DOCUMENT RESUME

ED 219 253 SE 038 755

TITLE Recommended Standards for the Preparation and Certification of Teachers of Science at the Elementary and Middle/Junior High School Levels.

INSTITUTION National Science Teachers Association, Washington, D.C.

PUB DATE 1 Apr 82

NOTE 21p.

EDRS PRICE MF01/PC01 Plus Postage.

DESCRIPTORS *Elementary School Science; Elementary School Teachers; Elementary Secondary Education; Field Experience Programs; Guidelines; Junior High Schools; Methods Courses; Middle Schools; *Preservice Teacher Education; Science Education; *Science Teachers; *Secondary School Science; Secondary School Teachers; *Teacher Certification; Teacher Education Programs; Teacher Educator Education; Teacher Educators; *Teacher Qualifications

ABSTRACT

This document highlights areas of concern and proposes selected standards which, if implemented, could result in improved teacher preparation in the sciences and, ultimately, in improved learning experiences for children. These standards are intended to provide guidelines to institutions and agencies desiring to achieve minimal levels of quality in science preparation programs for preservice teachers of science for the elementary and middle/junior high school levels. Standards for the science preparation for preservice elementary teachers focus on the following areas of concern: science content preparation, science content courses for elementary teachers, science teaching methods, content of the science teaching methods course, field experiences in science, faculty preparation, facilities, equipment and materials, and professional orientation. Standards for the science preparation for middle/junior high school science teacher preparation focus on the following areas of concern: middle/junior high school teacher certification, science content preparation, support content preparation, science teaching methods preparation, classroom observation/participation, student teaching/internship, college/university science and science teaching methods faculty, instructional setting/materials, library holdings (at the college level), and professional orientation. (JN)

RECOMMENDED STANDARDS

for the

PREPARATION AND CERTIFICATION OF TEACHERS OF SCIENCE

at the

ELEMENTARY AND MIDDLE/JUNIOR HIGH SCHOOL LEVELS

National Science Teachers Association
1742 Connecticut Avenue, NW, Washington, D.C.

Steering Committee on Teacher Education
Ken Mechling, Chairman
April 1, 1982

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STANDARDS: SCIENCE PREPARATION FOR PRESERVICE ELEMENTARY TEACHERS

MIDDLE/JUNIOR HIGH SCHOOL SCIENCE TEACHER PREPARATION

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STANDARDS: MIDDLE/JUNIOR HIGH SCHOOL SCIENCE TEACHER PREPARATION

IMPLEMENTATION PLAN

PREFACE

The precollege preparation of quality teachers of science for the elementary and middle/junior high school levels is a primary concern of the National Science Teachers Association. We know that most elementary teachers take general survey courses in science or introductory courses for science majors--kinds of courses which practicing elementary teachers find of little use. We know that the professional component of the elementary teacher's preparation often neglects science. We know that middle and junior high school teachers of science are seldom prepared specifically for their work with early adolescents.

If good teachers are the key to good science programs, and we believe that they are, then we must strive to improve our teacher preparation programs in science. As the American Association for the Advancement of Science points out in its 1980 report to the National Science Foundation, "...good preservice programs are the best insurance for qualified teachers."

The purpose of this document is to highlight areas of concern, to propose selected standards which, if implemented, could result in improved teacher preparation in the sciences and, ultimately, in improved learning experiences for children whose lives will be so greatly affected by the processes and products of science. The standards herein proposed are intended to provide guidelines to institutions and agencies desiring to achieve minimal levels of quality in science preparation programs for preservice teachers of science for the elementary and middle/junior high school levels.

ACKNOWLEDGMENTS

The impetus for this document grew out of NSTA's concern for improving the quality of science teacher education. During the 1981-82 year, the Teacher Education Committee worked in concert with three other NSTA Committees---Preschool/Elementary, Middle/Junior High School, and Research--to plan strategies for developing NSTA position statements regarding the preparation and certification of teachers of science at the elementary and middle/junior high school levels.

This group, known as the Steering Committee on Teacher Education, met first in San Antonio on August 3, 1981 to lay plans and begin work. Following that meeting there were studies of the impact of accreditation agencies and surveys of state certification requirements, college and university programs for the preparation of teachers of science, and practicing elementary teachers. These data were collected, analyzed, and used as a basis for preparing the standards recommended in this document. On February 26 and 27, 1982, representatives of the four NSTA committees met in Washington to develop the preliminary draft statements included here.

Much work has already gone into this project and NSTA may be justly proud of the efforts and accomplishments of members who contributed. Don McCurdy provided the encouragement to begin. Don, Sarah Beth Klein, Bob Yager, and Bill Aldrige have all lent their support along the way. The following persons comprise the Steering Committee. These folks developed the initial plans for the project and guided it during the development.

Steering Committee on Teacher Education

Audrey Brainard
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Kathy Donnellan, Director, Preschool/Elementary Division
Ken Dowling
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Steve Henderson
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The following persons are gratefully acknowledged for spending two days at hard labor in Washington preparing the preliminary drafts of these documents.

Kathy Donnellan
Steve Henderson
Ken Mechling
Marty Tafel
Gil Twiest (representing Betty Burchett)
Carl Stedman

Finally, throughout this process we have attempted to involve the various NSTA Committees and utilize the expertise of our members. Members of the Teacher Education Committee who contributed to the project are Walter Smith, Thomas Evans, Walter Cory, and Bob Fisher. We appreciate their help and support.

Ken Mechling, Chairperson
Steering Committee on Teacher Education

SCIENCE PREPARATION FOR PRESERVICE ELEMENTARY TEACHERS

A. INTRODUCTION

Although science is a well-established curriculum requirement in the elementary schools of the United States, it is beset with many problems. Significant numbers of elementary teachers feel unqualified in science and uncomfortable when they have to teach it (1). Little time is devoted to science instruction and many teachers ignore it completely.

During the late 1970's, National Science Foundation case studies of elementary schools revealed a general deemphasis of science. Stake and Easley summed up their observations by concluding:

> *Although we found a few elementary teachers with a strong interest and understanding of science, the number was insufficient to suggest that even half of the nation's youngsters would have a single elementary school year in which their teacher would give science a substantial share of the curriculum and do a good job of teaching it. (2)*

Poor preservice teacher preparation is often cited as a prime contributor to the problems of science education at the elementary school level. State science supervisors and elementary school principals perceive inadequate teacher preparation in science as a serious problem (3). Teachers, too, blame their shortcomings on their preservice preparations. Many believe that their college or university programs did not adequately prepare them for the science teaching they are expected to do in their own elementary school classrooms (4). Colleges and universities are aware of the need for improvement. Recent National Science Teacher Association (NSTA) studies of leading teacher education institutions revealed that 50 percent or more felt that their programs for preparing preservice elementary teachers in science could be improved through increased emphasis on science content, science processes and methods, and science teaching techniques (5).

It must be noted that good guidelines for the preservice science education of elementary school teachers already exist. They were prepared more than a decade ago by the American Association for the Advancement of Science (AAAS) (6). While these guidelines are still relevant and valuable and should continue to be used, it appears that either many institutions failed to implement them, or slippage has occurred. Recent surveys conducted by NSTA (7, 8, 9) have disclosed serious deficiencies in the science preparation of elementary teachers. These deficiencies must be addressed if we wish to improve both the quantity and quality of science experiences for elementary school children.

B. PREPARATION IN SCIENCE CONTENT

There appears to be universal agreement that elementary school teachers should have a good knowledge of science content. This content then becomes the reservoir from which they draw as they teach science to elementary school children. Unfortunately, preservice elementary teachers may be getting neither the quantity nor kind of science content they need.

A recent survey of colleges and universities having the largest numbers of teacher education graduates revealed serious deficiencies in the science content preparation of preservice elementary teachers (10). For instance, in half of these leading institutions, only 8 semester hours or less of science were required for persons preparing to teach science at the elementary school level--very close to the same number of hours required in the general education of all students, none of whom will be expected to teach science.

Only 18 percent of the institutions required elementary teacher candidates to complete science courses in all three major areas of science; biological science, physical science, and earth science. In most institutions, preservice elementary teachers could get by without taking courses in one or two of these areas, such as physical science or earth science, thereby leaving them woefully lacking in subject areas they will later be expected to teach in their own classrooms.

Only one-third of the institutions design their science courses specifically to meet the needs of elementary teacher candidates. The rest appear to give preservice teachers the same "dose" of science as majors in history, art, business, or physical education. The result is that many teachers frequently complain that they see no relationship between the content and mode of instruction of their college courses and the science they are expected to teach. The AAAS Guidelines remind us that we should make an effort to relate the science topics that are taught to teachers to the science topics that are taught to children (11).

Recognizing these deficiencies, the National Science Teachers Association recommends that the following standards be recognized and implemented:

STANDARD I.A. SCIENCE CONTENT PREPARATION

All colleges and universities should require a minimum of 12 semester hours or 18 quarter hours of laboratory or field-oriented science including courses in each of the areas; biological science, physical science, and earth science.

STANDARD I.B. SCIENCE CONTENT COURSES FOR ELEMENTARY TEACHERS

These courses should be designed specifically to serve the needs of preservice elementary school teachers. They should a) provide knowledge of science content selected for its application to elementary school classrooms; b) increase skill in using the processes of science; and c) develop positive attitudes toward science and science instruction at the elementary school level.

C. SCIENCE TEACHING METHODS

Science has many characteristics which distinguish it from other school subjects. The basic objectives of science instruction include science process skills and attitudes as well as science content. Learning science process skills and developing scientific attitudes requires the use of activity-oriented, investigative teaching methods. These methods are different in kind and amount from the general methods of teaching elementary school subjects and can be taught most effectively in a separate methods course specifically for science.

Current research indicates that only 26 percent of the 50 states require a separate science methods course for certification and 17 percent require no methods course at all (12). Another survey shows that colleges and universities usually exceed minimal state certification standards for methods courses. Ninety-four percent of the colleges and universities which produce the largest number of teacher education graduates require a separate science methods course to complete program requirements in elementary education (13). Findings from a related study of experienced elementary teachers in the field indicated that 79 percent had completed a separate science methods course. Eighteen percent had completed only a general methods course (14).

While the data clearly indicate that a separate course in science methods is usually required, opportunities still exist for preservice elementary teachers to take a general methods course or no methods course at all, thereby excluding science.

Further, there is a potential problem regarding the timing of the science methods course. Preservice teachers should have an opportunity to acquire a fundamental knowledge in the sciences before they learn about strategies for teaching it. The methods course in science should occur late in the preservice teacher's career, after the science content courses have been completed and just prior to student teaching.

STANDARD II.A. SCIENCE TEACHING METHODS

Preservice elementary teachers should be required to complete a minimum of one separate course of approximately three semester hours in elementary science methods. This course should be scheduled after the science content courses have been completed and just prior to student teaching.

STANDARD II.B. CONTENT OF THE SCIENCE TEACHING METHODS COURSE

The elementary science methods course should develop instructional skills designed to assist preservice teachers to teach science processes, attitudes, and content to elementary school children, grades K-6. The course should include experiences such as hands-on activities to promote process skill development, the selection of science content appropriate for the elementary school, the design of classroom environments which promote positive attitudes, the selection and use of a variety of instructional strategies, and the development of techniques for evaluating pupil progress in science.

D. FIELD EXPERIENCES

Field experiences with children in schools should be an essential part of programs preparing preservice elementary teachers. During the last decade, the number of field experiences has increased. More emphasis has been placed on observation/participation experiences throughout the undergraduate years. Unfortunately, because of the general deemphasis of science at the elementary school level, science is often excluded from these field experiences, and, in some cases, even from student teaching.

The techniques of science instruction are best learned through practice. Preservice elementary teachers must be afforded the opportunity to teach sci-

ence to children throughout their college careers, preferably in a variety of schools at several different grade levels.

STANDARD III. FIELD EXPERIENCES IN SCIENCE

Preservice elementary teachers should have opportunities throughout their undergraduate years to teach science to children in schools. These field experiences in science may begin with observations, proceed through small and large group instruction and culminating, finally, in student teaching.

E. FACULTY PREPARATION

Identifying who it is that will teach science content and methods courses to preservice teachers is as important as identifying what it is that they will teach. Institutions desiring to develop teacher education programs of quality cannot afford to permit less than well-qualified individuals to teach content and methods courses for preservice elementary teachers.

Each faculty member teaching content courses to preservice elementary teachers should have credentials comparable to those required for other science courses. Moreover, these courses should be assigned to faculty having the most interest in teacher preparation. They should not be assigned to lesser qualified personnel such as graduate assistants who have little or no experience in science or science teaching.

Methods course teachers should also have had specific training and experience in the teaching of science, and should maintain a continuous association and involvement with elementary schools. In no way should the science methods experiences of preservice elementary teachers be given less emphasis than those of other academic areas.

STANDARD IV. FACULTY PREPARATION

Faculty assigned to teach science content and methods courses for preservice elementary teachers should have the qualifications, experience, and interest to provide high-quality instruction. They should be as carefully screened and selected as those faculty members who are assigned courses in other academic majors.

F. FACILITIES, EQUIPMENT, AND MATERIALS

Science can best be learned in an atmosphere where students can investigate, explore, and discover. Getting a feeling for the nature of scientific inquiry is no less important for a preservice elementary teacher than it is for those pursuing scientific careers. If preservice teachers are prepared in environments that invite and support curiosity, investigation and inquiry, they are more likely to provide similar environments for their own pupils. Such environments must be rich science learning resources.

Instructional programs for the preparation of preservice elementary teachers of science should include laboratory equipment, instructional materials, and library holdings comparable to those used by practicing elementary teachers. Further, such programs should include regular budgetary allocations to ensure the acquisition of quality science education resources in quantities sufficient to guarantee hands-on experiences.

STANDARD V. FACILITIES, EQUIPMENT, AND MATERIALS

Preservice elementary teachers should be instructed in well-equipped science laboratories and educational facilities which provide science instructional resources comparable to those they will be expected to use as teachers in elementary classrooms.

G. PROFESSIONAL ORIENTATION

Science is but one of the many subjects that elementary teachers must learn to teach. Along with science content, processes, attitudes, and teaching methods, preservice teachers must gain an appreciation for the role of science in the total elementary curriculum and in the lives of the children. The pressures of teaching all subjects in self-contained classrooms has often relegated science to a less important role--a role which is unacceptable in a world increasingly characterized by science and technology.

Every effort must be made to instill in preservice elementary teachers positive attitudes toward science and science teaching. They must sense the joy of science and its value to the lives of the children they will teach. They must see science as an opportunity to learn how to ask significant questions, to seek relevant answers, to apply problem-solving skills to everyday life, to think rationally, to test ideas, to make decisions, to explore, to investigate, to try and fail, and try again.

Their preservice experiences in science should provide the foundation for life-long learning in science--a commitment to continue their education in science through reading, participation in professional organizations, and further education, including inservice experiences.

STANDARD VI. PROFESSIONAL ORIENTATION

The professional orientation of preservice elementary teachers should include experiences which 1) instill positive attitudes toward science and science teaching, 2) foster an appreciation for the value of science to the lives of the pupils they will teach, and 3) develop a commitment to continue their education in science through reading, participation in professional organizations, and further education, including inservice experiences.

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3. Ref. 1, p. 161.

4. Donnellan, Kathleen M., *NSTA Elementary Teacher Survey on Preservice Preparation for Science Education,* Washington, D.C.: National Science Teachers Association, February 10, 1982. p. 2.

5. Mechling, Ken, *Survey Results: Preservice Preparation of Teachers of Science at the Elementary, Middle, and Junior High School Levels,* Washington, D.C.: National Science Teachers Association, March 1, 1982, pp. 6-7.

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8. Ref. 4.

9. Ref. 5.

10. Ibid., pp. 3-4.

11. Ref. 6, p. 18.

12. Ref. 7, p. 2.

13. Ref. 5, p. 5.

14. Ref. 4, p. 1.

STANDARDS
SCIENCE PREPARATION FOR PRESERVICE ELEMENTARY TEACHERS

STANDARD I.A. SCIENCE CONTENT PREPARATION

All colleges and universities should require a minimum of 12 semester hours or 18 quarter hours of laboratory or field-oriented science including courses in each of the areas; biological science, physical science, and earth science.

STANDARD I.B. SCIENCE CONTENT COURSES FOR ELEMENTARY TEACHERS

These courses should be designed specifically to serve the needs of preservice elementary school teachers. They should a) provide knowledge of science content selected for its application to elementary school classrooms, b) increase skill in using the processes of science, and c) develop positive attitudes toward science and science instruction at the elementary school level.

STANDARD II.A. SCIENCE TEACHING METHODS

Preservice elementary teachers should be required to complete a minimum of one separate course of approximately three semester hours in elementary science methods. This course should be scheduled after the science content courses have been completed and just prior to student teaching.

STANDARD II.B. CONTENT OF THE SCIENCE TEACHING METHODS COURSE

The elementary science methods course should develop instructional skills designed to assist preservice teachers to teach science processes, attitudes, and content to elementary school children, grades K-6. The course should include experiences such as hands-on activities to promote process skill development, the selection of science content appropriate for the elementary school, the design of classroom environments which promote positive attitudes, the selection and use of a variety of instructional strategies, and the development of techniques for evaluating pupil progress in science.

STANDARD III. FIELD EXPERIENCES IN SCIENCE

Preservice elementary teachers should have opportunities throughout their undergraduate years to teach science to children in schools. These field experiences in science may begin with observations, proceed through small and large group instruction, and culminating, finally, in student teaching.

STANDARD IV. FACULTY PREPARATION

Faculty assigned to teach science content and methods courses for preservice elementary teachers should have the qualifications, experience, and interest to provide high-quality instruction. They should be as carefully screened and selected as those faculty members who are assigned courses in other academic majors.

STANDARD V. FACILITIES, EQUIPMENT, AND MATERIALS

Preservice elementary teachers should be instructed in well-equipped science laboratories and educational facilities which provide science instructional resources comparable to those they will be expected to use as teachers in elementary classrooms.

STANDARD VI. PROFESSIONAL ORIENTATION

The professional orientation of preservice elementary teachers should include experiences which 1) instill positive attitudes toward science and science teaching, 2) foster an appreciation for the value of science to the lives of the pupils they will teach, and 3) develop a commitment to continue their education in science through reading, participation in professional organizations, and further education, including inservice experiences.

MIDDLE/JUNIOR HIGH SCHOOL SCIENCE TEACHER PREPARATION

A. INTRODUCTION

It is axiomatic that our nation's well-being is a direct result of the success or failure of its scientific and technologic enterprises. The foundations of science and technology lay in our schools and are built upon by our science teachers. It is here where the spark of interest is struck for future scientists and engineers. It is here where our young people learn to make wise decisions. It is here where students turn on or off to science and technology. Too many of our students terminate their formal science education as early as the ninth grade. The fact that many science career choices are made during the early adolescent years make it particularly important that middle school and junior high school science classes are taught by certified teachers who have been specifically prepared to teach at these levels.

Current certification standards and practices in most states allow teachers, with either elementary certificates or secondary certificates, to interchangeably provide instruction for middle and junior high school students(1). Consequently, science teachers at these levels may have science preparations ranging from zero hours of science coursework to as much as a full major in one of the science disciplines. If a science teaching methods course does exist, it is typically specified for either elementary or secondary teachers, not for middle/junior high school teachers(2). When we consider that there are more middle and junior high school science teachers than there are high school science teachers, the oversight of adequate preparation for middle/junior high school science teachers is unforgivable.

The following guidelines are intended to provide a framework for the improvement of programs designed to prepare science teachers who will work with early adolescents.

STANDARD I. MIDDLE SCHOOL/JUNIOR HIGH SCIENCE TEACHER CERTIFICATION

Separate, specific middle school/junior high school science teacher certification programs should be established. They should contain science content, methodology, field experiences and professional orientation activities designed specifically for the middle school/junior high science teacher.

B. PREPARATION IN SCIENCE CONTENT

Science courses as envisaged in the middle/junior high school, generally include biological, earth, and physical sciences. The breadth of offerings, and significance of science instruction during the early adolescent years makes it imperative that the middle/junior high school teacher have both sufficient preparation in science content and science teaching methods. The science courses required of middle school and junior high teachers should be designed to develop: a) knowledge of science content selected for its application to middle and junior high classrooms; b) skill in using the processes of science; and, c) positive attitudes toward the learning and teaching of science.

STANDARD II.A. SCIENCE CONTENT PREPARATION

A minimum of 36 semester hours of collegiate science instruction should be required of all preservice, middle/junior high school science teachers. This coursework should include the major science disciplines of biology, earth science, and physical science with at least 9 hours of biological or life science, 9 hours of physical science (physics and chemistry), and 9 hours of earth science. The remaining 9 hours would include electives from among the major science disciplines.

STANDARD II.B. SUPPORT CONTENT PREPARATION

The middle/junior high school science teacher should also have a minimum of 9 hours in mathematics and computer science instruction. The nature of science and technology today demands that the science teacher understand basic mathematic operations and applications of computer technology. Without this knowledge, real scientific problems cannot be solved nor can the benefits of computers as an instructional aid be utilized.

C. SCIENCE TEACHING METHODS

Since most states employ broad-field (several subject areas) certification in elementary schools and specific subject area certification in secondary schools, the methods courses in most university settings relate to either elementary or secondary science instruction. A recent survey (3) showed that only 2 of the 45 responding teacher-training institutions had specific middle school/junior high school science teaching methods courses. Most institutions, 89 percent, required a secondary science methods course for prospective middle/junior high school science teachers. Because of the wide range of sciences taught at the middle/junior high school and the special curriculum materials available, and the nature of the early adolescent student, the earlier-mentioned, restrictive practices are clearly unsatisfactory.

STANDARD III. SCIENCE TEACHING METHODS PREPARATION

Middle/junior high school teachers should have a specific science teaching-methods course which addresses not only current content, but also recent pedagogy relating specifically to early adolescents.

D. FIELD EXPERIENCES AND STUDENT TEACHING

It is universally recognized that practical experiences provide invaluable learning opportunities for prospective teachers. Most states now require a student teaching or internship experience for students during their final year of undergraduate preparation. Recently, emphasis has been placed upon "observation/participation" experiences throughout the undergraduate program. Observation/participation provides concrete examples of "real world" classroom situations. These experiences also enable students to apply instructional theory directly, to develop instructional skills, to determine personal suitability for the teaching of science as a profession, and most importantly, to ascertain whether working with early adolescents is personally satisfying.

STANDARD IV.A. CLASSROOM OBSERVATION/PARTICIPATION

Prospective middle/junior high school science teachers should have opportunities for classroom observation/participation in early adolescent science

classes taught by competent teachers. Such experiences should be provided during each year of their preservice preparation program.

STANDARD IV.B. STUDENT TEACHING/INTERNSHIP

The culminating field experience for the preservice middle/junior high school science teacher should be an internship of one semester's or quarter's duration. There must be ample time and opportunities to plan and provide instruction for students in a middle/junior high school science classroom supervised by a competent science teacher.

E. FACULTY PREPARATION

Identifying who will teach science content and methods courses to preservice teachers is as important as identifying what will be taught. Institutions desiring to develop teacher education programs of quality cannot afford to permit less than well-qualified individuals to teach content and methods courses for preservice teachers.

Each faculty member teaching content courses to preservice, middle/junior high school teachers should have credentials comparable to those required for other science courses. These courses should not be assigned to faculty members having little interest in teacher preparation, nor should they be assigned to lesser-qualified personnel such as graduate assistants, who may have little preparation in the sciences and science education.

Likewise, science teaching methods instructors should have had specific training and experience at the middle/junior high school level. These instructors must maintain a continuous association and involvement with schools in an effort to remain "in touch" with the field and retain credibility.

STANDARD V. COLLEGE/UNIVERSITY SCIENCE AND SCIENCE TEACHING METHODS FACULTY

The university/college faculty members selected to teach science and/or science teaching methods courses to preservice teachers should have adequate professional preparation and be committed to the education of teachers of early adolescent children.

F. FACILITIES, EQUIPMENT, AND MATERIALS

If the preparation of preservice, middle/junior high science teachers is to be of high-quality, then library holdings, laboratory materials, teaching equipment, and instructional materials must be adequate, related to middle/junior high school science teaching, and funded appropriately.

STANDARD VI.A. INSTRUCTIONAL SETTING/MATERIALS

Preservice middle/junior high school science teachers should be instructed in well-equipped science laboratory settings with sufficient instructional materials in order to develop the science instructional base needed for early adolescent teaching.

STANDARD VI.B. LIBRARY HOLDINGS

Library holdings for preservice, middle/junior high school science education should be comparable to other academic areas, budgeted sufficiently to keep holdings current, and include adequate specialty books, periodicals, microfilms, curricular guides, etc., to supply the demands of research and instruction.

G. PROFESSIONAL ORIENTATION

The lack of specific undergraduate programs for the middle/junior high school teacher has often produced "professional misfits," many of whom suffer an identity crisis. Commitment and allegiance to the teaching of early adolescents, and to the early adolescents themselves, is often lacking because teachers have been conditioned to aspire to high school or elementary instruction.

Since there are often more middle/junior high school science teaching positions available than high school science positions, employment opportunities must be made known to all teacher-education students at the outset of their programs.

STANDARD VII. PROFESSIONAL ORIENTATION

The preservice, middle/junior high school science teacher program should provide experiences which will engender professional pride, dedication, and commitment to the early adolescent child and early adolescent instruction. The professional orientation should also encourage continual self-improvement, via current literature, professional organization involvement, both formal and informal inservice education, and continuing education.

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1. Stedman, Carl and Ken Dowling, *Data Summary and Discussion for State Requirements for Teacher Certification in Science Questionnaire,* Washington, DC: National Science Teachers Association, March, 1982, p. 2.

2. Ibid. p. 3.

3. Mechling, Ken, *Survey Results: Preservice Preparation of Teachers of Science at the Elementary, Middle, and Junior High School Levels,* Washington, DC: National Science Teachers Association, March 1, 1982, p. 9.

STANDARDS
MIDDLE/JUNIOR HIGH SCHOOL SCIENCE TEACHER PREPARATION

STANDARD I. MIDDLE SCHOOL/JUNIOR HIGH SCIENCE TEACHER CERTIFICATION

Separate, specific, middle school/junior high school science teacher certification programs should be established. They should contain science content, methodology, field experience and professional orientation activities designed, specifically, for the science teacher of early adolescents.

STANDARD II.A. SCIENCE CONTENT PREPARATION

A minimum of 36 hours of collegiate science instruction should be required of all preservice, middle/junior high school science teachers. This coursework should include the major science disciplines of biology, earth science, and physical science with at least 9 hours of biological science, 9 hours of physical science, and 9 hours of earth science. The remaining 9 hours would include electives from among the major science disciplines.

STANDARD II.B. SUPPORT CONTENT PREPARATION

The middle/junior high school science teacher should also have a minimum of 9 hours in mathematics and computer science instruction. The nature of science and technology today demands that the science teacher understand basic mathematic operations and applications of computer technology. Without this knowledge, real scientific problems cannot be solved, nor can the benefits of computers as an instructional aid be utilized.

STANDARD III. SCIENCE TEACHING METHODS PREPARATION

Middle/junior high school science teachers should have a specific science teaching methods course which addresses not only current content, but also recent pedagogy relating specifically to early adolescents.

STANDARD IV.A. CLASSROOM OBSERVATION/PARTICIPATION

Prospective middle/junior high school science teachers should have opportunities for classroom observation/participation in early adolescent science classes taught by competent teachers. Such experiences should be provided during each year of their preservice preparation program.

STANDARD IV.B. STUDENT TEACHING/INTERNSHIP

The culminating field experience for the preservice, middle/junior high school science teacher should be an internship of one semester's or quarter's duration. There must be ample time and opportunities to plan and provide instruction for students in a middle/junior high school science classroom supervised by a competent science teacher.

STANDARD V. COLLEGE/UNIVERSITY SCIENCE AND SCIENCE TEACHING METHODS FACULTY

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Preservice, middle/junior high school science teachers should be instructed in well-equipped science laboratory settings with sufficient instructional materials in order to develop the science instructional base needed for early adolescent teaching.

STANDARD VI.B. LIBRARY HOLDINGS

Library holdings for preservice, middle/junior high school science education should be comparable to other academic areas, budgeted sufficiently to keep holdings current, and include adequate specialty books, periodicals, microfilms, curricular guides, etc., to supply the demands of research and instruction.

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The preservice, middle/junior high school science teacher program should provide experiences which will engender professional pride, dedication, and commitment to the early adolescent child and early adolescent instruction. The professional orientation should also encourage continual self-improvement, via current literature, professional organization involvement, both formal and informal inservice education, and continuing education.

IMPLEMENTATION PLAN

It is important to recognize that the standards recommended in this document are draft statements. They represent a beginning, a first step toward improving science-teacher education and certification at the elementary and middle/junior high school levels.

The Steering Committee is presenting this draft to the NSTA Board of Directors at the NSTA Convention in Chicago, not for action, but rather, for review and study. Directors are invited to provide comments and suggestions prior to the Board meeting later this summer. A final draft of the standards will be presented to the Board for action at that time.

Meanwhile, the Steering Committee will circulate this draft to state science supervisors for their review and reaction, and to other persons and groups who share our stake in science-teacher preparation. For instance, NSTA has already become an affiliate of the National Association of Colleges of Teacher Education (NCATE). We hope we can be effective in helping to shape their accreditation processes which impact science-teacher preparation. We have also contacted the National Association of State Directors of Teacher Education and Certification (NASDTEC) to inform them of our interest and progress and seek cooperation in the development of standards.

These guidelines are not proposed for the purpose of being filed away in the NSTA offices, or put on a shelf to gather dust. They are proposed with the intent of achieving action toward the improvement of teacher education through implementation by college and universities, accreditation agencies, and state departments of education. Those challenges lie before us.