade. Poor students are required to take Natural Science in ninth grade.
(7) Agriculture I may be substituted.

Table IX shows that the one activity reported by the largest proportion of all schools was science clubs. Science seminars were reported by the smallest percentage of all schools.

After-school and Saturday activities were reported by the second largest proportion of the total group of schools and science fairs by the third largest proportion.

By type of school, the largest percentage which reported the greatest variety of related activities were in the junior high school category; elementary schools offered the least variety.

The smallest proportion of schools which conducted science fairs were in the elementary group and the largest percentage were senior high schools.

In general, a larger percentage of junior high schools provide a greater variety of related activities than do the elementary and senior high schools.

Table IX. Related activities available to 7th, 8th, 9th grade science students

Type of School	Number Schools Having									
	Science Club		Science Seminar		Summer Science Activity		After Sch. and Sat. Activity		Science Fair	
	No.	%	No.	%	No.	%	No.	%	No.	%
ELEM.	12	48	0	0	0	0	13	52	2	8
JHS	43	88	5	10	19	39	19	39	20	41
SHS	52	79	4	6	1	2	14	21	25	38

NOTE: Percentages calculated on basis of total number of schools in each type of school.

Table X shows that in 60% of the elementary schools, 63% of the junior high schools, and 33% of the senior high schools the content of science courses was determined on a school or district-wide basis. On the basis of formal organization which existed for structuring the science curriculum, 88% of the elementary schools, 78% of the junior high schools, and 32% of the senior high schools were served by curriculum committees actively involved in the science programs for grades seven, eight, and nine at the time of the study.

The number of schools which had a science curriculum guide that provided for grades seven, eight, and nine constituted 52% of the elementary schools, 41% of the junior high schools, and 12% of the senior high schools.

Comparing the percentages of the types of schools which make content determinations on a district-wide basis, it is seen that the organizational structure which would facilitate K-12 development and coordination of programs occurred at most in 60% of the schools. Within types of schools, it is apparent that an organizational structure which could facilitate sequential planning by individual schools existed in 60% of elementary schools, 63% of junior high schools, and 33% of senior high schools. In the elementary school group content determinations were most frequently made on the district level, whereas in the junior high and senior high schools these determinations were most frequently determined by the individual teachers.

Table X. Modes of structuring the science curriculum

Type of School	Level of Content Determination						Districts w/Gen.Curr. Committee		Number Gen. Curr.Comm. Involved w/7,8,9		Number of Districts w/Gen.Sci. Curr.Comm.		Number of Sci.Curr. Comm.Inv. w/7,8,9		Number Having Sci.Curr. Guide		Number of Guides Providing for 7,8,9	
	Teacher		School		District													
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEM.	10	40	4	16	11	44	10	40	7	28	15	60	15	60	13	52	13	52
JHS	18	37	15	31	16	32	20	41	15	31	26	53	23	47	22	45	20	41
SHS	44	67	18	27	4	6	22	33	7	11	18	27	14	21	14	21	8	12

NOTE: Percentages calculated on basis of number of schools in each type.
Percentages may not total to 100 due to rounding.

Table XI shows that the single textbook was the most frequent basis on which the content of science courses was determined by teachers in elementary and senior high schools. In junior high schools, however, a greater percentage of teachers reported use of the curriculum guide than reported the use of any other single basis for determining content.

With respect to the total group of teachers representing all three types of schools, the teacher's professional opinion was the second most frequent basis used for content determination (21%). Use of the curriculum guide was reported by 16% of all teachers as the major means used to determine the content taught.

Between types of schools certain differences are discernable. In elementary schools, the single text, curriculum guide, and teacher opinion were reported by 75% of the teachers as the bases employed for content determination. The single text, text series, curriculum guide, and teacher opinion account for the bases used by 78% of the junior high school teachers. In the senior high school group the single text and teacher opinion represent the basis used by 64% of the teachers while each of the remaining bases listed were used by only a few percent (3% - 8%) of teachers in the group.

Table XI. Modes of determining the content of science courses

Type of School	METHODS																	
	Single Text		Multiple Texts		Textbook Series		Curr. Guide		Prof. Opinion of Teacher		Students Suggest		Teacher Pupil Decisions		ETV	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEM.	13	48	2	7	2	7	3	14	3	13	1	2	1	2	2	7
JHS	17	16	6	6	17	16	28	26	21	20	7	7	10	9	0	0
SHS	36	38	7	7	7	7	5	5	25	26	5	5	8	8	3	3
TOTALS	66	29	15	7	26	11	36	16	49	21	13	6	19	8	5	2

NOTE: Percentages calculated on basis of number of teachers in each type of school.
Percentages may not total to 100 due to rounding.

Tables XII and XIII show the rather great extent to which all of the listed objectives of science instruction were evaluated by pencil-paper tests and subjective determinations.

Content achievement was the objective most frequently evaluated by all teachers. Critical thinking ability was the second most frequently measured outcome claimed by teachers. Measurement of interests, attitudes, and appreciations were each reported by approximately the same percentage of teachers within groups but with a tendency for frequency of measurement to decrease in the order the objectives are listed.

Very little difference between strata was discernable, although a greater percentage of the junior high school teachers measured all objectives than did the elementary and senior high teachers. It should be noted that a single exception, percentage of junior high school teachers measuring content, is indicated in Table XII.

With respect to how often teachers measured these outcomes of science instruction by objective means, the data show that content achievement was most frequently evaluated at one-week intervals by junior high school and senior high school teachers, and at one-week and one-month intervals by an equal number of elementary teachers. Critical thinking abilities were most frequently measured by teachers in each type of school at one-month intervals and the second largest number of these teachers measured the objectives at one-week intervals. Very few teachers in each type of

school reported that they rarely or never evaluated critical thinking skills by objective means. Junior high school teachers lead in the frequency of evaluating science interests, attitudes, and appreciations by objective means, followed by the elementary school teachers. Of the three groups of teachers, those in senior high schools least frequently measured interest, attitudes, and appreciations by this method.

Content achievement was most frequently measured by subjective methods at one-week intervals by teachers in each type of school. An equal number of elementary teachers subjectively measured critical thinking skills at one-week and one-month intervals while the outcome was most frequently measured at one-week intervals by junior high school teachers and at one-month intervals by senior high school teachers. Elementary teachers most frequently evaluated science interests, attitudes, and appreciations at one-month intervals, while about the same number of junior high and senior high school teachers evaluated these objectives at one-week intervals as did at one-month intervals.

In comparison of the two methods of evaluation, content achievement and critical thinking abilities were most frequently evaluated by objective means by teachers in each type of school while interests, attitudes, and appreciations were most frequently evaluated by subjective means by these teachers.

It seems reasonable to assume that, in general, the teachers who did not respond to individual items either did not evaluate the objective or its evaluation had an insignificant effect from the teacher's point of view, hence, might well be included in the "rarely" category.

Table XII. Frequency of evaluating certain objectives by objective means

Type of School	Frequency of Evaluation	Teacher Developed Written Tests: Content Achievement		Critical Thinking		Science Interests		Science Attitudes		Appreciations	
		No.	%	No.	%	No.	%	No.	%	No.	%
ELEMENTARY	1/wk	13	48	8	30	3	11	3	11	2	7
	1/mo	13	48	10	37	7	26	7	26	7	26
	Less 1/mo	1	4	2	7	9	33	6	22	6	22
	Rarely	0	0	1	4	1	4	2	7	4	15
	Total	27	100	21	78	20	74	18	67	19	70
	No Response	0	0	6	22	7	26	9	33	8	30
JUNIOR HIGH	1/wk	67	63	33	31	18	17	17	16	15	14
	1/mo	31	29	52	49	26	25	30	28	25	24
	Less 1/mo	2	2	10	10	31	29	22	21	25	24
	Rarely	1	1	2	2	14	13	17	16	18	17
	Total	101	95	97	92	89	84	86	81	83	78
	No Response	5	5	9	8	17	16	20	19	23	22
SENIOR HIGH	1/wk	72	75	27	28	13	14	11	11	9	9
	1/mo	23	24	37	39	17	18	16	17	18	19
	Less 1/mo	0	0	15	16	21	22	22	23	16	17
	Rarely	1	1	6	6	20	21	21	22	22	23
	Total	96	100	85	89	71	74	70	73	65	68
	No Response	0	0	11	11	25	26	26	27	31	32

NOTE: Percentages calculated on the basis of the total number of teachers in each stratum.

Percentages may not total to 100 due to rounding.

Table XIII. Frequency of evaluating certain objectives by subjective means

Type of School	Frequency of Evaluation	Subjective Evaluation: Content Achievement		Critical Thinking		Science Interests		Science Attitudes		Appreciations	
		No.	%	No.	%	No.	%	No.	%	No.	%
ELEMENTARY	1/wk	12	44	8	30	5	19	5	19	4	15
	1/mo	8	30	8	30	9	33	9	33	5	19
	Less 1/mo	2	7	3	11	4	15	3	11	5	19
	Rarely	0	0	1	4	1	4	2	7	3	11
	Total	22	81	20	74	19	70	19	70	17	63
	No Response	5	19	7	26	8	30	8	30	10	37
JUNIOR HIGH	1/wk	54	51	42	40	30	28	30	28	27	25
	1/mo	28	26	34	32	24	23	27	25	27	25
	Less 1/mo	8	8	11	10	24	23	17	16	20	19
	Rarely	3	3	2	2	4	4	5	5	3	3
	Total	93	88	89	84	82	77	79	75	77	73
	No Response	13	12	17	16	24	23	27	25	29	27
SENIOR HIGH	1/wk	38	40	23	24	17	18	17	18	17	18
	1/mo	31	32	25	26	17	18	19	20	17	18
	Less 1/mo	6	6	18	19	16	17	19	20	13	14
	Rarely	6	6	7	7	18	19	15	16	22	23
	Total	81	84	73	76	68	71	70	73	69	72
	No Response	15	16	23	24	28	29	26	27	27	28

NOTE: Percentages calculated on the basis of the total number of teachers in each stratum.

Percentages may not total to 100 due to rounding.

Table XIV shows that in elementary and junior high schools a greater percentage of science instruction was conducted within a departmentalized organization than otherwise. In the case of junior and senior high schools, the data may be misleading with respect to the self-contained classroom information. It is reasonable to assume that the connotation of self-contained classrooms was different for high school teachers than for elementary teachers; however, sufficient information was not available for interpretation of this aspect of the table.

The data are quite clear with respect to how science was taught in relation to other subjects. The greatest percentage of all teachers at all grade levels taught science as a separate subject. None of the teachers reported that science was taught on an incidental basis, and relatively few teachers integrated science with other subjects.

A greater proportion of junior high school teachers than teachers in the other two types of schools integrated science with other subjects. Science and other courses were integrated least frequently by the senior high school teachers.

Of elementary school integrated courses the larger proportion were conducted at the eighth grade level and none were reported at the ninth grade level. In junior high schools, integrated courses were most frequently taught in the seventh grade and none were taught in the ninth grade.

A greater proportion of junior high school teachers reported student grouping on the basis of ability than did teachers in the

elementary and senior high schools. In the elementary schools, ability grouping occurred most frequently in the ninth grade and least frequently in the seventh grade. In junior high schools grouping in the eighth and ninth grades was about equal (62% and 60%) and occurred with the least proportion of teachers in the seventh grade. In senior high schools about the same percentage of teachers reported grouping in the seventh grade (30%) as did in the eighth grade (29%). Ability grouping in the ninth grade was reported by the smallest percentage of senior high school teachers.

Table XIV. Organization of staff and pupils for science instruction

Type of School	Grade Level	Total Number Schools	Classroom Organization						Subject Organization						No. Grouping By Ability	
			No. Self-contained		No. Departmentalized		No. Team Teaching		Separate Subject		Integrated Subject		Taught Incidentally			
			No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEM.	7	25	11	44	13	52	1	4	23	92	2	8	0	0	6	24
	8	18	8	44	10	56	0	0	16	89	2	11	0	0	6	33
	9	5	3	60	2	40	0	0	5	100	0	0	0	0	3	60
JHS	7	59	16	27	41	70	2	3	48	81	11	19	0	0	32	54
	8	64	24	38	39	60	1	2	61	95	3	5	0	0	40	62
	9	42	12	29	29	69	1	2	42	100	0	0	0	0	25	60
SHS	7	30	13	43	17	57	0	0	30	100	0	0	0	0	9	30
	8	35	19	54	16	46	0	0	35	100	0	0	0	0	10	29
	9	67	32	48	35	52	0	0	66	99	1	1	0	0	17	25

NOTE: Percentages calculated on the basis of the number of schools which include the grade. Percentages may not total to 100 due to rounding.

The extent and type of science consultant or supervisory assistance which was available to schools are presented in Table XV. A greater proportion of elementary and junior high schools had consultant service available than senior high schools. A science supervisor or a general supervisor with special competence in science was available to 28% of elementary schools, 40% of junior high schools, and 16% of senior high schools. School principals provided this assistance in 20% of the schools. Almost half of the schools had no consultant assistance available.

Table XVI shows that few teachers in each type of school made some utilization of available consultant and supervisory assistance. However, each of the functions listed was of some importance to teachers. Utilization of this service was greatest by elementary teachers and least by high school teachers.

Of the three groups of teachers, the greater percentage of teachers utilizing the service once per month to once per week occurred in the elementary group. Overall, teachers in the senior high school group made least frequent utilization of the service of the three groups.

In terms of the services provided, the greatest proportion of senior high school teachers obtained assistance in planning. Among elementary and junior high school teachers, provision of reading materials, science education information, and planning were reported by the larger percentage of teachers.

Table XVII, page 97, shows that a relatively small proportion of elementary schools had a laboratory available for science instruction at each of the three grade levels, yet a rather high percentage had special science facilities within the classroom. A greater percentage of senior high schools than schools in the other two groups had a laboratory available to seventh, eighth, and ninth grade students.

A greater proportion of elementary schools had an area for special project work for students in each of the three grades than did junior high and senior high schools. The senior high school group had the least proportion of schools with project areas. The proportion of elementary schools having facilities for equipment construction and repair and a preparation room exceeded that of the other types of schools.

A greater percentage of elementary schools had a reference and reading materials area in the classroom than did senior high and junior high schools. The senior high school group had the smallest percentage of schools with this arrangement.

With the exception of special facilities reported in elementary classrooms and the ninth grades of junior high schools, less than 50% of schools in each category had the listed facilities and in terms of specific facilities the percentage of schools which reported having them was considerably less than 50%.

Table XVIII, page 98, shows that in 50% of all science classes pertinent to this study, class time was rarely to never used for laboratory work. In 96% of those classes which were provided laboratory activities, the teacher demonstration technique was utilized. Frequent utilization of this technique was reported in 43%, and no use of

teacher demonstrations was made in 2% of the classes. Some use of demonstrations by students was made in 90% of the science classes included in this report. The approach was used frequently in 27% of the science classes and in 5% of the classes this technique was not used. Individual experimentation was utilized at some frequency or other in 74% of the science classes studied. In forty-four percent (44%) of the classes this type of activity was rarely or never provided and in only 13% was class time frequently used for individual experiments. Sixty-eight percent (68%) of all responses reported utilization of small-group experiments; 53% of the responses indicated rare or no use of this approach; and frequent use of small-group experiments was indicated by 14% of the responses.

By type of schools, junior high schools had the greatest percentage of classes (32%) in which class time was never used for laboratory activities. Senior high schools had a greater percent (54%) of classes in which class time was utilized for laboratory than did elementary schools (33%) or junior high schools (25%).

Teacher demonstrations were occasionally to frequently used in 85% of the senior high school classes, 77% of the elementary school classes, and 61% of the junior high school classes. Student demonstrations were used more frequently in a greater percentage of elementary school science classes than were used in the other two groups.

Provision for individual experimentation was most frequently made in junior high classes and least frequently in senior high school classes.

Experiments by small groups of students were utilized in a greater percentage of elementary science classes than in the other two groups. The smallest percentage and least frequent provision for small-group experimentation was made in the senior high school classes.

Table XV. Staff available for science consultant and supervisory assistance

Type of School	None		Principal		Gen'l.Supv. w/o Sci.Spec.		Gen. Supv. w/Sci.Spec.		Science Supervisor	
	No.	%	No.	%	No.	%	No.	%	No.	%
ELEM.	8	32	7	28	3	12	1	4	6	24
JHS	20	41	6	12	3	6	3	6	17	34
SHS	39	60	15	23	1	2	7	10	4	6

NOTE: Percentages calculated on basis of number of schools in each type.
Percentages may not total to 100 due to rounding.

Table XVI. Utilization of consultants and supervisors by the teachers

Type of School	Degree of Utilization	Ways Utilized																	
		Planning		Demon. Teaching		Science Dem. to Class		Provide Matls.		Assist in Evaluation		Working with Ind. Students		Workshop Instr.		Sci.Ed. Info Services		Other	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEMENTARY	1/wk	0	0	1	4	1	4	2	7	0	0	1	4	1	4	1	4	0	0
	1/mo	4	15	0	0	0	0	5	19	3	11	0	0	1	4	6	22	0	0
	Less 1/mo	2	7	2	7	2	7	4	15	4	15	4	15	3	11	3	11	0	0
	Rarely	6	22	7	26	6	22	2	7	5	19	5	19	5	19	2	7	1	4
	Total	12	44	10	37	9	33	13	48	12	44	10	37	10	37	12	44	1	4
	No Response	15	56	17	63	18	67	14	52	15	56	17	63	17	63	15	56	26	96
JUNIOR HIGH	1/wk	5	5	2	2	3	3	7	7	1	1	5	5	0	0	3	3	2	2
	1/mo	12	11	1	1	1	1	15	14	6	6	1	1	1	1	12	11	2	2
	Less 1/mo	8	8	7	7	5	5	13	12	14	13	7	7	6	6	5	5	1	1
	Rarely	11	10	22	21	23	22	7	7	15	14	20	19	27	25	15	14	3	3
	Total	36	34	32	30	32	30	42	40	36	34	33	31	34	32	35	33	8	8
	No Response	70	66	74	70	74	70	64	60	70	66	73	69	71	67	71	67	98	98
SENIOR HIGH	1/wk	3	3	1	1	2	2	4	4	2	2	4	4	0	0	0	0	0	0
	1/mo	7	7	1	1	3	3	5	5	3	3	3	3	1	1	3	3	0	0
	Less 1/mo	9	9	3	3	1	1	9	9	5	5	2	2	0	0	8	8	0	0
	Rarely	10	10	19	20	18	19	7	7	15	16	16	17	20	21	13	14	0	0
	Total	29	30	24	25	24	25	25	26	25	26	25	26	21	22	24	25	0	0
	No Response	66	69	72	75	72	75	71	74	71	74	71	74	75	78	72	75	0	0

NOTE: Percentages calculated on the basis of the number of teachers in each type of school. Percentages may not total to 100 due to rounding.

Table XVII. Facilities available for science instruction.

Type of School	Grade	Lab		Regular Classroom w/Spec. Fac.*		Regular Classroom w/o Spec. Fac.**		Project Areas		Equip. Const. Rep.Fac.		Prep Room		Photo Lab		Ref/Reading Materials Area	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEM.	7	3	13	18	80	3	13	5	21	6	25	4	17	2	8	8	33
	8	2	11	15	78	2	11	5	26	4	21	4	21	2	11	8	42
	9	0	0	5	100	0	0	3	60	2	40	1	20	1	20	2	40
JHS	7	8	17	19	40	8	17	10	21	5	11	4	9	5	11	12	26
	8	9	19	30	63	6	13	11	23	6	13	9	19	6	13	16	34
	9	5	14	20	56	3	8	12	33	5	14	10	28	5	14	13	36
SHS	7	11	26	13	31	6	14	8	19	2	5	1	2	4	10	7	17
	8	15	31	14	29	6	12	7	14	1	2	1	2	3	6	8	16
	9	28	42	24	36	4	6	15	23	5	8	8	12	17	26	18	27

NOTE: Percentages calculated on the basis of the number of schools which include the grade. Percentages may not total to 100 due to rounding.

* With special facilities.

** Without special facilities.

Table XVIII. Frequency and type of laboratory activity

Type of School	Degree of Utilization	Class Time Used for Lab Activity		Teacher Demon.		Student Demon.		Individ. Exper.		Small Group Exper.	
		No.	%	No.	%	No.	%	No.	%	No.	%
ELEMENTARY	Not Used	5	10	0	0	0	0	2	4	5	10
	Rarely	18	38	10	22	12	25	16	34	11	23
	Occasionally	14	29	10	22	19	40	20	42	20	42
	Frequently	2	4	28	56	17	33	5	10	9	19
	No Response	9	19	0	0	0	0	5	10	3	6
JUNIOR HIGH	Not Used	52	32	1	1	5	3	12	7	29	18
	Rarely	41	25	61	36	40	24	50	30	56	34
	Occasionally	34	21	50	30	48	29	65	40	30	18
	Frequently	7	4	51	31	69	42	23	14	28	17
	No Response	31	18	2	2	3	2	15	9	22	13
SENIOR HIGH	Not Used	5	4	5	4	13	10	36	27	38	29
	Rarely	52	40	13	10	48	36	37	28	41	31
	Occasionally	48	36	41	31	47	36	25	19	25	19
	Frequently	24	18	71	54	11	8	16	12	16	12
	No Response	3	2	2	2	13	10	18	14	12	9

NOTE: Percentages calculated on the basis of the total number of responses in each stratum.
Percentages may not total to 100 due to rounding.

Table XIX, page 104, shows that the requisition, control, and utilization of equipment and supplies was conducted on an individual teacher basis by a large proportion of all types of schools.

Table XX, page 105, shows that in-service education programs were available to 44% of the elementary schools, 35% of junior high schools, and only 21% of senior high schools. College instructors and science supervisors were mainly responsible for the conduct of in-service programs in each type of school.

Of those teachers in all types of schools to whom in-service education programs were available, 64% attended few to none of the sessions and the greater percent (47%) attended none. A greater percentage of elementary teachers attended the majority of sessions (60%) than did teachers in the other types of schools. The smallest proportion of teachers who attended the majority of sessions was found to be in the junior high school group.

Science courses were seldom offered and the most common types of activities involved teaching methods and curriculum workshops.

In elementary schools methods courses, curriculum workshops, and a program combining science course work with methods and curriculum studies predominated over types of programs. Programs available to senior high school staff were predominately of the workshop type but a greater proportion were of or included science course work than was the case in the other two types of schools. Less than 5% of all teachers reported any released time for in-service activities. With the exception of three teachers who

reported from two to four weeks of summer employment for curriculum development activity, the amount of released time was negligible.

The data in Table XXI, page 106, provide evidence that audio-visual aids were used least in the science classes of the secondary schools. With the exception of educational films, the elementary school group made greatest use of these aids.

In all three types of schools more teachers used films and film strips than used the remaining aids listed. Field trips were rarely to never used in at least 60% of the elementary school science classes, in 76% of junior high science classes, and in 77% of senior high science classes. Of the three groups of teachers, educational and commercial television was most frequently used in the elementary schools and least frequently in the senior high schools. Programmed learning materials were used by only a few teachers on an occasional to frequent basis and in more elementary school science classes (10%) than junior high (8%) or senior high science classes (6%). In general, the same pattern of utilization holds for the use of records and radios.

Table XXII, page 107, shows that the larger percentage of classes in each type of school occasionally to frequently used additional textbooks, popular periodicals, and daily newspapers than used any of the other types of literature listed. A greater proportion of

elementary classes made occasional to frequent use of additional texts than did junior or senior high school classes. The percentage of elementary, junior high, and senior high classes that rarely or never used additional texts was 19%, 28%, and 27%, respectively. Occasional to frequent use of trade books was made most frequently in the junior high schools and least frequently in the senior high schools.

A greater proportion of junior and senior high school classes made occasional to frequent use of professional journals than did elementary school classes; however, at least 50% of senior high classes, 44% of junior high classes, and 49% of elementary school classes rarely to never made use of this type of literature.

Table XXIII, page 108, reflects those changes in science programs which had been made during the past three years. Change of textbooks, increased use of supplementary reading materials, development of curriculum guides, addition or elimination of topical units, and changes in the science field emphasized were classified as content changes. Grouping of students, increased utilization of demonstrations, experiments, projects, and other approaches which reflected a departure from lecture-reading activities were included as methodological changes. Procurement of additional teaching equipment and improved laboratory facilities constituted equipment and facilities change.

The data show that a rather high percentage of elementary and junior high schools had made program changes at each of the three grade levels. A smaller percentage of senior high schools reported changes at each grade level than did elementary and junior high schools. A greater proportion of junior high schools reported changes at the eighth and ninth grade levels than did the elementary schools; however, the greater percentage of schools which reported changes in the seventh grade were in the elementary group.

In each of the three types of schools, changes at the ninth grade level were reported by a greater percentage of schools than were changes at the other two grade levels. Changes at the eighth grade level were reported by a smaller percentage of all schools than were changes at the seventh grade level. Changes at the seventh grade level were reported by a smaller proportion of senior high schools than elementary or junior high schools.

Of the elementary and senior high schools, the greatest proportion reported changes of ninth grade programs and the smallest percentage of changes at the eighth grade level.

With respect to the junior high schools, the greatest percentage made changes in the ninth grade and the smallest percentage effected changes in the seventh grade programs.

In terms of types of changes, those related to content and equipment-facilities were most frequently reported by all three types of schools. Those changes classified as methodological

were less frequently noted. A greater proportion of junior high schools than the other two types made changes in methodology.

Table XIX. Bases for requisition, control, and utilization of equipment and supplies

Type of School	BASES					
	Teacher		Building		District	
	No.	%	No.	%	No.	%
ELEM.	18	72	3	12	4	16
JHS	27	55	16	33	6	12
SHS	50	76	14	21	2	3

NOTE: Percentages calculated on basis of number of schools in the type.

Table XX. Extent of in-service science education opportunities provided by schools

Type of School	No. Schools Providing In-service Programs		TYPE OF PROGRAM** (1) Science Courses		(2) Methods Courses		(3) Curr. Workshop		1 & 2		1 & 3		2 & 3		1,2 & 3	
	No.	%*	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEM.	11	44	0	0	2	18	4	36	0	0	0	0	0	0	5	45
JHS	17	35	0	0	3	18	8	47	0	0	3	18	1	6	2	12
SHS	14	21	2	14	1	7	5	36	1	7	3	21	0	0	2	14
TOTALS	42	30	2	5	6	14	17	40	1	2	6	14	1	2	9	21

Type of School	No. Schools Providing In-service Programs		CONDUCTED BY** (A) Science Supervisor		(B) College Instructor		A & B		Admin-Staff		Co-Teachers	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEM.	11	44	4	36	0	0	4	36	0	0	3	27
JHS	17	35	5	29	6	35	5	29	0	0	1	6
SHS	14	21	1	7	10	71	1	7	2	14	0	0
TOTALS	42	30	10	24	16	38	10	24	2	5	4	10

Type of School	No. Schools Providing In-service Programs		DEGREE OF TEACHER PARTICIPATION*** SESSIONS All		Most		Few		None	
	No.	%	No.	%	No.	%	No.	%	No.	%
ELEM.	11	44	2	20	4	40	0	0	4	40
JHS	17	35	8	16	5	10	9	18	28	56
SHS	14	21	5	28	4	22	4	22	5	28
TOTALS	42	30	15	19	13	17	13	17	37	47

* Percentages calculated on basis of total number of schools in the stratum.
** Percentages calculated on basis of total number of schools in the stratum providing a program.
*** Percentages calculated on basis of total number of teachers to whom programs are available.

Table XXI. Utilization of audio visual aids by teachers

Type of School	Frequency of Evaluation	Educational Films		Film Strips		Records		Radio		Com. mercial T.V.		Educational T.V.		Field Trips		Programmed Learning	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEMENTARY	Not Used	4	8	7	15	18	38	17	35	19	40	18	38	15	31	18	38
	Rarely	8	17	3	6	6	12	11	23	9	19	2	4	14	29	3	6
	Occasionally	15	31	26	54	5	10	3	6	4	8	6	12	6	12	0	0
	Frequently	18	38	9	19	1	2	0	0	0	0	7	15	0	0	5	10
	No Response	3	6	3	6	18	38	17	36	16	33	15	31	13	28	22	46
JUNIOR HIGH	Not Used	5	3	12	7	94	57	75	45	82	50	89	54	48	29	93	56
	Rarely	34	21	56	34	35	21	49	30	40	24	18	11	78	47	10	6
	Occasionally	73	44	63	38	1	1	4	2	3	2	11	6	18	11	11	7
	Frequently	52	32	26	16	1	1	4	3	0	0	4	3	1	1	2	1
	No Response	1	1	8	5	34	20	33	20	40	24	43	26	20	12	49	30
SENIOR HIGH	Not Used	8	6	42	32	97	73	91	69	87	66	100	76	62	47	95	72
	Rarely	39	30	29	22	18	13	24	18	21	15	14	11	39	30	7	5
	Occasionally	56	42	26	20	2	2	1	1	5	4	6	4	13	10	7	5
	Frequently	25	19	23	17	0	0	0	0	4	3	2	2	7	5	1	1
	No Response	4	3	12	9	15	12	16	12	15	12	10	7	11	8	22	17

NOTE: Percentages calculated on the basis of the total number of responses in each stratum.

Table XXII. Utilization of supplementary literature by teachers

Type of School	Frequency of Evaluation	Additional Tests		Trade Books		Monographs		Professional Journals		Popular Periodicals		Newspapers		Business Industry Pamphlets	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEMENTARY	Not Used	1	2	15	31	16	34	7	15	4	8	7	15	10	21
	Rarely	8	17	6	12	5	10	16	34	6	13	10	21	18	39
	Occasionally	9	19	4	8	5	10	6	12	22	46	22	46	5	10
	Frequently	26	54	5	10	3	6	3	6	12	25	8	16	5	10
	No Response	4	8	18	39	19	40	16	33	4	8	1	2	10	20
JUNIOR HIGH	Not Used	14	9	47	29	65	39	26	16	14	9	7	4	25	15
	Rarely	31	19	36	22	22	13	46	28	31	19	34	21	60	36
	Occasionally	58	35	45	27	18	11	50	30	57	34	58	35	36	22
	Frequently	57	34	22	13	4	3	9	5	42	25	44	27	12	7
	No Response	5	3	15	9	56	34	34	21	21	13	22	13	32	20
SENIOR HIGH	Not Used	12	9	57	43	64	49	29	23	9	7	10	7	38	29
	Rarely	24	18	30	23	11	8	35	27	20	15	37	28	33	25
	Occasionally	45	34	10	8	17	13	26	20	58	44	55	41	33	25
	Frequently	38	29	6	4	7	5	21	15	29	22	19	15	4	3
	No Response	13	10	29	22	33	25	21	15	16	12	11	9	24	18

NOTE: Percentages calculated on the basis of the total number of responses in each stratum.

Table XXIII. Changes in science programs which have occurred during the past three years

Type of School	Grade Level	Number of Schools Reporting Changes		Type of Change													
				Content		Methodology		Equipment and Facilities		Content + Methodology		Content and Equip. + Facilities		Methodology and Facilities		Content, Methodology, + Facilities	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
ELEMENTARY	7	17	71	7	29	2	8	2	8	0	0	5	21	1	4	0	0
	8	12	63	4	21	1	5	2	11	0	0	4	21	1	5	0	0
	9	4	80	1	20	1	20	0	0	0	0	2	40	0	0	0	0
JUNIOR HIGH	7	29	62	14	30	5	11	2	4	4	9	3	6	0	0	1	2
	8	38	81	22	47	1	2	4	9	4	9	3	6	3	6	1	2
	9	32	89	19	53	1	3	4	11	3	8	2	6	2	6	1	3
SENIOR HIGH	7	20	48	6	14	3	7	5	12	2	5	3	7	0	0	1	2
	8	20	41	7	14	4	8	6	12	1	2	2	4	0	0	0	0
	9	42	64	23	35	4	6	6	9	2	3	2	3	2	3	3	5

NOTE: Percentages calculated on basis of number of schools having each grade. Percentages may not total to 100 due to rounding.

Table XXIV presents a summary of comments made by teachers in response to the question which sought identification of major obstacles to more effective science instruction. Comments relating to inadequate laboratory facilities and equipment constituted 26% of all comments. Teacher loads and student grouping within classes were two sets, accounting for 24% of the total number of comments (these two sources of obstacles were related in that the opinion of the teachers was that heterogeneous grouping contributed to teacher load as did the number and variety of courses assigned to them).

Several differences between types of schools were apparent. The percentage of comments which related to the lack of consultant service, the lack of coordination of instruction within and between schools, and the lack of communication between teachers (between and within schools) was highest for the junior high schools (14%) and lowest for the elementary group (4%). The lack of adequate laboratory facilities was most frequently noted within the elementary school group as was the fact that the variety of subjects taught did not allow sufficient time for science instruction. A greater percentage of elementary and junior high school teachers commented on their quandary about what should be taught (content) and what is being taught at the various levels (lack of structural guide lines) than did the teachers in senior high schools. A greater percentage of senior high school teachers (10%) noted concern about their academic preparation in the sciences than did elementary and junior high teachers (2% and 5%, respectively).

Inadequacy of textual and reference materials was more frequently noted by senior high and junior high teachers (10%) than by elementary teachers (8%). The lack of understanding of and commitment to a modern science program by school administrators was noted by about the same percentage of teachers in each group (5% - 6%).

Table XXIV. Major obstacles to more effective science instruction identified by teachers

SOURCE OF OBSTACLES	TYPE OF SCHOOL							
	Elem.		JHS		SHS		Totals	
	No.	%*	No.	%*	No.	%*	No.	%**
Phys. Fac.:								
Classroom	2	4	5	2	9	4	16	3
Laboratory	9	19	25	11	32	15	66	13
Equipment	3	6	29	13	33	15	65	13
Curriculum:								
Time	7	15	9	4	7	3	23	5
Content and Structure	5	10	11	5	4	2	20	4
Teacher:								
Overload	2	4	24	11	24	11	50	10
Preparation	1	2	12	5	21	10	34	7
Student:								
Grouping	7	15	34	15	29	13	70	14
Personal	3	6	9	4	9	4	21	4
Text and Ref. Materials	4	8	22	10	22	10	48	10
Administrative	3	6	11	5	10	5	24	5
Program Coordination, Communication, Consultant Service	2	4	32	14	17	8	51	10
Parents and Public	0	0	2	1	0	0	2	1
TOTALS	48	99	225	100	217	100	490	99

* Percentages calculated on basis of total number of comments given in each school type.

** Percentages calculated on basis of grand total comments (490).

NOTE: Percentages do not total to 100 due to rounding.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

The purpose of this study was to (1) elucidate the status of science programs in grades seven, eight, and nine of Michigan Public Schools, and (2) to develop a set of recommendations which would contribute to further improvement of science education at both the seventh, eighth, and ninth grade levels and, directly or indirectly, the K-12 program. Primary consideration was given to certain of those school provisions and/or practices which give general indication of current procedures and the bases on which programs are conducted. The questionnaire technique was employed to gather data pertinent to this study.

The population studied consisted of all schools which contained one or more of grades seven, eight, and nine (1101) in the K-12 Public School Districts of Michigan. These districts accommodated approximately 93% of the public school students in this State. The school was selected as the sampling unit. A disproportionate stratified sampling design was employed. The sample of schools (140) to be studied was selected by use of a table of random numbers. The close approximation of the distribution of schools in the sample to that of the population was shown in Tables I and II of Chapter IV, pages 61 and 62.

The vast, and heretofore unprecedented, expenditure of human and financial resources which has been applied to science education at the pre-college level since World War II was noted. Cognizance was taken of the fact a relatively small proportion of the National effort has been applied at the junior high school level to date, although it appears that guidelines for future direction are emerging.

A review of major developments related to science education at the grade levels under consideration revealed discontent with organization patterns in use during the late 1800's which culminated in the establishment of the junior high schools. The nature of the early adolescent students and adequate articulation between levels of instruction were identified as the primary bases for formation of this division of instruction, and which continue to be fundamental to curriculum development in the junior high school.

The period of early adolescence was characterized as one of rapid growth and maturation, and of extreme heterogeneity in terms of physical, emotional, social, and intellectual development. It was noted that certain special needs of junior high school youth are derivable from the physical-mental-social characteristics of the group. Similarly, unique functions relating to the transitional needs of this age were identified for junior high schools.

A paucity of recently conducted studies on junior high school science programs was noted. Among the results of related studies described was identification of: a trend toward objectives of exploration, differentiations, socialization, and articulation;

an increase in the amount of time for science; a prevalence of general science courses and an increased amount of laboratory work; a list of general principles and related experiments of importance to general science courses; a lack of uniformity in texts with respect to content; the role of assumptions in science instruction; findings negative to placement of biology in the ninth grade and physical science in the tenth; a lack of in-service education programs in schools; and lack of permanence on the part of junior high teachers.

Research studies about Michigan schools revealed lack of a pattern of organizational procedures at the local level; lack of understanding of principles of administrative organization; overlapping and vaguely defined functions of administrators and committees.

Results of a survey of State Departments of Public Instruction to identify new ideas and approaches to elementary and junior high school science were reported. Among the findings was a trend toward K-12 curriculum development at state and local levels, provision of consultant services and in-service education programs.

Backgrounds and origins of objectives for science education were discussed and the statement of objectives proposed by a committee of the National Society for the Study of Education in 1947 was defended.

Major developments for the improvement of science instruction which have occurred in the last decade were discussed. In Michigan a State Science Curriculum Committee was formed in 1958.

Subsequently, the Committee published a statement of philosophy and objectives for science instruction which was supplemented by a publication in 1961 which set forth criteria for the evaluation of K-12 science programs.

A general summary of the data collected for this investigation follows under major headings which correspond to the aspects of science programs listed in Chapter I, page 3, as being of importance to this study.

The science course offerings and requirements. All elementary schools which included one or more of grades seven, eight, and nine offered science in each of these grades. Science was offered in every junior and senior high school. However, at least 13% of junior high schools and at least 10% of senior high schools did not offer a course at one or more of the three grade levels (7-8-9). The grade at which science was most frequently omitted was seventh grade.

General science was the only course offered in elementary schools, and was the course most frequently offered and required in the junior and senior high schools. Project science was the second most frequently offered course in junior high schools. Biology was the second most frequently offered and required course in the senior high schools with 12% of the schools requiring the course. Both project science and biology were designated as ninth grade courses. It is noted that the number of different course offerings increased from the seventh to the eighth to the ninth grades. A few junior and senior high schools offered earth science

and physical science in lieu of the traditional general science courses.

Related activities. Science clubs were the most frequently reported related activities in the junior and senior schools. Forty-one percent (41%) of the junior high schools and 38% of the senior high schools indicated participation in science fair activities. After school and Saturday activities were conducted by 52% of the elementary schools, 39% of the junior high schools, and 21% of the senior high schools. Junior high schools appeared to provide more related activities than either the elementary or senior high schools. Inspection of Table IX, page 80, supports this conclusion.

Teaching assignments. At least 50% of the science teachers in each type of school were full-time science and/or mathematics teachers. It is interesting to note that less than 5% of the teachers responding indicated physical education or administrative responsibilities. Discernable data were not available relative to the specific responsibility of the half-time or less teachers.

Organizational patterns. In the elementary schools 44% - 60% reported the self-contained classroom pattern and 40% - 52% reported a departmentalized plan. The departmental plan was more frequent at each grade in both the junior and senior high school with the exception of the eighth grade in the senior high school group. Very little team teaching was reported in the elementary and junior high schools and none in the senior high school.

The teaching of science as a separate subject far exceeded any other organizational plan. None of the teachers at any level

indicated that science instruction was on an incidental basis. A few teachers reported the integration of science with other subject areas.

Ability grouping was indicated by 24% - 60% in the elementary group, 54% - 60% in the junior high group, and 25% - 30% in the senior high school group. Ability grouping appeared to be more frequent in each of the junior high grades than in either the elementary or senior high schools.

In comparison with the time allotted for science to that allotted to other subjects, more time was given science in the junior and senior high school groups. In the elementary schools, 44% of the respondents indicated that science received an equal allotment of time with other subjects, while 48% indicated the allotment of less time for science than for other disciplines.

Organization level-content determinations. The content taught in the elementary schools was most frequently determined at the district level although individual teacher determinations occurred in 40% of the schools. In the junior and senior high school, teacher determination was the most frequent single method employed for content determination. However, 63% of the junior high schools and 33% of the senior high schools reported that content determinations were made at the school or district levels.

Specific factors employed in determining course content. A single textbook was used most frequently by the teachers in the elementary and senior high schools as the basis for the course content, whereas the use of a curriculum guide was most frequently

used in the junior high school. Multiple texts were used by less than 8% of the teachers in each of the three types of schools. A textbook series was employed most frequently in the junior high group than in the other two groups. Likewise, teachers were more prone in the junior high school group to consider the suggestions of pupils relative to course content than were the teachers in the elementary or senior high school groups.

Use of supplementary science reading materials. Additional textbooks, popular periodicals, and daily newspapers were used more frequently by teachers in the three types of schools than the other types of literature listed. Additional textbooks and popular periodicals were used by more elementary school teachers than junior or senior high school teachers. The monograph was the type of literature least used by elementary and junior high teachers as was the trade book by senior high school teachers.

Forty-three percent (43%) of elementary school teachers, 51% of junior high school teachers, and 69% of senior high school teachers rarely to never used trade books. Likewise, 49%, 44%, and 50% of elementary, junior high, and senior high school teachers, respectively, rarely to never used professional journals as supplementary reading materials. It appears that elementary teachers are more prone to use supplementary reading materials, followed by junior high school and senior high school teachers in that order.

Use of audio visual aids. Films and film strips were the aids most frequently used by teachers in each type of school. Very

few teachers used records, radio, commercial television and programmed learning materials. Twelve percent (12%) to 15% of responses from teachers in the three types of schools indicated that field trips were utilized on an occasional to frequent basis. Educational television was reported to have been used occasionally to frequently in 9% of junior high school science classes, 6% of senior high school science classes, and 27% of elementary school science classes pertinent to this study.

Elementary school teachers lead in the use of each of the audio visual aids listed with the exception of films and field trips. Junior high school teachers lead in the use of films followed by the elementary school teachers. Senior high school teachers lead in the use of field trips. The same proportion of elementary and junior high school teachers (12%) utilized field trips on an occasional to frequent basis.

Laboratory instruction. Fifty-four percent (54%) of the responses from senior high school teachers, 25% of those from junior high school teachers, and 33% of those from elementary school teachers noted use of class time for laboratory activities on an occasional to frequent basis. Demonstrations by the teacher were more often utilized on an occasional to frequent basis in the elementary and senior high school science classes, 78% and 85%, respectively, than were the other types of laboratory activities. Demonstrations by students were more often used in junior high school classes (71%) than were the other types of laboratory activities. Student demonstrations were employed in the second

greatest proportion of elementary (73%) and senior high school (44%) classes while teacher demonstrations were utilized in the second greatest proportion of junior high school science classes (61%).

Individual experimentation was provided on an occasional to frequent basis in more elementary school and junior high school science classes, 52% and 54%, respectively, than senior high school science classes (31%). Likewise, small group experimentation was provided in 61%, 35%, and 31% of elementary, junior high, and senior high school science classes, respectively.

Facilities. A regular classroom with special facilities for science instruction was the most frequently reported facility available in the elementary and junior high schools. About the same number of senior high schools reported having a laboratory available as had a regular classroom with special facilities. Few schools of each type did not have either a laboratory or special classroom facilities.

Elementary schools lead in the proportion of those having a project area, equipment construction and repair facility, and a reference-reading materials area in the classroom. The second largest proportion of schools having these three facilities comprised the junior high school group. Few senior high schools had facilities for the construction and repair of equipment. Junior high schools lead in the proportion of those having a preparation area followed by the elementary schools.

Less than 50% of the schools (in most instances considerably less than 50%) reported having the individual facilities listed available for instruction at each of the grade levels studied, with the exception of special classroom facilities reported by elementary and junior high schools and project areas for the ninth grade science in elementary schools.

Practices related to the acquisition and control of materials. In most schools the requisition, control, and utilization of equipment and supplies for science teaching was handled on an individual teacher basis. In 12% of the elementary schools, 33% of the junior high schools, and 21% of the senior high schools these processes were handled on a single building basis. Very few schools reported that these determinations were made at the district level. Approximately 53% of all teachers had a petty cash fund available for local purchases of incidental school supplies.

District provisions for curriculum development and implementation. Thirty-three percent (33%) to 40% of the schools were in districts which had a general curriculum committee and 21% to 60% of the districts utilized a science curriculum committee. Twenty-eight percent (28%) of the elementary schools, 31% of the junior high schools, and 11% of the senior high schools reported that the general curriculum committees were actively engaged in the science program at the grade levels pertinent to this study. A higher percentage of schools (21% - 60%) of each type reported

that science curriculum committees were actively concerned with science programs at these grade levels. Combining data on the two types of curriculum committees, 60% of the elementary schools, 47% of the junior high schools, and 21% of the senior high schools reported having a district committee which was actively engaged in the science programs of these grades. A science curriculum guide was available to 52%, 45%, and 21% of the elementary, junior high and senior high schools, respectively. However, only 41% and 12% of the junior and senior high schools, respectively, had guides which provided for grades seven, eight, and nine while all the guides available to elementary schools provided for these grade levels.

Consultant-supervisory assistance available within school systems. A science supervisor or general supervisor with special competence in science was available in 28% of the elementary schools, 40% of the junior high schools, and 16% of the senior high schools. Few teachers in each type of school reported utilization of available consultant service. Elementary teachers lead the other two groups in utilization of the service, and the smallest proportion of teachers who used the service were in the senior high school group. Among elementary and junior high school teachers the greatest percentage reported use of the specialist in providing reading materials, science education general information, and in planning. The greatest proportion of senior high school teachers utilized the specialist for planning purposes.

Evaluation practices. All of the listed objectives of science instruction were evaluated by both objective and subjective means to a considerable extent by all teachers.

Content achievement was the objective most frequently evaluated by all teachers. Critical thinking ability was the second most frequently measured outcome claimed by teachers. Measurement of interests, attitudes, and appreciations were each reported by approximately the same percentage of teachers within groups but with a tendency for frequency of measurement to decrease in the order the objectives are listed.

Very little difference between strata was discernable, although a greater percentage of the junior high school teachers measured all objectives than did the elementary and senior high teachers. It should be noted that a single exception, the percentage of junior high school teachers measuring content, is indicated in Table XII, page 87.

With respect to how often teachers measured these outcomes of science instruction by objective means, the data show that content achievement was most frequently evaluated at one-week intervals by junior high school and senior high school teachers, and at one-week and one-month intervals by an equal number of elementary teachers. Critical thinking abilities were most frequently measured by teachers in each type of school at one-month intervals and the second largest number of these teachers measured the objectives at one-week intervals. Very few teachers in each type of

school reported that they rarely or never evaluated critical thinking skills by objective means. Junior high school teachers lead in the frequency of evaluating science interests, attitudes, and appreciations by objective means, followed by the elementary school teachers. Of the three groups of teachers, those in senior high schools least frequently measured interest, attitudes, and appreciations by this method.

Content achievement was most frequently measured by subjective methods at one-week intervals by teachers in each type of school. An equal number of elementary teachers subjectively measured critical thinking skills at one-week and one-month intervals while the outcome was most frequently measured at one-week intervals by junior high school teachers and at one-month intervals by senior high school teachers. Elementary teachers most frequently evaluated science interests, attitudes, and appreciations at one-month intervals, while about the same number of junior high and senior high school teachers evaluated these objectives at one-week intervals as did at one-month intervals.

In comparison of the two methods of evaluation, content achievement and critical thinking abilities were most frequently evaluated by objective means by teachers in each type of school while interests, attitudes, and appreciations were most frequently evaluated by subjective means by these teachers.

In-service education practices. In-service education programs provided by school systems were available to 44% of the

elementary schools, 35% of the junior high schools, and 21% of the senior high schools. The most common types of activities involved teaching methods and curriculum workshops. Science courses were seldom offered. Programs available to senior high school staff were predominately of the workshop type but a greater proportion were science courses or included science course work than was the case in elementary and junior high schools. College instructors and science supervisors conducted the majority of the programs.

Less than 5% of all teachers were afforded released time for participation in these programs. Three teachers reported from two to four weeks of summer employment for curriculum development activity; otherwise, the amount of released time provided was negligible.

Of those teachers to whom in-service programs were available, 60% of the elementary teachers, 26% of the junior high, and 50% of the senior high teachers attended all or most of the sessions. It is suggested that attendance of in-service education programs by the senior high school teachers may have been stimulated by the new high school science curricula.

Changes in programs during the last three years. A larger proportion of elementary and junior high schools reported changes at each of the three grade levels than did senior high schools.

In general, changes in content were reported by a greater proportion of all schools than any other single change listed. Changes in equipment and facilities were reported by the second greatest proportion of junior high and senior high schools while

the second greatest proportion of elementary schools noted changes in content plus equipment and facilities. Except in the ninth grade of elementary schools and the seventh grade of junior high schools, very small proportions of the types of schools reported changes in methodology alone. It appears that elementary schools and junior high schools lead in the proportion of those schools which had effected changes and the least proportion among types of schools which made changes were the senior high schools.

Obstacles to program improvement and to teacher effectiveness. The greater percentages of the total number of comments by teachers which identified major obstacles to more effective science instruction related to lack of laboratory facilities (13%), lack of equipment (13%), teaching overload (10%), lack of ability grouping (14%), lack of good textbooks (10%), and lack of program coordination, communication, and consultant service (10%). It should be noted that teacher loads and student grouping practices were related in that the opinion of the teachers was that heterogeneous grouping contributed to teacher load as did the number and variety of courses assigned to them. Thus, a combination of these two items results in a situation of rather great concern to teachers. Small percentages of the total group of teachers classified the other items listed as major obstacles.

Differences between types of schools were apparent. A greater percentage of elementary school teachers indicated lack of laboratory facilities as a major obstacle than did teachers in the

other two groups. However, relatively large percentages of junior and senior high school teachers also noted lack of adequate laboratories. Elementary school teachers also appeared to be more concerned about the time available for teaching science and the problem of what science content to teach than were teachers in the other two groups. Junior and senior high school teachers more frequently noted lack of science teaching equipment than did the elementary teachers. More senior high school teachers considered insufficient academic background of the teacher in science an obstacle than did elementary or junior high teachers. Lack of program coordination, communication between teachers and consultant services were of concern to more junior high school teachers than to elementary and senior high school teachers.

RECOMMENDATIONS

Recommendation: All school districts should organize a curriculum committee which undertakes active consideration of science programs at the seventh, eighth, and ninth grade levels. The important position of science instruction at this level in the K-12 sequence, the transitional nature of the stage of human development represented by the age group of these students, and the need for adequate articulation from grade level to grade level should be prominent factors in the deliberations of these committees.

The diversities between and within types of schools which are demonstrated throughout the data collected for this study, the

comments by teachers which noted lack of communication and coordination, as well as indecision as to what content should be taught, support the contention that effective organization is needed. The recommendation is further supported by the Michigan State Science Curriculum Committee[1] and if the assumption is accepted that curriculum change is primarily a change in people, then the recommendation is further strengthened.

The key position of science instruction at these grade levels has been pointed out by the National Science Teachers Association as noted in Chapter I, page 6, of this thesis. The transitional nature of the stage of human development represented by the age group of these students and the implications for education were substantiated in Chapter II, pages 22-26.

Recommendation: School districts should establish an organizational mechanism for providing the following functions:

1. To coordinate the purchase of science equipment and related teaching materials.

2. To provide for more efficient utilization of equipment which, through a central storage-distribution plan, would increase the availability of a variety of materials to teachers.

3. To provide equipment maintenance services.

4. To centralize responsibility for reviewing science teaching materials and promoting their utilization.

5. To provide consultant and information services related to these materials and their utilization, and to other aspects of the instructional program.

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[1]The Michigan Department of Public Instruction. "The Science Curriculum." Guidelines for the K-12 Science Program, 309. Lansing: The Department of Public Instruction, 1961.

The data of this study show that in most schools the acquisition, control, and utilization of science teaching materials occur on an individual teacher basis, that in less than one-third of the schools it is handled generally on a per-building basis, and that very few schools reported a district level plan. Such evidence implies that little planning for best utilization of equipment monies occurs. Hence, it is reasonable to assume that at least a part of the difficulties noted by teachers who cooperated in this study could be alleviated by (1) wiser purchases of materials and (2) shared usage of a great deal of equipment.

The data also show that a large number of schools do not have facilities for repairing and maintaining equipment. It can be assumed that equipment in disrepair relates to shortages and that a maintenance/repair service would contribute to alleviation of the problem.

At the present time, the science teaching materials market is deluged with competing products in many categories of teaching materials. Again, it is reasonable to assume that the adequate review and evaluation of these materials can hardly occur on the individual teacher level.

The lack of program coordination, communication, and consultant services was noted specifically as an obstacle to improvement of science instruction by 10% of the teachers included in this study. The data of availability and utilization of consultants by teachers indicate also that assistance in the performance of classroom instruction is desired. From an organizational

point of view, it is suggested that assignment of specific responsibility to consultant staff for providing leadership and coordination at the district level and professional assistance to teachers at the classroom level could contribute greatly to the improvement of science instruction.

Recommendation: Adequate laboratory facilities should be available for use and laboratory activities should be utilized in every science class. The adequacy of basic facilities in rooms designated as laboratories as well as in the regular classrooms having special laboratory facilities should be evaluated with respect, not only to such items as water and electric service and storage facilities, but to adequate area for placement of projects underway and experiments which require observation over a relatively long period of time, and availability of laboratory facilities for all science classes.

If the assumption that primary experiences with natural phenomena are of major importance to science instruction and that individual and small group experimentation are necessary to optimum achievement of the objectives of science instruction, the data of this study indicate deficiencies in the science programs. Although few schools included in this study did not have either a laboratory or classroom facilities available, most teachers did not utilize class time for laboratory activities on an occasional to frequent basis. It appears from the data that demonstrations are more frequently utilized than individual and small group experiments,

and that few schools have areas for the conduct and storage of special projects to be undertaken by individual students.

Recommendation: School districts should provide in-service education programs directly related to science education for its teachers to a greater degree than is the current case.

Assuming that teachers have a need for (1) continuous improvement of their professional competencies, (2) keeping abreast of the developments in science as well as contemporary methods for presenting science effectively, and (3) increased communication and coordination between all those who are concerned with K-12 science instruction, provision of an effective in-service education program is a prime responsibility of the school district. The data show that these opportunities were not available to most teachers, and of these teachers, the frequency of attendance by a large percentage was low. Recommendations of the Michigan State Science Curriculum Committee which were previously noted support this position.

Recommendation: That a staff of state-level science supervisors/consultants be developed by the State Department of Public Instruction and that members of the State Science Curriculum Committee provide their services individually or collectively to promote constructive action at the local level, to assist local school districts in the exploration and development of strong science programs, and to provide state-level perspective, coordination, and necessary support.

The extent to which human and financial resources have been expended on science education in the past few years coupled with the relatively small effort which has been applied to science teaching at these grade levels has been established in this thesis and accentuates the need for rapid development of this segment of the pre-college science program. The diversity of teacher practices and district-wide provisions for curriculum development and implementation which exists in the state has been noted as well. On the basis of these considerations, it is reasonable to assume that a concerted attack needs to be made on the problem at all levels of organization within the State.

Recommendation: That studies related to junior high school level science be conducted about the following:

1. The degree of permanence of science teachers at these grade levels.
2. The adequacy of subject matter preparation of these teachers.
3. The role of science supervisors at the local level.
4. The adequacy of evaluation practices claimed by these teachers.
5. The advisability of student grouping techniques or other means of reducing teacher load.

The unique attributes of the "ideal" teacher of these grade levels was evidenced in Chapter II as was the lack of permanence of teachers at these grade levels. In that the lack of permanence of these teachers appears to militate against effective instruction at this level, such an investigation would seem to be

timely. Very few elementary and junior high school teachers as compared to a percentage of senior high school teachers indicated that insufficient academic background in the sciences was a serious obstacle to more effective instruction. Thus, teacher expressions, or lack of, on this point do not coincide with national statements which have been made concerning the inadequate preparation of pre-college teachers.

The little utilization of science supervisory services reported by teachers to whom the service is available raises the question as to why greater utilization is not made when teachers note the lack of such service as a major obstacle to improved effectiveness. The high degree that major objectives of science instruction were reported to have been evaluated by both objective and subjective means needs further study in light of the lack of procedures and instruments available for this purpose. Ability or other grouping is a topic of warm discussion among educators; however, teachers in this study listed the lack of grouping as a major obstacle and indicated that heterogeneous grouping increased the overall load of teachers. For this, as well as other reasons, further study on the subject is warranted.

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APPENDIX

Appendix A

Schools in the Sample

Muskegon - Lincoln Elementary School

Allenson - Littlefield Elementary School

Leroy Elementary School

Three Rivers - Barrows Elementary School

Fowler Elementary School

Kingsford - Garden Village Elementary School

Frankenmuth Elementary School

Three Rivers - Hoppin Elementary School

Bay City - Kolb Elementary School

Iron River - Central Elementary School

Detroit - Vandenburg Elementary School

Bay City - MacGregor Elementary School

Ferndale - Calvin Coolidge Elementary School

Detroit - Lodge Elementary School

Detroit - Vernor Elementary School

Detroit - Trix Elementary School

Detroit - Herman Elementary School

Detroit - Marquette Elementary School

Detroit - Crary Elementary School

Detroit - Ann Arbor Trail Elementary School

Mt. Clemens - Seminole Elementary School

Detroit - Dixon Elementary School

Detroit - Newton Elementary School

Detroit - Garfield Elementary School

Detroit - Noble Elementary School

Detroit - Butzel Junior High School

Horton - Hanover Junior High School

Benzonia - Benzie Junior High School

Akron Junior High School

Shelby Junior High School

Mason Consolidated Junior High School

St. Johns - Central Junior High School

Petoskey Junior High School

Grand Rapids - Kelloggsville Junior High School

Harris - Bark River-Harris Junior High School

Bloomfield Hills - East Hills Junior High School

Warren P. O. - Walcott Junior High School

Dearborn - Maples Junior High School

Ishpeming - C. L. Phelps Junior High School

Jackson - East Junior High School

Center Line - Wolfe Junior High School

Port Huron - Fort Gratiot Junior High School

Tecumseh Junior High School

Livonia - Whittier Junior High School

Dearborn - Stout Junior High School

Rochester - West Junior High School

Dearborn - Bryant Junior High School

Garden City - Cambridge Junior High School

Whitehall Junior High School

Saginaw - Mackinaw Junior High School

Ann Arbor - Tappan Junior High School

Detroit - Burroughs Junior High School

Utica - Sterling Junior High School

Pontiac - John D. Pierce Junior High School

Livonia - Riley Junior High School

Albion - Washington Junior High School

Detroit - Jackson Junior High School

Detroit - Burbank Junior High School

Detroit - Burt Junior High School

Flint - Whittier Junior High School

Berkley - Anderson Junior High School

Royal Oak - Jane Adams Junior High School

Clinton Park Junior High School

Detroit - Nolan Junior High School

Melvindale - Dasher Junior High School

Southfield - Alice M. Bierney Junior High School

East Detroit - Oakwood Junior High School

Flint - Lowell Junior High School

Detroit - Greusel Junior High School

Detroit - Harding Junior High School

Escanaba Junior High School

Detroit - Cooke Junior High School

Ypsilanti - East Junior High School

Garden City - Radcliffe Junior High School

Unionville Senior High School

Covert Senior High School

Brethern - Norman Dixon Senior High School

Onekama Senior High School

Au Gres Sims Senior High School

Vanderbilt Senior High School

Johannesburg - Central Senior High School

Trenary - Mathias Senior High School

McCosta Senior High School

Dearfield Senior High School

Custer - Eastern Senior High School

Springport Senior High School

Harrison Senior High School

Climax - Climax Scotts Senior High School

Central Lake Senior High School

Cedarville Senior High School

Almont - Community Senior High School

Mason - Eastern Senior High School

Chelsea Senior High School

Lake Linden Senior High School

Tustin Senior High School

Pittsford Senior High School

Fairview Senior High School

Freeland Senior High School

Carney Senior High School

Otisville - Lakeville Senior High School

Deckerville Senior High School

New Haven Senior High School

Addison Senior High School

Wakefield Senior High School

Kinde - North Huron Senior High School

Montague Senior High School

Richland - Kellogg Senior High School

Petersburg - Summerfield Senior High School

Stevensville - Lakeshore Senior High School

Whitehall Senior High School

Capac Senior High School

Stephenson Senior High School

Hopkins Senior High School

Bronson - Central Senior High School

Yale Senior High School

Cass City Senior High School

Algonac Senior High School

Saline Area Senior High School

Livonia - Clarenceville Senior High School

Middleville - Thornapple Senior High School

Clare Senior High School

Holt Senior High School

Lincoln - Alcona Senior High School

Edward G. Kingsford Senior High School

Bay City - Central Senior High School

Madison Heights - Madison Senior High School

Owosso Senior High School

Jackson - Northwest Senior High School

Inkster Senior High School

Detroit - Northwestern Senior High School

Ishpeming Senior High School

Grand Rapids Senior High School

Scott Senior High School

Caro Senior High School

Port Huron Senior High School

Mount Clemens Senior High School

Gwinn Senior High School

Hazel Park Senior High School

Calumet Senior High School

Grosse Isle Senior High School

Appendix B

A STUDY
OF
SCIENCE PROGRAMS IN GRADES 7, 8, AND 9

PURPOSE

This is a study of science programs in grades 7, 8, and 9 of public schools in Michigan. Results of the study will be utilized by the State Science Curriculum Committee and the Science and Mathematics Teaching Center of Michigan State University for science curriculum development purposes.

SCOPE

The study is being conducted on a sampling basis. As a teacher of science in one or more of grades 7, 8, and 9, you have been selected as a member of a sample that will ensure valid and reliable coverage of Michigan.

The validity of the study depends upon completeness of returns. Your cooperation in responding will be greatly appreciated and will contribute significantly to information provided the State Science Curriculum Committee.

HANDLING OF INFORMATION

All information provided about your science program will be treated in complete confidence. The findings will be reported in summary form so that information from individual teachers or school systems cannot be identified. Therefore, we hope you will be completely frank in answering the questions.

INSTRUCTIONS

Trial completions indicate that only about 30-40 minutes are required to respond to all items.

The form has been designed so that responses to each item may be given independently for each grade, 7, 8, and 9, which you may teach.

Please respond to all items appropriate to your situation and for each grade level at which you teach science. If you do not teach science in one of the grades listed, leave these spaces blank.

Please check over the questionnaire to get an idea of the scope of questions and modes of response before beginning to fill out the form.

Your cooperation in completing the form and returning it at your earliest convenience in the enclosed addressed and stamped envelope will be greatly appreciated.

★ ★ ★

Name of Teacher _____ School District _____

Name of School _____ School Address _____

Circle grades included in your school: 7th 8th 9th

1. The science course offerings and requirements in my school are:

Grade Level	Name of Course	Req'd (check)	No. Periods per week	No. Min. per period	Course Length (check) 1 yr.	1/2 yr	Less
7							
8							
9							

Comments (please note any special circumstances which are not accounted for above):

_____

_____

2. What additional activities related to the science program are available to your students? (Check grade level(s) available to.)

	Grades		
	7	8	9
a. Science clubs			
b. Science seminars			
c. Summer science camp			
d. After-school and Saturday programs			
e. Other (specify)			
f. Other			

3. My teaching assignment is: (please include all courses taught at all grade levels)

Grade Level	Name of Course	No. Periods per week	No. Min. per period	Course Length (check) 1 yr.	1/2 yr.	Less

4. Within what organizational pattern(s) do you teach science? (Check grade level(s) applicable patterns are used.)

	Grades		
	7	8	9
A. 1. Self-contained classroom (see part "B" and "C")			
2. Departmentalized			
3. Team teaching			
4. Other (specify)			
5. Other			
B. 1. As a separate subject with time for science regularly scheduled			
2. Integrated with or in relation to other subjects			
3. Incidentally; taught whenever an appropriate occasion arises			
4. Other (specify)			
5. Other			

C. Are your classes grouped with respect to ability?

Grade 7 ☐ Yes ☐ No

Grade 8 ☐ Yes ☐ No

Grade 9 ☐ Yes ☐ No

D. What allotment of time and effort is made for science compared to most other subject areas taught?

	Grades		
	7	8	9
1. Equal to other subjects			
2. Less than other subjects			
3. Greater than other subjects			

5. On what organizational level is the content of your science course(s) predominatly determined? (Check the one most appropriate response.)

	Grades		
	7	8	9
a. Individual teacher level			
b. Single-school level			
c. District level			

6. By what means is the content of your science course(s) predominantly determined? (Check the one most appropriate response.)

	Grades		
	7	8	9
a. Single textbook			
b. Multiple textbooks			
c. Textbook series			
d. Curriculum guide			
e. Professional opinion of the teacher			
f. Student-generated topics			
g. Teacher-pupil decision			
h. Other (specify)			
i. Other			

7. What science textbooks do you use?

Grade Level	Name of Course	Author and Name of Text	Edition and Latest Copyright

8. Indicate your use of the following sources of supplementary science reading materials, using the numbers "3" for frequently used (about once per week); "2" for occasionally used (about once per month); and "1" for rarely used (less than once per month). Use "0" if not used.

	Grades		
	7	8	9
a. Additional textbooks			
b. Trade books			
c. Monographs			
d. Professional journals			
e. Popular periodicals			
f. Newspapers			
g. Business-industry pamphlets			
h. Other (specify)			
i. Other			

9. Indicate your use of the following audio visual aids, using the numbers "3" for frequently used (about once per week); "2" for occasionally used (about once per month); and "1"

for rarely used (less than once per month). Use "0" if not used.

	Grades 7	8	9
a. Educational films			
b. Film strips			
c. Records			
d. Radio			
e. Commercial T.V.			
f. Educational T.V.			
g. Field trips			
h. Programmed learning materials			

10. To what extent is classtime used for laboratory-type activities?

	Grades 7	8	9
a. Regularly (equivalent of once per week or more)			
b. Occasionally (equivalent of once per month)			
c. Rarely (less than once per month)			
d. Never			

11. Indicate your use of the following laboratory activities, using the numbers "3" for frequently used (about once per week); "2" for occasionally used (about once per month); and "1" for rarely used (less than once per month). Use "0" if not used.

	Grades 7	8	9
a. Teacher demonstrations			
b. Student demonstrations			
c. Individual experiments			
d. Small group experiments			

12. What facilities are available to you for science instruction?

	Grades 7	8	9
A. 1. A laboratory			
2. Regular classroom with special facilities for science			
3. Regular classroom without special facilities for science			
B. 1. Area for individual or small group project work			
2. Workbench, tools, etc. for construction and repair of equipment			
3. Preparation room			
4. Photo darkroom			
C. Reference and reading materials section in teaching area (non-library)			
D. Other (specify)			

13. What is the prevailing basis for the requisition, control, and utilization of equipment and supplies?

A. ☐ 1. Individual teacher requests and has subsequent control.

☐ 2. Determination of needs for each school building with a system of central control and shared use.

☐ 3. Determination of needs with centralized control on a district basis.

☐ 4. Other (specify)

☐ 5. Other

B. Is the procedure indicated "A" above generally conducive to efficient utilization of equipment and supplies?

☐ Yes ☐ No

Comments: _____

_____

C. Is there a petty cash fund available to you for local purchase of incidental science supplies?

☐ Yes ☐ No

14. Does the district have:

	YES	NO
a. A science supervisor, coordinator, or similar science specialist?		
b. A general curriculum committee?		
1. If so, is it actively engaged in the science program for grades 7, 8, and 9?		
c. A science curriculum committee?		
1. If so, is it actively engaged in the science program for grades 7, 8, and 9?		
d. A science curriculum guide?		
1. If so, does it provide for grades 7, 8, and 9?		

15. What consultant or supervisory assistance in teaching science is available to you from within the school system?

☐ a. None

☐ b. Principal

☐ c. General supervisor or helping teacher with only general knowledge of science.

☐ d. General supervisor or helping teaching with special competence in science.

☐ e. Science supervisor or consultant.

16. (Do not answer if "16-a" above (none) was checked.)

In what ways and to what extent do you utilize science consultant or supervisory assistance?

UTILIZATION	About once week	About once month	Less than once month	Rarely if ever
a. Planning or consultation	☐	☐	☐	☐
b. Demonstration teaching in class	☐	☐	☐	☐
c. Giving science demonstrations to class	☐	☐	☐	☐
d. Providing materials	☐	☐	☐	☐
e. Evaluation	☐	☐	☐	☐
f. Working with individuals	☐	☐	☐	☐
g. Workshop instructor	☐	☐	☐	☐
h. Science-education information services	☐	☐	☐	☐
i. Other (specify)	☐	☐	☐	☐

17. What do you evaluate in your science courses and what techniques are used?

	About once/week	About once/month	Less than once/month	Rarely if ever
A. Teacher-developed written tests of:				
1. Subject-matter achievement	☐	☐	☐	☐
2. Critical-thinking or problem-solving skills	☐	☐	☐	☐
3. Science interests	☐	☐	☐	☐
4. Attitudes	☐	☐	☐	☐
5. Appreciations	☐	☐	☐	☐
B. Subjective evaluation of:				
1. Subject-matter achievement	☐	☐	☐	☐
2. Critical-thinking or problem-solving skills	☐	☐	☐	☐
3. Science interests	☐	☐	☐	☐
4. Attitudes	☐	☐	☐	☐
5. Appreciations	☐	☐	☐	☐

C. Standardized tests (for science - please specify tests, grade levels, and frequency of administration).

Name of Test	Grade Level(s)	Frequency of Administration

D. Other evaluation (specify outcome measured, technique used, grade levels, and frequency of measurement).

_____

_____

18. Are in-service education opportunities for teaching science available to you?

☐ No ☐ Yes: (if so, please respond to the remaining items)

A. Hours per week _____; for _____ weeks; for _____ months.

B. Type:
- ☐ 1. Science courses
- ☐ 2. Teaching techniques
- ☐ 3. Curriculum workshops
- ☐ 4. Other (specify)_____
- ☐ 5. _____

C. Conducted by:
- ☐ 1. Staff science supervisor or coordinator
- ☐ 2. College instructors
- ☐ 3. School Administrative staff
- ☐ 4. Other (specify)_____
- ☐ 5. _____

D. Degree of your participation
- ☐ 1. All sessions
- ☐ 2. Most sessions
- ☐ 3. Few sessions
- ☐ 4. None

E. Amount of released time for:
- ☐ 1. None
- ☐ 2. Other (specify) _____

F. Has summer employment been offered for curriculum development course preparation, preparation of teaching materials, and/or similar activities?

1. ☐ No ☐ Yes (If so, please respond to remaining items in "2")

2. Activity

a. _____

b. _____

c. _____

Duration

a. _____

b. _____

c. _____

19. What changes in the science programs of grades 7, 8, and 9 have been effected during the past three years? (Curriculum structure, content, teaching practices, facilities and equipment, evaluation procedures, etc.)

Grade Level	Former Program	Present Program

20. Please list in order of importance those factors which are major obstacles to the improvement of your science program and to your effectiveness as a science teacher.

MICHIGAN STATE UNIVERSITY EAST LANSING

SCIENCE AND MATHEMATICS TEACHING CENTER • EDUCATION BUILDING

April 26, 1963

Dear Sir:

A study of interest to the Science Curriculum Committee of the Michigan Department of Public Instruction concerning science programs at the 7th, 8th, and 9th grade levels in K-12 districts of Michigan public schools is being carried out by the Science and Mathematics Teaching Center of Michigan State University.

The general intent of the study is to collect data which will provide greater insight into improved ways of organizing and administering the science curriculum in those grades that have unique problems of transition.

If you are agreeable to the participation of your teachers in the study, please provide the names of all teachers in each school listed below who teach one or more sections of science in one or more of the 7th, 8th, and 9th grades. Questionnaires then will be mailed to the teachers whomyou identify for return before the end of the current school year.

Since the end of the school year is rapidly approaching, the need to obtain your reply by return mail is urgent.

We will greatly appreciate your assistance in this very important phase of the study and your cooperation in surmounting the critical time element.

Sincerely yours,

Joseph E. Bowles

Joseph E. Bowles

Name of School	Names of Teachers of Science in Grades 7, 8, and 9

MICHIGAN STATE UNIVERSITY EAST LANSING

SCIENCE AND MATHEMATICS TEACHING CENTER • EDUCATION BUILDING

May 6, 1963

Dear Teacher:

A study of interest to the Science Curriculum Committee of the Michigan Department of Public Instruction concerning science programs at the 7th, 8th, and 9th grade levels in K-12 districts of Michigan public schools is being carried out by the Science and Mathematics Teaching Center of Michigan State University.

Your school has been selected as a member of the sample group from which data are to be collected and, as such, represents a large number of schools.

The superintendent of your school district has kindly provided the names of teachers in the schools which were selected and questionnaires have been mailed to each teacher responsible for one or more sections of science courses in one or more of the 7th, 8th, and 9th grades.

In recognition of the importance of science instruction at these levels with their critical problems of articulation and transition, we hope you will agree to sharing your experience and practices for purposes of the study through completion of the enclosed questionnaire.

The schedule for this study includes the beginning of data analysis by the end of May and the completion of a summary of findings by fall, 1963. Since the end of the school year is rapidly approaching, the need to obtain your completed questionnaire within the next few days is urgent.

Additional information is provided in the cover sheet of the questionnaire. Please feel free to insert additional pages if more space is needed for comments and explanation.

We greatly appreciate your interest and cooperation in this effort to obtain information essential to an understanding of practices and problems of science instruction at these intermediate levels of science programs.

Sincerely yours,

Joseph E. Bowles

Joseph E. Bowles

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