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A SOURCEBOOK FOR SCIENCE SUPERVISORS.

BY- HARBECK, MARY BLATT
NATIONAL SCIENCE TEACHERS ASSN., WASHINGTON, D.C.

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THIS SOURCEBOOK REPRESENTS A RESOURCE TO PROVIDE DIRECTION FOR SCIENCE SUPERVISORS IN EXERCISING THEIR RESPONSIBILITIES IN THE SCHOOLS OF TODAY AND TOMORROW. SECTION 1 DEALS WITH THE ROLE OF THE SUPERVISOR FROM THE VIEWPOINT OF SCIENCE SUPERVISORS, SCHOOL ADMINISTRATORS, AND SCIENCE TEACHERS. SECTION 2 REVIEWS (1) TECHNIQUES OF WORKING WITH OTHER PEOPLE IN ACCOMPLISHING THE GOALS OF SUPERVISION, AND (2) THE SUPERVISOR'S WORK IN PLANNING CURRICULUM AND DIRECTING ITS IMPLEMENTATION IN CLASSROOMS. SECTION 3 DEALS WITH GRADUATE AND INFORMAL EDUCATION AS THEY RELATE TO THE CONTINUING EDUCATION OF THE SCIENCE SUPERVISOR. SECTION 4 CONSIDERS THE RESOURCES AVAILABLE TO THE SUPERVISOR INCLUDING (1) FEDERAL PROGRAMS, (2) PROFESSIONAL ORGANIZATIONS, (3) INDUSTRY, (4) HIGHER EDUCATION, AND (5) COMMUNITY RESOURCES. THE LAST SECTION INCLUDES A SELF-EVALUATION CHECKLIST FOR SCIENCE SUPERVISORS. A BIBLIOGRAPHY AND LIST OF PROFESSIONAL SOCIETIES FOR SCIENCE TEACHERS AND SUPERVISORS ARE ALSO PROVIDED. THIS DOCUMENT IS AVAILABLE AS STOCK NUMBER 471-14430 FOR $3.00 FROM NEA PUBLICATIONS SALES, 1201 SIXTEENTH STREET, N.W., WASHINGTON, D.C. 20036. (DS)

a sourcebook for science supervisors

national science supervisors association
a section of the
national science teachers association

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MARY BLATT HARBECK
Editor

NATIONAL SCIENCE SUPERVISORS ASSOCIATION
A Section of the
National Science Teachers Association
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introduction

About the Sourcebook

ANNIE SUE BROWN
President of NSSA, 1966-67
Coordinator of Science
Atlanta Public Schools
Atlanta, Georgia

SCIENCE today occupies a most strategic place in education. One of the chief generalizations derived from scientific investigation is that we are part of a constantly changing environment. We are becoming much more aware than ever before that man is, indeed, a part of his environment. Because of this, the reality of change is being recognized by the general populace who perceives that there is no such thing as anything being fixed in time and space. It is not the fact of change, however, but the direction and the rate of change which are important. We cannot stop change but we can slow it down, speed it up, and to a certain extent, give direction to it. This direction may be beneficial, but it may also be destructive or detrimental to certain aspects of the environment. If change is the most obvious reality brought out by science teaching, the science supervisor should have enough intelligence, experience, and background to direct change. He must avoid super-organization, must stay close to the immediacy of the child who is being educated, must not be too general nor too specific. The guidelines for his activity must not be too rigid, because he must adapt to individual circumstances, must realize that the freshness of science experience is lost without a great deal of freedom, and must always remember that the teacher is the key to the situation.

More and more, scientists are coming together from various disciplines, pooling their specialities and working with each other to tackle common problems. Most noticeable is the great increase in synthesis and problem-solving research of benefit to society.

In like manner, science supervisors seek opportunities to exchange ideas, to study and plan together, to seek answers to problems relating to man's welfare. Our organization, the National Science Supervisors Association, is dedicated to providing such opportunities.

One main question bedeviled me when I became President of NSSA on April 4, 1966. What would be the most worthwhile activity that could take place during the coming year?

Philip G. Johnson of Cornell University suggested publishing a Science Supervisors Sourcebook. Soon after this suggestion was made, the NSSA Commission on the Role of the Science Supervisor released its preliminary report and suggested that the report be used as the basis for a more comprehensive guide. A dream was evolving. The work of the Commission is outlined in the following pages, and the text of its statement on the role of the science supervisor appears in Section I—setting the stage for further discussion of the work and relationships of the supervisor, which are presented in the succeeding chapters and sections of this Sourcebook.

Mary Blatt Harbeck accepted the responsibility of editing the Sourcebook. She was ably assisted by Albert F. Eiss and members of the NSSA Publications Committee. Authors were contacted, assignments made. The Shell Companies Foundation provided partial financial assistance, and NSTA offered to publish the Sourcebook, providing us with the guidance of Robert H. Carleton, NSTA executive secretary, Mary Hawkins, director of publications, and members of Standing Committee II.

We express sincere gratitude to the dreamers, the authors, and all who worked to provide the members of NSSA with the Sourcebook. Appreciation is also expressed to Eleanor Snyder of the NSTA staff for editorial work and to all who made the production of the publication possible.

By the tremendous efforts of these and many other unnamed people a Science Supervisors Sourcebook is born.

The NSSA Commission on the Role of the Science Supervisor

THE ORIGINAL intent of the Commission on the Role of the Science Supervisor was that of defining the specific tasks of the supervisors, coordinators, consultants, departmental chairmen, or other persons who had specific responsibilities in developing or implementing the science curriculum, procuring science supplies or equipment, or in upgrading science instruction in the classroom. A survey of school systems indicated that persons of different titles were doing many identical tasks, while persons with similar titles were performing tasks with little or no similarity. To illustrate this: When considering the position of *departmental chairman*, the Commission noted that in some schools this position held responsibilities related to the supervision and administration of the science program which exceeded those of the principal. In other schools the departmental chairman was a figurehead whose only task was that of collating the requests for supplies of the science department members of a building. The terms *coordinator, consultant, supervisor,* or *science curriculum specialist* in no way seemed to indicate any hierarchy of prestige or specific responsibilities.

In view of this, the Commission recognized the prerogative of any school system to assign titles commensurate with the administrative pattern of the school, and that it was the task to be accomplished that was the important aspect, not the title. This established a new direction for the Commission; namely, that of defining the task to be accomplished.

In the Commission's report, therefore, when the term *supervisor* is used, it will carry a very broad connotation and will refer to the science-trained person who, at any level, has specific responsibilities for the task of developing the science curriculum; the coordination and/or administration of the science curriculum; the selection and/or procurement of supplies, materials, or equipment; the selection and/or assignment of science personnel; the evaluation of the science program; the improvement of science classroom instruction; and for providing leadership to initiate desirable changes in the science program.

The Commission in no way considers its report as a final assessment of the task of science supervision. Instead, it has hoped to establish some broad and general guidelines which may be used by various school administrators, those working in science supervisory roles, and other individuals and groups concerned with the upgrading of science instruction at all levels.

It is further hoped that each individual facet of the report may become an item for further consideration in greater depth and objectivity by public school administrators, science supervisors, individual school staffs, future NSSA Commissions or study groups, and independent groups or individuals interested in improving classroom science instruction.

The Commission on the Role of the Science Supervisor of the National Science Supervisors Association takes the position and makes recommendations as set forth in its report, which appears in Section I of this Sourcebook.

A. C. Brewer
Chairman of the Commission

ACKNOWLEDGMENT

The Commission on the Role of the Science Supervisor wishes to recognize the significant contributions made by the studies of Paul Ploutz, Verlin Lee, J. Hervey Shutts, Philip Johnson, Glenn D. Berkheimer, and Tillman Jackson. The Commission wishes to extend further thanks to the 300 persons who completed questionnaires at the 1965 National Science Teachers Association Convention. Appreciation must also be extended to those who served in an advisory capacity to the Commission, including Glenn D. Berkheimer, Charles Bridges, and Tillman Jackson.

Science Supervisors, Today and Tomorrow

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SCIENCE supervisors generally accept the fact that they hold positions of prestige in a school system. But many have "inherited" the title of supervisor without being certain as to what was involved in their new positions of influence or how they were to carry on their new responsibilities. It was for supervisors such as these that this Sourcebook was primarily prepared.

Recent innovations in science teaching represent recurring episodes in a never-ending sequence of inevitable developments in science education. As in the past, future developments will be greatly influenced by advancements in science and by the application of various technologies to educational practices. There is no certainty about the nature of changes yet to come, but we can be certain that there will be change.

The supervisor plays a critical role in determining how schools adapt to changes and to developing and broadening viewpoints. He functions as the science educator who counsels the administration of the school on matters regarding the improvement of science education in the system. He also serves as the leader of those who put the science program in motion in the classrooms. The quality of science teaching in any school system is determined largely by the manner in which the supervisor conceives and performs his role.

The first section of this Sourcebook deals with the role of the supervisor. His role is examined from the point of view of science supervisors, school administrators, and science teachers. It is one thing to understand clearly the role of the science supervisor, but quite another to carry on his work in an effective manner. Therefore, the second section deals with one of the supervisor's greatest needs, techniques of working with other people, in accomplishing the goals of supervision. It also deals with the supervisor's work in planning the curriculum and directing its implementation in classrooms. The continuing education of the science supervisor is discussed in the third section. The fourth section deals with resources available to the supervisor, and the final section is given over to the all-important topic of self-evaluation.

This Sourcebook represents an excellent resource for science supervisors and should do much to bring the practice of supervision of science in today's schools to higher levels of performance. But what about tomorrow's schools and future challenges that will face the supervisor?

In tomorrow's schools, supervisors will be expected to take more active roles in dealing with at least three of the pressing problems facing education today: (1) development of more effective practices for inducting college graduates into teaching, (2) evaluation of curriculum innovations and evaluation of technological innovations as they are applied to teaching and learning, and (3) guidance in selection of both curriculum and technological innovations.

Traditionally, we have expected collegiate institutions to assume such responsibilities as these and to make the products of their efforts available to the schools. This has been the case even though institutions have been almost completely dependent upon the schools for both facilities and resources. In this cooperative relationship, schools too often have been considered the junior partners rather than the cooperators they should be. Schools of the future have too much at stake not to become more actively involved in attacking basic problems of educational change.

When schools take on these new responsibilities, the role of the supervisor will broaden considerably. Rather than being concerned primarily with the inservice improvement of science teachers in his school, he will also be highly involved with developing and managing experiences that will effectively induct college students into teaching. Rather than being concerned solely with the implementation of a single curriculum in his school, he will also be involved in directing experimental studies to evaluate promising innovations. Further, he will be responsible for seeing that there is continuous feedback from each of these new enterprises into the ongoing efforts of his staff toward the improvement of science teaching in the school.

In these and other ways the supervisor will become increasingly influential in directing the future of science education in the schools. Concurrently, he will become increasingly influential in bringing about needed changes in the collegiate education of science teachers. He will be recognized as the clinical authority in the teaching of science. In the science education community he will attain coequal status with professors of science education in colleges and universities. And this is as it should be, for science teaching in the schools cannot attain its maximum development either today or tomorrow, until professional leadership of this caliber is directly available to science teachers in the schools.

section I

THE ROLE OF THE SUPERVISOR

The Role of the Science Supervisor

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SCOPE OF POSITION

To best accomplish the goal of upgrading the K-12 science program, direct responsibility, either full time or part time, depending on the size of the school, should be assigned to adequately trained science personnel in each of the following general areas:

K-12 supervision, or direction of the total science program
Supervision of the elementary program
Supervision of the secondary program

It must be recognized that there are many avenues whereby specific responsibilities for the science program can be defined. In the small school system this might be accomplished by a classroom teacher devoting a portion of his time exclusively to the K-12 science supervisory task. In larger school systems the K-12 supervisory task becomes a full-time responsibility. In the metropolitan systems, in order for the task to be carried out effectively, it may be necessary to add further assistance. At the elementary level, this may be in the form of assistants, supervisors, consultants, or special teachers. At the secondary level, assistants or departmental chairmen may assume many of the responsibilities.

GENERAL RESPONSIBILITIES

The general responsibility of science supervision must be that of the upgrading of science instruction through the involvement of the teacher, administration, community, and all professional channels. The fruits of this effort may be assessed through desirable changes in the behavioral patterns of children as demonstrated in the development of scientific skills, attitudes, usable knowledge, and methods of approaching the solution of scientific problems. It is also apparent in the behavioral patterns of teachers, as evidenced by improved teaching methods, increased scientific knowledge, and continuing professional growth in all of its aspects; of the administrators as displayed by their cooperative efforts and guidance; and of the community by its acceptance of the program, its support, and its sharing of resources.

ADVISORY RESPONSIBILITIES

If science supervision is to be effective in the discharging of the stated general responsibilities, the supervisor must be recognized by the school administration as the best available source of information in the field of science education. In this capacity the supervisor should be asked for advice and direction, and such advice and direction should have a significant role in shaping policy and making decisions in matters related to:

- Selection and assignment of science staff
- Design and construction of science facilities and selection of science equipment, supplies, and materials
- Science curriculum content, structure, and articulation
- Interpretation of the science program to the school staff and general public
- Inservice training of teachers
- Newest developments in science methods and evaluation of curriculum innovations
- Effective classroom methods and techniques of science instruction
- Budgetary matters as they relate to the science program

Each of the above advisory responsibilities is accompanied by demands upon the supervisor that he have the specific knowledge upon which opinions must be based and that he assume the responsibility for the action of such advice and direction.

RESPONSIBILITIES FOR PROFESSIONAL GROWTH

Many of the supervisory tasks of the science supervisor are not unlike those of supervisors in other fields. However, the wide and varied fields of science, its constantly expanding body of knowledge, its emphasis on the laboratory approach to learning, and its rapidly evolving methodology demand from the science supervisor, perhaps more than from a supervisor in any other field, that he exercise every possibility to grow professionally. This implies a continued reschooling through media such as institutes, conferences, visitations, and a study of literature, in order that the supervisor may keep informed of the newest developments in content, methods, materials, equipment, supplies, and philosophy as applied to all branches of science at all levels. At the same time, the supervisor must develop an association with other leaders in the field of science and science education. As a member of a professional organization, he must stand ready to make contributions of time, talents, and energies to the growth of his professional organization.

By his own professional growth he places himself in a position to better serve in his supervisory capacity and to direct the professional growth of the teachers of science in the school system.

Boards of education and administrators should provide released time and remuneration to contribute toward the continuing professional growth of supervisors and teachers.

RESPONSIBILITIES FOR IMPROVING INSTRUCTION

Science supervision must provide services to teachers both in the area of curriculum improvement and methods of teaching science and in the selection and use of materials for instruction. This will include services such as the initiation and implementation of inservice training opportunities, bringing about awareness of available institutes and conferences, the demonstration of proper usage of materials of instruction, and provision of opportunities for leadership development.

RESPONSIBILITIES FOR EQUIPMENT, SUPPLIES, AND FACILITIES

Those in the area of science supervision are charged with the responsibility of one of the largest capital outlays for equipment and supplies of any of the instructional areas of the school system. They must be able to assume the responsibility for the wise selection, maintenance, and use of such equipment and supplies as will best fulfill the goals of the science program.

Science supervisors must be aware of the facilities necessary to carry out the desired science program and be able to communicate their nature and desirability to those responsible for the acquisition of such facilities.

RESPONSIBILITIES FOR USE OF SCHOOL AND COMMUNITY RESOURCES

Science supervisors must be aware of available school and community resources, must evaluate their effectiveness as they relate to the curriculum to be implemented, must utilize those which would seem most effective in upgrading the science curriculum, and must work effectively in the development of new community and school resources.

LINES OF COMMUNICATION

Effective open lines of communication involving teacher, supervisor, administration, and public should be established and used. Rapidly changing content, methodology, materials, and philosophy at each level of instruction demand a continued interpretation if a cooperative team effort is to be established and maintained.

When a school system adds the position of science supervisor to its structure, it should at the same time define the supervisor's responsibilities and communicate such defined responsibilities to the total staff.

TIME ALLOTMENT

The person or persons responsible for the task of science supervision must have time alloted commensurate with the breadth of the responsibility. The following schedule suggests the minimum requirements to accomplish the task:

1. A full-time science supervisor should be provided in any K-12 school system encompassing 50 or more elementary teachers in three or more elementary units, and with ten or more science teachers in the junior and senior high school units.

   When the size of the system exceeds the above, there should be provided additional adequately trained staff assistants who can work with elementary and/or secondary teachers and departmental chairmen. Departmental chairmen should be added in proportion to the size and numbers of the secondary schools. In the case of schools smaller than that defined above, a well-trained science person with both breadth and depth in science and science education might be used in a teacher-supervisory capacity.

2. Science departmental chairmen or science coordinators within a secondary school should be provided released time from regular teaching duties at the rate of one hour per day for each five science teachers or fraction thereof in the department.
3. Assistance to the K-12 supervisor should be provided at the elementary school level on the basis of the task to be accomplished. It would appear that an elementary supervisor could not work comprehensively with a large number of teachers, and would lose much of his effectiveness when the ratio exceeded one supervisor for each 100 teachers. Where several buildings are assigned to one assistant, the ratio of teachers to assistants should be reduced.

FACILITIES

Adequate facilities should be provided for all persons involved in the task of science supervision, coordination, or administration of the science program. These include:

1. Adequate office space to enable the science supervisor to carry out the tasks assigned (Space should include floor area for desks, shelves, steel files, a table, and chairs.)
2. Adequate storage and laboratory space for equipment and supplies to carry out the assigned tasks, which will include preparing, assembling, and evaluating teaching materials
3. Trained, paid secretarial help sufficient to do the necessary clerical work, thus relieving the supervisors of routine office duties in order that he may do the unique task for which he is trained

REMUNERATION

Salaries for these positions should be sufficient to give the science supervisor professional stature commensurate with other administrative and/or supervisory positions in the school and community. The salary offered such supervisors should attract the most highly qualified persons in the field of science and science education—from colleges and universities if necessary. The salary must be such as to enable the supervisor to assume the responsibility for professional growth as required by the position.

In the case of the full-time K-12 supervisor, this would be interpreted in the form of a salary equivalent to that of the building principals with whom he must act in an advisory capacity. According to the NEA Research Report, 1967-R3, in school systems enrolling over 25,000 students, the mean maximum salary of the elementary principal is 130 percent that of the classroom teacher, while that of the high school principal is 143 percent that of the classroom teacher.[1] Similar figures may be used to equate the salary of the science supervisor.

Departmental chairmen should receive salary increments in proportion to their supervisory load. The differential for the departmental chairman should range from 5 percent to 20 percent above that of the classroom teacher.

The Commission on the Role of the Science Supervisor

commissioned by the National Science Supervisors Association, a section of the National Science Teachers Association

A. C. Brewer, Chairman of Commission
Members of Commission
Richard F. Blake
Ruth E. Cornell
Lois E. Dunn
Robert Grogan
Howard N. Hubbard
Norman P. Taylor
Robert L. Walker
Donald Stotler, President NSSA, 1964-65
J. Hervey Shutts, President NSSA, 1965-66
Annie Sue Brown, President NSSA, 1966-67

[1] *Salary Schedules for Administrative Personnel 1966-67*. Research Report 1967-R3, Public School Salaries Series. National Education Association, Washington, D.C. p. 28. [Current figures used.—Ed.]

What an Administrator Expects from a Supervisor

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THE ULTIMATE purpose of supervision is the improvement of teaching. The successful supervisor recognizes the importance of human relations and possesses those qualities which command the respect of his colleagues. His efforts become most effective when he has not only met this test, but when teachers eagerly seek his advice and consultation.

The role of the supervisor, like that of any individual with important responsibilities in this time, has become more difficult and complex. Having a key position in the school organization, the supervisor has always been at the center of significant action. Today this action is influenced by a great whirlwind of change.

Others have written about, and I shall only emphasize here, some of those factors that are brought to bear upon the supervisor in the schools of the 1960's.

The increase of knowledge and the continuous pressure for curriculum change have made greater demands on the supervisor. His role has been made more difficult by the fact that we are attempting to educate all of the children, with their varying levels of ability and motivation.

It is becoming widely recognized that changes must be made in the patterns of school organization, as well as in teaching techniques, if we are to prepare youth more adequately for productive and happy lives. Preschool education, team teaching, and the middle school are illustrations of this movement.

The technological revolution, both in and out of the educational arena, presents a threat to some teachers and the prospect of desirable change and growth to others.

Social change, coupled with an economic revolution, has made our schools unlike those of a decade ago. The mobility of our people, urban blight, the population shift to the suburbs, the information explosion, and the lack of employment opportunities for school dropouts have brought change to every community and to every school.

The availability of resources, both financial and human, presents a unique opportunity to educators. We have previously claimed that, given adequate amounts of money, we could find the solutions to the problems of education. Are we now finding it difficult to devise programs that are innovative? What are the best ways to use the talents of the layman, the paraprofessional, and the trained artist in our classrooms?

Rapid curriculum change in all of the disciplines is sweeping the nation. Parallel curriculum studies in many subject areas may confuse the serious student and certainly require that he be widely read.

Recognizing then the climate of change that the supervisor must face, what should the school superintendent expect of the supervisor? I believe that he must expect him to be well informed in his area of special competence and, equally important, to possess the desire and the ability to keep himself continuously informed.

The supervisor should have that special quality that marks those persons who possess an excitement, an interest, and a great dedication to their area of specialization.

The successful supervisor must also possess to a marked degree the ability to win the admiration and cooperation of those with whom he is working. To use an old cliché, he must also be a "well-rounded individual."

How to bring about desired change in the school is a question with a thousand answers, but this is what we do expect of a supervisor. He must use many approaches, each geared and nicely attuned to the changing situations, different personalities, and the varying attitude of teachers, principals, and other workers in the vineyard.

Leadership in curriculum change, inservice programs for the new and experienced teachers, the kindly and timely word to the beginner, the request for assistance from the veteran teacher, these are part of the daily fare of the ideal supervisor.

Within a framework of administration support that creates freedom of action and well-defined areas of responsibility, the supervisor working with teachers and discovering their special interests and talents is a jewel in the excellent administrative structure. The supervisor should expect the superintendent to provide this foundation on which he can build his contribution to the aspirations of his professional colleagues.

He should expect the superintendent to support the curriculum proposals that have been arrived at as a result of intelligent and cooperative action. This involves not only budgetary action but also some positive participation in the further implementation of new programs. The superintendent should, in short, become a partner in the enterprise. I would like to think of the superintendent as one who gladly gives credit to others—in this case to the members of his supervisory staff.

The task of the supervisor today is patently a most difficult one, perhaps greater than that faced by any of his predecessors. The well-prepared, dedicated, energetic, and tactful supervisor must be a leader in the necessary change that is taking place in classrooms everywhere. He must be given the freedom to explore, to experiment, and sometimes to fail. He deserves the respect and the support of the superintendent in the many ways that that office can pave the way for change in the continuous search for excellence.

What a Science Teacher Expects from a Supervisor

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WE HAVE HEARD and read much about the duties of a science supervisor. Most of these observations have been authored by science supervisors. This is as it should be, since it is they who are involved in the daily execution of the duties and responsibilities of the office.

The classroom teacher in science welcomes the opportunity to voice his expectations of the supervisor. Of necessity, he must speak from the restricted domain of the classroom. But it is there that the fate of any program is decided. What happens in the classroom contributes most directly to the formal education of the child.

A teacher expects constructive observation. He wants his presentations reviewed frequently, depending upon how experienced he is. Even the most experienced teacher knows he may unwittingly fall into poor teaching habits. The discussion of his observation should include motivation, discipline, personal appearance, pupil-teacher rapport, and all the standard items of the accepted evaluation forms.

A beginning teacher or a teacher new to the system would expect an orientation session which would familiarize him with the physical plant. This session should show him what equipment and supplies are available and where they can be found. It would also include how he can procure these items when he needs them. The briefing should cover standard classroom supplies, audio-visual equipment, and science equipment and materials. If the teacher is unfamiliar with the application of any of this equipment, he would expect that there would be some opportunity for him to learn. This applies most to instrumentation equipment in science. The teacher also needs to know what is available in the school library as reference material. It would be helpful to have all this information available in handbook form for permanent reference.

The teacher expects that he will be kept abreast of what changes are being made, not only in his department but in other departments of the school. For the less experienced teacher it would be helpful to explain the prospective impact of these other-department changes upon the science department. This will help him develop an overall concern for the child in terms of the entire educational process rather than only in science.

In the process of curriculum review, the science teacher expects to be consulted for proposals. These proposals can then be made by the department as a unit. The teacher feels that since he is the one who must implement whatever changes are brought about, his knowledge of what happens in the classroom should be used to advantage.

All science teachers expect to take part in budget preparation. Since science teachers may tend to ask for more money than a district can afford, limitations must be realized. It would be desirable to consider these limits within the framework of a long-range plan of acquiring equipment. Science teachers need specialized and expensive equipment. They expect the supervisor to be at least conversant with the educational values of such equipment. When both teacher and supervisor understand the educational purpose of equipment, values can be compared with cost, and decisions to accept or reject proposals for equipment acquisition can be made on an objective basis. Once a decision has been made, the teacher expects the supervisor to be his "friend in court" with the administration and to make every effort to have the proposals accepted.

The teacher also expects to be kept aware of curriculum innovations outside of his own school or school system. The supervisor can provide this information directly, or he can direct the teacher to publications or organizations which can keep him informed. The teacher expects to be urged to join professional associations, such as NSTA and other affiliated groups. The teacher can then examine the curriculum materials and organization programs to see what is pertinent to his situation.

The teacher expects that the supervisor will help him plan a long-range program of self-improvement. This could include suggestions for summer institutes, inservice courses, or available university offerings. The professional advancement of the teacher is important to good teaching. This program should also include attendance at local, regional, and national meetings, with the expense of the meetings being borne by the school district. The supervisor and the teacher can decide on which sessions will be most useful.

Most important, the teacher needs time to prepare lessons, demonstrations, laboratory exercises, and tests. He needs time to correct laboratory reports, check homework, look at records in the guidance department, give individual help to students, schedule parent interviews and do all the extra tasks which have accrued to teaching over the years, such as keeping registers, checking buses, and playing patrolman in the lunchroom.

The teacher looks to the supervisor to help him keep the size of his laboratory groups small enough to permit close supervision. Since so many of the newly developed programs are laboratory-oriented, this is a most important factor. The best-designed course in science can be made ineffective by lack of attention to this detail.

The teacher is a teacher because he wants to teach. He expects the supervisor to make it possible for him to do so, and to do so in the best manner possible for both students and the teacher. The more obstacles a supervisor can remove or minimize, the better the teacher will be. Both teacher and supervisor want the same result—good classroom teaching. If we direct our combined energies to the problem, we can achieve that result.

What a Teacher Expects from a Supervisor

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STATED with maximum brevity, teachers expect supervisors to help improve classroom effectiveness and efficiency. Sought-for improvement may involve the total building or room facilities; equipment and supplies; prior preparation of students; student attitudes toward science courses and the total scientific endeavor; working arrangements with colleagues, administrative, and supporting service personnel; attitudes of parents and community leaders toward the school in general and the science offerings in particular; and involvement in research and development activities intended to advance our comprehension and management of the factors which seem to accompany the learning phenomenon.

Perhaps the spirit of this essay can be best introduced by reviewing some aspects of the teacher-supervisor relationship that are almost axiomatic. Teachers and supervisors devote their time and energy to the achievement of common goals. Although each can always improve his effectiveness, by nature of appointment to his position each teacher and supervisor possesses the required credentials of his office. Although we tend to refer to teachers and supervisors as collective entities, supervision of classroom instruction is invariably a person-to-person affair and, as such, is subject to all of the phenomena which accompany personal relations. Each supervisor looks forward to encountering as wide variations in the teachers he supervises as are the individual differences among the pupils the teachers teach.

In light of the wide differences among teachers and supervisors and the separate school systems in which they function, it is difficult to frame a general formula for supervisors to accomplish what teachers want accomplished. In some situations, the traditional "by precept and example" may be an appropriate formula. In other situations, the supervisor may choose to look upon his work pretty much as a course he is to teach. He can publish his goals, translate hopes and ambitions into lesson plans, and assess improved classroom performance as the "final examination."

Probably, the greatest number of supervisors can cause their work to be felt most sharply by the greatest number of teachers through the general formula of improving communications. Supervisors occupy a crucial link in communication channels. In effect, they alone are on a "first-name" basis with all segments of administrative organization. The supreme rank of this supervisory function deserves illustration.

The teacher who finds his new physics laboratory to have only one or two electric outlets will encounter countless annoyances while creating makeshift solutions to the problems generated when several groups of students must make *safe* connections between their laboratory stations and electric outlets. The only adequate solution to this problem calls for correction of an architectural error. This solution, in turn, requires effective and sometimes embarrassing communication through a long chain of personnel. Delay in achievement of the solution breeds discontent on the part of the teacher. The hardships and canceled laboratory exercises visited upon his students transfer additional frustrations to the teacher. His references to the "one-outlet goof" become increasingly "unprofessional." If the problem is not corrected promptly, the teacher is nudged toward becoming truly unprofessional.

There is the long-standing proverb that 10 percent of the student population neutralizes 90 percent of the teacher's energy and enthusiasm. The teacher who has his heart set on investing his time and talents in the achievement of goals other than putting up with the disruptive behavior of this 10 percent is sure to seek help from all available sources, including, of course, supervisory personnel. The elimination of the students who are involved, their segregation, or the conversion of their behavior becomes a crucial problem that can well set the limits to total achievement within the classroom. Without the assistance of an empathic supervisor, the teacher must wage his battles through appointments with the many people who share the responsibility for the disruptive element in his classes. These appointments are very, very time consuming and are often fraught with personality accusations, many of which could be avoided through the actions of an appropriate intermediary.

The procurement of equipment and supplies provides a third window through which we can view the effectiveness of communication within a total school system. Prompt delivery of requisitioned and informally ordered supplies provides a constant boost to a teacher's morale and a delightfully effective nudge toward launching new and creative classroom and laboratory experiences for his students. The supervisor who keeps an accurate log of each requisition he approves and who expedites processing of the orders through each potential bottleneck wins for himself an honored position in the minds and hearts of those whom he supervises. And when insurmountable delay becomes evident, prompt notification of the teacher allows for revision of lesson plans, revisions which permit the teacher to continue to provide effective classroom instruction.

In nearly all school systems, excitingly creative investigations are carried on in certain divisions. Many teachers want to share in these activities. Similarly, they want their colleagues and administrative associates to share in the excitement of their own small-dimension excursions into investigations of the learning phenomenon and the factors most likely to accompany it. Again, the supervisor is the person who should be cognizant of all of these exploration and research activities. In many senses of the word, his effective role as the communication link will serve to catalyze the research and development aspect of the total school system.

To continue this point, in many school systems each teacher is "evaluated" in one way or another at stated intervals in his professional career. These evaluation sessions become perfect opportunities for the teacher to be reminded of his long-term hopes and ambitions. Similarly, these sessions provide equally effective opportunities for the supervisor to go on record with his offers of assistance. In turn, the evaluation forms can record the supervisor's invitations for the teacher to lend a hand in the achievement of the supervisor's long-term hopes and ambitions. Subsequent evaluation sessions become automat... "pointings with pride" and "viewings with alarm."

Although referred to less often in the literature (and for sure in teachers' lounges) it is probably proverbial that 10 percent of the teachers a supervisor supervises neutralizes 90 percent of the supervisor's energy and enthusiasm. There are sure to be insecure and sorely disenchanted teachers in every large school system. Unfortunately, their "properly adjusted" colleagues expect supervisors to solve the problems these less-than-adequate 10 percent create or foment. Solutions to these problems loom so difficult as to suggest that it is better to strive for their prevention rather than solution.

Teachers whose goals and efforts to achieve them run counter to those adopted by the total school seem to trace their disenchantment to what they feel was inadequate help at some crucial point in their becoming established as a member of the school faculty. A new person or an established person facing a new assignment or situation is especially receptive to feeling the effectiveness of efficient supervisory help. The teacher assumes that his supervisor enjoys the advantage of having been through the "new" situation and has accumulated solutions to all recurring problems. Nothing damages the evolving morale of the new person more significantly than to be told in the faculty lounge, "Your problems are exactly those which distressed me when I was new here." Or, "Yes, I have opened several new buildings, and I had to go through exactly what you are going through now."

Recalling the favored position the supervisor occupies in the total communication pattern, he becomes the one person who can maintain feedback of information from one to another generation of problems and solutions. Similarly, he is in the best position to circulate solutions to problems from school to school within the total system. He alone knows whether the "squeakiest wheel" really deserves the "most grease." Thus, the supervisor who publishes to all who may be concerned the problems which must be faced by the total school system, the progress that is being made toward achievement of their solutions, and objective descriptions of all factors which seem to be delaying this achievement, is certainly doing all that his teachers can expect him to do to maintain morale and head off disenchantment.

In summary, the supervisor who fulfills his role as the communication link between the teacher and the total school system stands best to be of maximum help to the teacher.

The Role of the State Science Supervisor

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STATE and local science supervisors share a common goal, the improvement of science instruction. While the former provide assistance and services on a state-wide basis but do not operate the schools, the latter are directly concerned with the actual day-by-day operation of the schools of a given local system.

A few state science supervisors were active prior to the enactment of the National Defense Education Act of 1958; however, most of these positions have come into being since that time. Today almost all state educational agencies have one or more science supervisors or consultants who can help in the development of the science program from the state level. While the duties and the role of the state science supervisors may vary considerably among the states, they all have a common responsibility and interest in stimulating and strengthening science education throughout their state. In most cases this is accomplished by the state science supervisor working with and through local school systems.

From a historical point of view, many state science supervisors were originally concerned with the implementation of the National Defense Education Act through the mechanics of the acquisition program and the development of state supervisory services. As the implementation processes have become better organized and more routine and as additional personnel were appointed, considerably more attention has been given by state science supervisors to the more fundamental aspects of science education, including: curriculum development, improved teaching methods, selection of science equipment, design of science facilities, and inservice training programs. To work effectively in these areas, state science supervisors are active in professional organizations, including the National Science Supervisors Association and the Council of State Science Supervisors. They maintain liaison with agencies and organizations interested in science education; they keep familiar with federal programs and maintain contact with the United States Office of Education; and they initiate and develop programs at the state, regional, and local levels.

Because he works across an entire state, or even a part of a state, the state science supervisor is somewhat remote from the scene of direct classroom action and from continuous contact with a given group of teachers in a particular local system with its board of education and administrative staff. In this context he is unique, yet highly compatible with respect to local science supervisors. In effect, as a leader in science education, the state science supervisor is a catalyst for change and improvement of science education throughout the entire state, a coordinator of science education activities within his state, and another contact person who can provide assistance to local school systems and local science supervisors in the development of their specific science programs.

More specifically, state science supervisors are usually equipped to help local supervisors in numerous ways. Some of these are as follows:

> The state science supervisor has a state-wide perspective of the science program and is familiar with its strengths and weaknesses. He has the advantage of seeing differences in local school programs, and from his vantage point he can assist local school systems in determining their own strengths and weaknesses and in working toward improvement.
>
> He has a broad range of contacts with leaders in science education at the local, state, and national levels. He can involve these leaders in improvement programs, conferences, and workshops, and can disseminate their ideas throughout the state.
>
> He has knowledge of and familiarity with federal programs, their objectives and provisions. He can assist local school systems in the improvement of science education through the development of projects using these programs and other resources.

He has access to current information on curriculum developments and other programs in science education and usually has some means of disseminating this information to all local school systems. Many states use newsletters, bulletins, and other releases for this purpose.

Working outside of the regular structure of the local school system, he can provide support to the local supervisor with respect to needs and desirable improvements to the science education program and can assist in the communication and interpretation of these needs to local administrative and teaching personnel.

On a state-wide or regional basis, he can help to provide conferences and workshops which may not be possible within an individual local system.

He can help to coordinate the activities and interests of science organizations and agencies within the state in order that all local systems may derive benefits from their programs.

Using a variety of resources and providing financial assistance available at the state level, he can help stimulate and initiate special projects or pilot projects in local school systems.

He can provide direct consultant service in conferences, workshops, and visitations to local school systems that otherwise might not have such services available and can supplement the services of the local supervisor.

He can initiate curriculum development programs or guidelines of a state-wide nature, receiving contributions and involving personnel from many local systems and reducing the duplication that would result if each system proceeded independently.

He can maintain a friendly, personal relationship with local science supervisors, enabling them to serve as catalysts in initiating new ideas; and, in turn, he has friends who can help implement these ideas.

He can arrange for exchange visitations among supervisors and teachers from different local systems to see new programs, methods, and facilities.

He can arrange regular meetings of local supervisors to explore new directions, consider current problems, and work together for the general improvement of science education.

On the other hand, supervision is a two-way street, whether at the state, local, or any level, in that it involves mutual respect, confidence, sharing, and planning together by all concerned for the achievement of common objectives. In this respect, local science supervisors can contribute to the work of the state science supervisor as follows:

The local science supervisor can initiate contacts with the state science supervisor, request his services, and invite him to see local programs in action. Remember, there is probably only one, or at most, several state supervisors compared with many supervisors at a local level. Seek a personal relationship for mutual benefit.

He can keep the state supervisor advised of local projects and programs.

He can initiate and implement promising new programs and report on their progress.

He can participate actively as speaker or in other capacities in conferences, workshops, and other programs designed to bring about an exchange of ideas and a consideration of new directions and programs.

He can serve as coordinator for local inservice programs.

He can work cooperatively with the state supervisor in initiating, planning, and developing programs and activities of mutual benefit to both.

In summary, the state science supervisor is another link in the pattern of cooperative approach to the development of improved science education. While his work and responsibility is with respect to a total state program, it is achieved through cooperative effort of local supervisors within the state. All of the thought, planning, and action that can be directed toward better understanding and better interaction between supervisors at the state and local levels can result in only one basic outcome—better science education for boys and girls.

section ii

THE SUPERVISOR AT WORK

- Working with others
- Preparing for change
- Implementing curriculum change

Working with Teachers

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IN AN INCREASING number of cases the science supervisor is becoming a member of a team composed of teachers, paraprofessionals, curriculum coordinators, and administrators. This team is striving to provide learning situations for each child. Advancing technology makes the attainment of this objective more feasible than ever before. Also, as the trend toward individualized instruction gains in momentum, the traditional classroom-centered school with group scheduling patterns will evolve into facilities engineered to provide a high degree of flexibility in grouping and scheduling. New types of teaching and learning equipment will necessitate the setting up of learning situations for larger numbers of students in an increasing scope and variety.

The responsibilities of the supervisor working with and for his administrator are discussed in the following chapter. Careful budgeting of time and thoughtful establishment of priorities also make it possible for a supervisor to fulfill the other half of his professional commitment—service to teachers. There are several ways in which his work with teachers may be organized. One useful classification is working with (a) individual teachers, (b) groups of teachers, (c) students and their teachers, and (d) personnel activities.

INDIVIDUAL TEACHERS

The individual science teachers with whom supervisors work present many of the same problems to him that a group of students presents to the classroom teacher. Individualized help to each teacher according to his needs is the ideal for which the supervisor strives. A single system for the observation, evaluation, and help for teachers will not suffice for improving the science program in a school, no matter how well it is planned and structured.

One approach to the problem of providing for the individual differences among teachers is to think of them in several different categories. Just as students are placed in different reading and arithmetic groups in an elementary classroom, teachers may be considered as being in one set of groups when the supervisor is planning inservice programs and in another when individual classroom visits are being scheduled.

Most supervisors schedule at least one visit to each teacher sometime during the semester, plus, of course, visits made by invitation. Each teacher needs to have personal contact with the supervisor. This provides an opportunity for the supervisor to bolster the confidence of a competent teacher who is hesitant, or—diplomatically—to define areas in need of improvement to the complacent or overconfident teacher. Individual visits help him to spot innovative ideas being developed by a teacher so that these ideas can be properly applauded and disseminated to other teachers. Potential troubles can be identified and perhaps corrected before any real damage is done.

As individualized instruction for children becomes more commonly practiced, supervisors will need to increase the attention given to each teacher. The use of new technology will be difficult for many teachers as they find themselves being scheduled for large- and small-group instruction, for individual help sessions, and for especially prepared lectures. Elementary teachers responsible for 30 children in a self-contained classroom, and secondary teachers accustomed to a six- or seven-period day in which a similar lesson is taught to two or more groups of children, must adjust both thinking and planning. Many secondary teachers have had no previous experience with grouping children within a class, much less the planning of individual learning situations for a variety of students.

A science supervisor will need to be alert to an individual teacher who flounders while attempting a new teaching technique. Perhaps a demonstration lesson for several teachers with similar problems would be helpful. In some cases the supervisor can work with the troubled or doubtful teacher in a two-man teaching team for a day or two. Most successful supervisors exercise much creative ingenuity in devising ways to help a teacher in trouble. The fact that they are not at first able to find a way does not deter them from trying again. The hardest aspect of this problem is probably finding a way to effect a change in the teaching behavior without hurting the pride or self-image of the teacher.

A more formal way of observing and helping new teachers is usually necessary. Some type of check list or evaluation sheet, to be used by the teacher and the supervisor, is a practical way to provide data to be used for post-observation discussion. When working with practice teachers, the supervisor must give guidance in how learning situations for children, as opposed to instructional situations by teachers, can be best structured and maintained. It is so easy to get sidetracked into discussing housekeeping chores and bulletin board construction!

Part of the supervisor's job is to inform teachers about the resources of the school and community. Because most supervisors do not have the time to help individual teachers with direct information at every time of need, it is necessary to develop procedures by which teachers can help themselves. An information card file listing the names and addresses of persons to be contacted for special equipment, field trip guidance, or similar services is a valuable adjunct to the supervisor's desk. The simpler the information retrieval devices of this sort are, the more efficient and speedy will be the task of informing teachers so that they can proceed without the supervisor's individual attention. A file of information about new national curriculum projects or one describing the summer school offerings at local colleges is an example of indirect help to teachers. A monthly one-page bulletin for staff distribution is a practical way to report news about science education in the school.

Many supervisors will be expected to work directly with the library, testing, guidance, and research staff members or, from time to time, to confer with department chairmen in mathematics and science. Staff members who work with each other above the teaching level should plan and practice shortcuts to facilitate communication and the exchange of information among themselves.

In working with individual teachers, the challenge is found in maintaining a balanced schedule so that all teachers are served, not just those who clamor for attention. The quiet teacher may be the one in most need of help and may also be the one who will, in the long run, contribute the most strength to the program.

Science supervisors can also facilitate recognition of outstanding work or special talents by publicizing fellowships and awards and by nominating teachers for awards, for fellowships, and for assignments in professional organizations. Beginning in 1967, NSTA has given awards each year for distinguished service to science education. Industries and other professional organizations are interested in recognizing outstanding science teachers. Some of these programs and opportunities are listed in *Keys to Careers in Science and Technology—1967 Edition.*[1]

GROUPS OF TEACHERS

The science supervisor may find himself being asked by his administrator to plan and implement teachers' workshops, curriculum writing groups, textbook selection committees, and discussion groups. It is very often advantageous for a supervisor to take the time to assess the real need for these activities so that he can initiate group work for which teachers can see some necessity or value.

The science supervisor has the responsibility for quality control when helping teachers to plan activities for themselves or their students. Teachers, as a group, must be led by the supervisor to establish priorities for using time and energy to implement special activities. Teachers should not be asked to undertake a new instructional program, inservice courses, a formal evaluation program, and the planning of a science seminar simultaneously. The supervisor is in a position to look at the whole picture from a long-range point of view. Teachers who find themselves trying to do too many projects, some of which are of questionable value, are not likely to remain enthusiastic about program innovations.

After the priorities have been established, the supervisor has the additional task of establishing guidelines for the activities which have been selected. Any project must be shown to be educationally worthwhile, pedagogically sound, economically feasible, and of possible accomplishment with the available resources and staff members. The supervisor may have to convince any or all of the administrators, teachers, and students of the value of the project, and its precedence over other desirable activities.

[1] *Keys to Careers in Science and Technology—1967 Edition.* National Science Teachers Association, Washington, D.C. (Order from NEA Publications Sales, 1201 16th St., N.W., Washington, D.C. 20036. Stock No. 471-14524, $1. Payment must accompany orders of $2 or less.)

Much of the work with groups of teachers will be in the area of curriculum development. There are organizational chores in setting up committees, collecting materials, and arranging the meetings. When the work of the committee is finished, much time is involved in editing materials, printing and distributing them, and then encouraging appropriate experimental use and evaluation. With practice, these chores become easier, so that the supervisor can turn his attention to the more important roles of leadership for and evaluation of the work as it is being done.

As group work of any kind proceeds, it is important that the objectives originally formulated do not become lost in the mass of details. At the end of the project, someone must equate the results with the original purposes and make an evaluation. It is assumed that the objectives were first designed to fulfill some clearly recognized requirement and that the composition of the committee and its work was engineered into a manageable task.

For example, most districts have now abandoned the practice of trying to evolve a science education program which originates completely in the minds of the committee. Neither are groups of teachers being asked to sit down alone to develop a curriculum. A new course of study for a local district is much more likely to be an adaptation synthesized from one or more of the national curriculum projects or from commercially prepared materials. Teacher committees should work with a consultant knowledgeable in devising curriculum building techniques—a task for which most teachers have had little training or experience. The supervisor or a qualified person from outside the school system may fill this role on a short-term or intermittent basis. Some school districts are employing selected teachers and supervisors during the summer months. Such committees usually include persons from all levels of instruction in order to bring a diversity of talents and viewpoints to bear upon the work to be done. See also the chapter entitled "Tactics for Curriculum Change."

As the year-to-year curriculum revisions are made, a supervisor is faced with the continual educational needs of the teaching staff. Opportunities for additional education must be provided by the local district in a variety of ways. How many different opportunities are offered and what the scope of these programs should be will depend upon the competences and characteristics of the teachers. Inservice programs are now more likely to be of a developmental nature, rather than remedial.

The methods of instruction used in inservice programs should be worthy of imitation in the classroom. Teachers do not learn how to conduct lab-centered lessons by listening to a lecture. Inservice sessions may be conducted by the supervisor himself, a professor from a neighboring college, a talented teacher from the local or a nearby school system, or a publisher's representative. The supervisor, in any case, should assume a great deal of responsibility for the planning of the content and format of the sessions. He can then be assured that a balanced offering of different teaching techniques is used.

Group work with teachers may be necessary for a variety of reasons. In addition to the curriculum development and inservice programs, teachers may need meetings to share teaching ideas among themselves, to plan equipment purchases, to plan visitation or exchange programs with other districts, to hear visiting lecturers, to tour nearby educational facilities (nature park, museum, industry, learning-resource center), and to plan special science events for students, parents, and the community.

WITH OTHER STAFF MEMBERS

The supervisor will also find himself working periodically with a representative of the library staff. The newer science education programs require reference materials in larger quantities and greater scope than ever before. Many school libraries are receiving increased support from several sources so that present holdings can be more easily updated and enlarged.

However, many librarians do not feel qualified to make selections of reference materials for science. This is particularly true in the matter of journal and periodical acquisitions and in the field of science for the elementary grades. Help is needed in collecting books for the professional library used by staff members.

Librarians want to spend their money on materials of high quality that will be used. The supervisor can collect teacher requests and add his own selections to the list. The librarian can be of help to the supervisor in choosing references which are in the best format, printing, and binding. Together they can plan for the most satisfactory use of the money available and a sound long-range acquisition program.

Participation of schools in educational research projects is increasing. Supervisors and teachers are working together on research projects and grant-seeking proposals. School district budgets often include an item for research and development. The impetus for educational research may come from a higher education institution, the school board, the supervisor, or the teachers themselves. Working in ongoing research projects is a valuable experience for the professional growth of teachers and supervisors. This activity gives opportunities for teachers to learn about research design, searching the literature, reading and writing abstracts, and using the technological tools available to researchers. Doing scientific research (as many high school students are) is an excellent way to learn the nature of science and how scientists work. A supervisor who is doing some research will find that his teachers will be more willing to try it also.

Research activities will increase the work that science supervisors are already doing with guidance directors, general curriculum coordinators, testing officers, science department chairmen, and mathematics personnel. These people, including the science supervisor, make up a school services team which influences the philosophy and aspirations of a whole school. This team, in its work with the administrative staff, can literally make or break the reputation of the school.

When working with different groups of staff members, the supervisor will find himself in a role of double management. The objectives must be identified and fulfilled, and the people involved must be employed with efficiency and in harmony with each other. The supervisor may wish he had been a psychology major as he tries to keep the tasks narrow enough to manage but broad enough to be useful.

WITH STUDENTS

The science supervisor will be called upon to work with individual students or to plan programs for groups of students. Teachers should be encouraged to solicit the help of the supervisor in solving problems of certain students. If the invitation comes by some other route, the teacher should be notified promptly so that communication is open and smooth.

If a student or group of students is planning to work on a special project involving cooperation with an outside agency, such as an industrial firm, health associations, or a local scientist, the supervisor will be expected to act as a liaison person among the interested parties. This may involve the preplanning of schedule adjustments, contract negotiation, as well as the preparation of any publicity needed to give the community an understanding of the project and its value.

Science fairs or exhibits are a concern for many supervisors.

Educators, in increasing numbers, are coming to the realization that the traditional competitive science fair has some serious shortcomings and pitfalls. Supervisors who work in a district where a science fair each spring has become a school tradition may wish to work with teachers and students to re-examine the objectives of the fair to ascertain how much real value still exists in the program.

Some districts have abandoned the fair in favor of an event which affords the opportunity for individual students to report the scientific research which has been done as an integral part of course work or as a result of an individual interest. Good science fairs are a natural outgrowth of the school science program rather than being the reason for which the work was planned in the first place.

There are other types of special science activities which may reflect the spirit of science better than the traditional fair alone. Some schools are trying a plan whereby participating students meet in seminars, with or without an audience, to hear each other's reports and then ask questions. Others are using a junior academy of science approach which emphasizes the presentation of a paper rather than an exhibit. Subsequent publication of the proceedings provides a record of work done from year to year.

Supervisors should insist that when competitive types of science youth activities are planned their educational values should take precedence over their public relations value to sponsoring organizations. The quality of science fair projects can be expected to be in direct proportion as to the quality of the judging done from year to year. Judges should be chosen from the scientific community to assure that the evaluations will be based on and reflect the scientific merits of the projects. Good rules and regulations for conducting science fairs are available from the national science fair organizations. Supervisors should see that teachers transmit up-to-date information to their students about award programs and other activities such as the Ford-Future Scientists of America Awards (NSTA) and the International Youth Science Fortnight.

Students sometimes need advice in connection with individual work they are doing, which neither the teacher nor the supervisor is prepared to give. Again, outside help should be sought. Sometimes a disinterested, bored student can be stimulated by contact with a local scientist who will help him work on something of special interest to him. This becomes the student's science program. Supervisors are usually aware of valuable resource people in a variety of occupations who can provide for individual differences in this way.

Another area of interest for the supervisor is that of career guidance. He is in an advantageous position to identify and nurture the science-prone student who needs help in learning about the new occupations and professions arising in the field of science. With the help of the guidance counselor, he can portray to the student the science-oriented vocations which fit his particular capabilities and probable educational opportunities. Too often students are lost to the scientific fields because they think only the most intelligent and highly educated people can qualify for the work. Students are subjected to much misleading information about science.

Special lectures or seminars can also be planned for both students and teachers. Traveling exhibits sponsored by industrial firms, nonprofit educational institutes, and governmental agencies are also available to those who wish to enrich the science program for the entire student body or some segment of it. Preplanning and follow-up activities are necessary to make this kind of program a justified part of the total school instructional plan. The present trend is away from packaged traveling programs and toward flexible program segments which can be mixed and matched to fit the wishes of each individual school.

To implement an effective program for students, the supervisor must be well informed about and have rapport with local scientists and the institutions these scientists and other resource people represent.

PERSONNEL ACTIVITIES

A science education program will be no more effective than the combined efforts of the total teaching staff can make it. This idea will be in the back of the supervisor's mind as he engages in the recruitment of new teachers, the supervision of student teachers, the preparation of recommendations for teachers, and the assignment of the staff members to existing or new positions in the school.

As he travels about, attending conferences and visiting other programs, the supervisor will be alert in his contacts with people to identify individuals who are looking for new positions which offer a chance to grow professionally. Sometimes young teachers do not sense this growth need in themselves, except as a vague frustration about their present situation. Such teachers may need some gentle prodding toward positive thinking about the chances they have for advancement in the profession. With the advance of educational technology, many new directions for this growth will emerge.

The supervisor will also travel to observe teachers whose applications for positions have been received by the district. The written credentials of a prospective teacher are no substitute for knowing firsthand how the teacher relates to students and other teachers.

The science education staff can also be strengthened internally. The early identification of the most promising student teachers results in an opportunity to give preservice grooming to those who may become applicants for positions. By involving a student teacher in performing real tasks, instead of planned hypothetical exercises, in the school, it is possible to make a better evaluation of his potential, while at the same time giving him a vested interest.

The supervisor who is able to delegate responsibilities to others in an ethical, mutually satisfying way can also groom members of the present staff for reassignment to different positions where their particular talents can be most effectively used. When teachers are sparked by an enthusiastic supervisor, they will do many things which lighten his work load and at the same time help them to grow professionally. In a situation like this everybody wins.

A less-satisfying aspect of personnel work is the occasional necessity to help those teachers who are not making a satisfactory contribution to the science program to find a more appropriate niche somewhere else on the staff or to arrange for the termination of employment. This is a cooperative venture which involves the teacher, the supervisor, and the administrator of the school. No supervisor should attempt it alone.

Some teachers need and want experiences outside the framework of the school program. By judicious recommendations of teachers for fellowships, special courses, retraining in a particular skill, or participation in research studies, it is possible to upgrade the science teaching staff. Useful and rewarding ways for using these teachers should be preplanned so that they can see a genuine value in completing this special preparation. If this is not done they are likely to go elsewhere so that the new training can be used profitably.

The contemplation of so many tasks to be done with and for teachers can be a dazing experience. These ideas have been presented in the hope that each reader will gain insight into the many possible avenues of endeavor. No single school system can expect one supervisor to perform them all continually. Some may not be appropriate in a given school. Those most applicable and workable can be instituted immediately. Others may become more valuable later. As the supervisor gains skill in doing two or three things at a time (yes, really), he will feel more confident about enlarging the scope of his services.

An enthusiastic supervisor is not likely to want to operate in the same way each year. Abandoning ineffective work plans and shouldering new ones from time to time will help to keep the job of supervision exciting and satisfying. This practice also sets a good example to teachers. The work that the supervisor does with teachers will keep him close to the object of all his creative thinking—the students to whom he is responsible.

Working with Administrators

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THE SCIENCE supervisor, coordinator, or director of science education provides a liaison between the science teachers and the administrative leaders in his school, district, county, or other organization. This liaison is essential to teachers, for they depend on him to inform the members of the administrative staff on the NATURE and IMPLICATIONS of the SCIENTIFIC ENTERPRISE. This liaison is essential to the superintendent, for he needs one person he can depend upon to be the knowledgeable spokesman for the science phase of the total educational program. The science supervisor also represents science education in the school program to the school board, the parents, the community, and to other agencies. The special relationship between the science supervisor and the administrators of a school or district is the chief concern of this chapter.

A science supervisor sells one commodity only—confidence. To his superintendent he must sell confidence in his knowledge of the total scientific enterprise, both within his school or district and within the nation. The confidence or respect that a science supervisor can earn from his superintendent comes from his proven professional judgment based on:

1. Current knowledge about content in the sciences (chemistry, physics, biology, and earth and space science)
2. Current knowledge about curricular materials in science and methods in science teaching
3. Current knowledge about children and how they learn
4. Leadership ability based on improved management techniques

The science supervisor plays a unique role in administration, for this professional role requires a full-time commitment involving continuous study and extensive reading. Only by being current in the knowledge required can he serve two of the major functions of his position, the design and implementation of science programs and the provision of services and materials to facilitate the work of the science teachers.

The relationship between a competent science supervisor and his superintendent must be based on frequent, scheduled contacts, because the demands of science education are changing radically from the modest position science occupied a few years ago. As new, activity-oriented programs are added to or replace the outmoded, textbook-oriented science classes, increased financial support is needed on every front to provide:

1. Larger and better equipped rooms for science from first through twelfth grade
2. More equipment and supplies per pupil per year
3. More science scheduled for more students
4. Increased services in a laboratory program (e.g., laboratory technician, research projects, reduced class loads to allow better laboratory supervision)

These demands for financial support must compete with other programs in the total system. Careful judgment on the part of the supervisor is needed to see where and when the demands of a modern science program should be emphasized with his superintendent. At certain critical times in the administration of a dynamic district the supervisor must be prepared to present a carefully constructed program with aggressive salesmanship. Some of these critical phases include:

1. Long-range capital improvement programs
2. Annual budgeting for current operation of all programs
3. Planning facilities in a new building or renovations of older buildings

The science supervisor may be looked upon by his superintendent as the agent for "quality control" in the district. This description of his role would be deceptively easy to fill if the accepted quality were quite low—the "control" would present no problem. But when the quality demanded is high, then the pressures for bringing all schools up to the desired level work positively for the supervisor and his total enterprise. If he can move one school ahead in one aspect of the program, either in the physical plant or curriculum phase, then other schools will be critical of their own position. If the new position represents the quality all are striving for, then teachers and principals join the demand for a similar science program.

The major obstacle to the kind of professional relationship between the supervisor and the superintendent described above is the lack of opportunity to affect the key people. It, therefore, falls upon the supervisor to establish regular communications with all key people in administration in order that he be informed of plans and anticipated changes and that he, in turn, may confer and advise on those changes affecting science. A supervisor can easily get so involved in the teacher-committee and classroom activities that this important phase, exchange of vital information with key administrators, can be slighted. (Or, conversely, he could become top-heavy and lose the vital teacher-service phase of the position.)

EXPECTED FROM THE SUPERINTENDENT

No relationship can be adequately described from one direction. What can the science supervisor reasonably expect from his superintendent?

First, he needs the opportunity to present the design and implementation of the continuing science program for periodic review. Such a review should include long- and short-range goals, cost analysis, personnel, facilities, and inservice implications. The superintendent should provide the broad base of planning for the school or district with which the science phase must be coherent.

The superintendent should keep the supervisors informed of trends, discussions, and changes in total planning (fiscal, buildings, personnel, etc.) which are essential to the supervisory role. He should, in turn, ask for recommendations or advice on matters within the professional realm of a science supervisor in time for the supervisor to give a response based on available information rather than guesses. Examples of such "advice" questions might be:

1. What would be the effect on the science program if we changed to modular scheduling in the senior high school? How would the science facilities of a new school be planned under modular scheduling?
2. What kind of instructional organization at the elementary

level would produce the best science program? How would this organization affect the child, the teacher, the curriculum?
3. Should science be taught as a major subject to all students in grades 7-9? Why?

In his contacts with other administrators the superintendent must be supportive of the science supervisor. When the supervisor is in a "service" or "staff" position, where his advice may be accepted or rejected by principals, this kind of support from the superintendent is most essential. Administrators who lack the professional training to judge the supervisor's recommendations can defeat the movement of the science program if independent decisions are made.

The superintendent can provide the balanced fiscal policy within which a healthy and dynamic science program can function. For it is the long-term, regular financial support that builds the confidence of staff which, in turn, makes the essential difference in vigorous science education.

A key concept behind the relationship a supervisor establishes with the principals in his district is the fact that each one needs the other to do his job well. A principal cannot have the professional background in each discipline which the supervisor is expected to maintain; therefore, the principal must call upon the supervisor of science for advice on the science program based on the supervisor's broad background of information and experiences. The supervisor can produce no improvement or change without the support of the principal, who is traditionally "the educational leader of his building." Together they can plan for and implement the needed schedule, facilities, equipment, teacher assignment, inservice, etc. The supervisor brings the broader picture to the building and can often suggest resources not realized within the school. Rivalry has no place in the relationship between a supervisor and a building principal, for they have a common objective, the design and sustaining of a good science education program.

It is one role of a principal to bring the picture of the educational program in his building to the public through various publications, meetings, PTA programs, etc. The supervisor should encourage him to present the science program to his public; he should help the principal to interpret the needs and goals of science to the staff and community. The science supervisor can experience his greatest satisfaction when public recognition for the quality of the science program is bestowed upon the principal, his staff, and his pupils.

Involving the Community

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SERVING as a liaison between the schools and the resources of a community can be one of the more exacting and important tasks performed by the science supervisor. In this role, the science supervisor must bring together the segments of the community which have the most to offer to the school program in both help and support.

THE INITIAL CONTACT

This task requires more careful planning and management than perhaps any other single area in which the science supervisor functions. The supervisor must make the initial contact with the community. This first contact is very important from several points of view. First, while industry and private citizens are very eager to help, they are also very unsure of just what role they can play. A presentation from the schools which leaves them puzzled as to their exact role, frequently results in a confused retreat from the field of education. In order to avoid this first pitfall, it is important that the supervisor present a clearly formulated plan to these people with whom contact is being established. Within this plan must appear: WHAT, HOW, WHEN.

Creation of such a plan can take shape in a number of ways. A very successful method is the use of a committee composed of community people and several teachers on the science staff. Most people who volunteer to serve as community resources tend to be very idealistic in their attitudes toward education. Their ideas are very valuable, though at times soaring beyond the limits of practicality. These people will be able to define the kind and amount of help they are able to give to your program.

A second method used by many schools is the creation of a file of community resource persons. This file is usually compiled by asking members of the community to complete applications describing their particular specialty. These applications are then organized into a central file from which a teacher can choose the resource he feels will best suit his program.

Of the two alternatives, probably the resource committee will eventually prove to be the more effective. Members of this committee can provide a more direct contact with other individuals and industries who could and want to be a help in the program. Teachers on this same committee will be able to describe exactly the school needs and what they feel is important to them.

PROPER BALANCE

In the role of a catalyst, the science supervisor must avoid being the program. The best catalysts are never seen or heard unless they are in the best interests of the program. A middle ground must be established between being a constant bother to the people with whom the supervisor is working and giving them the impression that they are being ignored. Often the community resource people are made to feel that they are the most important part of the science program, then suddenly they find themselves being taken for granted. These two excesses are about equal in gravity.

Avoiding this major pitfall is not easy, but it is not an insurmountable problem. Providing a means of objective evaluation will give the community resource people a clear idea of what help they are providing, how the children are receiving it, and how their program can be improved. At the same time they are getting some recognition each time they participate in the school's program.

A happy balance of use is also a task at which the science supervisor must work long and hard. Like all problems in education, this area is a multiheaded monster. The biggest double-barreled problem is overuse or neglect. By acknowledging that some community programs are going to be more useful than others, it is possible to get maximum service from everyone. At the outset of most programs, community resource people are inclined to overestimate just how much work they are capable of doing. The result is that resource people frequently overextend themselves and are uncertain of how to approach the supervisor about reducing their work load. In setting up the program, the supervisor should allow everyone frequent opportunity to re-evaluate his commitment.

CONTINUING CONTACT

Contacts should not be made and then allowed to wither from non-use. In many instances, the school goes to the community resource for the first contact. Once this line of communication is open, it will generally continue to be self-renewing. However, if the first contact produces results that are not satisfactory, the supervisor must provide a means by which the resource presentation is strengthened or even changed. Unsatisfactory results may be the result of poor class preparation. Unhappily, some very talented people cannot present a good, understandable program on the K-12 level, and they may either have to be dropped from the program or have their orientation altered.

Museums, arboretums, zoos, nature centers, etc., present a different set of responsibilities for the science supervisor. These institutions frequently maintain their own staff of teachers under an education director. They have their own education program and usually serve a number of school districts.

These factors of staff and a prepared program reduce the flexibility available to any one school or school system. However, avenues of communication are generally easier than those for dealing with individuals, and the supervisor's job shifts from shaping community resources to modifying the school program to fit the presentations at established private educational institutions.

In many cases, the demand on private institutions to provide highly specialized instructions can be great. A large museum in the City of Philadelphia handles 60,000 schoolchildren a year with a staff of fewer than 10. This museum has been approached about the possibility of handling an additional 20,000 children a year. From an example such as this, it is obvious that school systems using this facility must adjust their program to the museum's.

The science supervisor must be familiar with the program and key his teachers' work to what they will do and see at the museum. At the same time, the supervisor should have a line of communication to the institution that will allow him to participate in the evaluation of the institution's educational program.

This participation will enable him to see that in some ways the children from his district or school are presented with a program that is of use to them in their regular school work.

In summary, the science supervisor must use certain basic tools as he works with the resources that his community has to offer to his science program.

The levels of use will differ, depending on the community and the extent to which the school makes use of the resources available. But in all cases, a good program of evaluation is a must. The evaluation can be effective only if a clear program of use of community resources has been developed. A good program must also have strong elements of flexibility and change.

Serving as a liaison between schools and the scientific resources of a community can be most rewarding and satisfying. It also requires the greatest amount of effort and skill in the fine art of "people management."

Providing the Teaching Environment

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ONE OF the major responsibilities of a classroom teacher is to provide an environment that is conducive to the best kind of learning. Likewise, it is the responsibility of the science supervisor to provide an environment in which teachers can adequately carry out their roles as professional persons working with boys and girls. Therefore, with the environment of learning and the environment of teaching in mind, the science supervisor helps teachers with the following:

1. Selecting, planning, and utilizing new facilities
2. Planning and implementing new curricula
3. Ordering and using new supplies and equipment effectively

FACILITIES

If facilities are to serve students and their teachers adequately, teachers themselves must be involved in selecting, planning, and utilizing them. Before existing facilities become inadequate is the time to start planning for new or remodeled ones. A new facility might be a science supply center, a science wing of a new high school, a remodeling of an existing science wing, or a new elementary school.

When facilities are to be planned, the supervisor should take part in or advise committees of teachers and curriculum personnel who are planning the change. He also needs to provide the committees with competent resource people who can advise and recommend in their specialized fields. The combination of the committee's experience and the recommendations of the resource people can be put together to form a set of recommendations that can be translated into an effective environment for learning science.

Even in such simple recommendations as the following, for example, one sees clearly how the teachers' specifications for the elements of the learning environment are combined with the recommendations of the architect or other resource person. These examples come from a committee working on the planning of a new science wing:

1. Movable laboratory facilities with quick disconnections
   This type of facility is extremely important in the ever-changing modern science curriculum. In a matter of minutes a laboratory table with electric, gas, and water connections can be disconnected and reconnected elsewhere in the classroom. Spaced floor connections are covered with waterproof covers when not in use.
2. Provisions for individualized instruction
   The plans include rooms that can be divided into small rooms so that team teaching, cooperative teaching, and individualized instruction can be properly used.
3. Combination storage room and preparation laboratory
   The increased amount of laboratory work in modern programs in science requires readily accessible space for storage. Supply and preparation rooms built between two classrooms can be utilized by both classrooms.
4. Adjustable shelving
   Shelving is adjustable to fit the varying needs of teachers and curriculum.

The science supervisor should not only see to it that he himself and teachers are included in the planning of facilities, but he must do what he can to make it possible for teachers to serve on committees, such as a facilities committee, without unduly adding to their other duties. Ideally, such committees should meet during school hours. This involves convincing the administration that substitutes should be provided for the teachers. Some school districts are solving the problem by paying their teachers to work on these special projects on Saturdays and during the summer months.

CURRICULUM INNOVATION

Other chapters in this book have discussed the planning and implementing of new curricula. Here we are concerned with the function of the supervisor in providing an atmosphere conducive to curriculum innovation. He makes time, funds, and leadership available to teachers and other curriculum personnel who are interested in changing the curriculum. But more than that, he creates an atmosphere of acceptance for the new program.

After a course of study has evolved from a local committee or when a national program has been reviewed and accepted, then it is time to advertise the availability of this material.

One way to get the new curriculum into the hands of the teacher is by offering inservice classes. Some suggestions on how to make a class successful are:

1. Use a local teacher, adequately trained as the instructor of the class.
2. Use college professors as advisors in local district curriculum change, so that they too become familiar with the new approaches and, in turn, can offer more effective college classes to prospective teachers.
3. Spread the required number of classes over a period of the school year so that material learned in the class can be tried and evaluated in the classroom and discussed with the instructor.
4. Supply adequate "hardware" to the inservice classes so that the teachers can take the materials back into their classrooms and truly evaluate the lesson when they use it with their own students.
5. Try offering the inservice classes at various times; i.e., Saturday mornings, immediately after school, evenings, or in a series of selected afternoons when students are excused early for the days involved.

The supervisor's role of creating a psychological atmosphere conducive to change is well illustrated by the following case study.[1]

Who Can Change a Curriculum?—A Case Study

It happened without warning. On a cloudy Monday morning, the supervisor called in Mr. Lawrence, teacher of ninth grade science, to say that some important changes in the curriculum were to be made. Said the supervisor,

"The university and the regional curriculum study group have developed a brand new course. You will be supplied with a new text, supplementary materials, tests, lesson plans, filmstrips. It's a new package. All you have to do is teach it."

[1] Reprinted with permission from *Teacher's Letter*, Volume 16, No. 9, January 1, 1967. Croft Educational Services, New London, Connecticut.

Mr. Lawrence was appalled. He had been a successful teacher for nine years; he had developed a carefully planned sequence over the years; and pupil achievement scores showed that he was on the right track. And now—this!

Should Mr. Lawrence: (1) Explain that he is following an acceptable course of study and plan of instruction—and refuse to have anything to do with the new course? (2) Accept the "package" as it was being offered to him—and do the best he can to follow it? (3) Accept the package in principle, but ignore its content wherever he sees fit?

Alternative action: Clearly, Mr. Lawrence was faced with a professional problem of the highest order. After considerable thought and consultation with colleagues, he took the following steps:

With the assistance of several other science teachers, Mr. Lawrence developed a list of questions and presented them to the supervisor. Among others, these included: What are the objectives of the new science course? What are the objectives of the science curriculum in our school? How well do the objectives of the course coincide with the objectives which have guided our science curriculum? Other questions concerned themselves with the flexibility of the new course; the validity of content and accompanying tests; and the purported advantages of the new course over the old.

Mr. Lawrence further suggested to the supervisor that a committee of teachers seek the answers to these questions, review current curricular materials. He presented a statement signed by himself and his colleagues indicating their willingness to serve on the committee.

The proposal was accepted. During the deliberations of the committee, one theme kept recurring: "The way to obtain evidence about the merits of the new course is to experiment with it." The debate forced all the members of the committee to become thoroughly familiar with the new course, to re-examine the old program, and to consider other alternatives.

The administration agreed to withdraw the mandate that all teachers were to use the new materials during the coming year. Instead, all teachers were urged to experiment with the new material. A healthy competition among the teachers ensued, as they turned a potential professional crisis into a stimulant for a first-rate educational enterprise.

Principles involved: The course of action which Mr. Lawrence followed was a professional's response to the problem. Outright rejection of the new course may have forced the supervisor to reconsider, but the resolution of the conflict would have been postponed, if not made impossible, by the personal antagonism engendered by such a confrontation. More important, the students in Mr. Lawrence's classes might have lost the opportunity to work with fresh and imaginative materials.

Total acceptance of the packaged new course without any effort to change the means by which it was imposed would have been an abdication of professional responsibility.

Token acceptance of the imposed course would have been even worse than outright rejection or begrudged acceptance. The problem of curriculum innovation by imposition also would have remained unsolved. Token acceptance leads to an educational game where everybody loses—the students are cheated, the teacher is entangled in deception, and the supervisor is frustrated.

(Based on research of Robert B. Ribble, Pennsylvania State University)

SUPPLIES AND EQUIPMENT

Selecting, ordering, and distributing supplies and equipment becomes increasingly difficult with the large variety of courses being offered today. Some districts are finding that a science center is an effective distribution center and that in other ways it can be organized to provide for effective use of supplies and equipment. Such centers are staffed with trained personnel who understand the use and care of the equipment. From such a center, expensive materials necessary for some courses can be distributed for multiple use, which may mean that equipment which could not be afforded for every school can be available. The center also saves money by serving as a central repair station for the district. A service repairman can make one stop at the center more easily than visiting several schools. Among the cities having science centers are Los Angeles, California; Pittsburgh, Pennsylvania; and DeKalb, Illinois. Districts not having science centers must rely on department heads, principals, and science coordinators to see that building equipment receives maximum use.

The actual ordering of supplies varies from district to district. In some districts each school orders individually from suppliers. In larger systems the supply orders are coordinated into one list to take advantage of quantity discounts. Regardless of the procedure, the foremost criterion is the immediate availability of supplies. Instructional materials must be in the classroom when the teacher and students need them. Needless to say, this is a major responsibility of the supervisor.

In summary: The role of the science supervisor is to free teachers to teach by providing them with materials, opportunities for professional growth, and a challenging environment. The supervisor is a teacher of teachers.

Identifying Trends and Their Implications

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EVER SINCE education came into being as a means of preparing the next generation to live in an already existing adult society, it has tended to be conservative in its approach. It has followed changing trends in society rather than acted as an instrument of change. Because of its conservative attitude, education has changed slowly. A rectangular classroom sheltering the lecture-recitation method of teaching was in use in Sumer in 2500 BC and can be found today in many countries of the world. The first major innovation in education, the textbook, occurred less than six hundred years ago, and the next major innovation, the use of technological teaching aids, occurred during the present century.

In spite of the evident lag in educational innovation, there are indications that several factors are working together to produce a change, the rate and extent of which has been unmatched in previous generations.

FACTORS EFFECTING CHANGE

The changes that are beginning to appear on the educational horizon are indications of the major forces that have affected our society during the present century, during which it moved from a predominantly agricultural economy into an era in which technology plays a dominant role. We first became aware of these forces in the 1930's and, in 1945, the advent of atomic energy dramatized the extent to which our technology had progressed. However, society was not really aware of the magnitude of these forces until the first space satellites were launched in 1957 and

1958. This technological breakthrough directed the attention of the public to technological progress, and the fact that the Russians orbited the first satellite caused a great change in the attitude of the general public toward education. This was a major factor in effecting change within our educational system.

Most adults had been more concerned with the rising costs of living than they were with education. They were largely unaware of efforts being made to improve the curriculum. When they realized that the Soviet Union, a country that they had considered handicapped by its political and educational systems, had suddenly "stolen the march" on the United States, which they had assumed was without peer, they altered their viewpoints. However, the change in public attitude, regardless of the validity of the cause or of the tactics used by the critics, had the beneficial effect of focusing the attention of the public on the school system and creating an atmosphere favorable to change.

A second factor in speeding up the educational revolution was the expansion of mass media, for example, television. The most isolated communities were suddenly able to see and hear what was occurring in the rest of the country. First-grade children suddenly began to come to school with quite sophisticated knowledge of new developments in science and technology. Television began to bring into the schoolroom ideas that some classroom teachers were afraid of or were incapable of introducing or developing.

Another factor in speeding up educational change, at least insofar as science was concerned, was the result of college and university professors' descending from their ivory towers into the educational arena when they started working on the "alphabet" courses for secondary schools.[1] This produced a two-way benefit. Teachers suddenly learned how inaccurate and inconsequential were many of the cherished bits of information they had considered essential in teaching science, and professors learned that there was a lot more to teaching at the secondary-school level than they had imagined. The critical study of the elementary- and secondary-school science curricula also revealed faults and weaknesses in the college curricula. As a result, what began as the reform of a few secondary-school science courses has spread all the way from the kindergarten to the graduate school.

[1] Nickname for the quickly familiar initials of the Biological Sciences Curriculum Study (BSCS), The Chemical Bond Approach (CBA), the Physical Science Study Committee (PSSC), and others.

A fourth factor in accelerating educational change was the large amount of funds that suddenly became available for educational research and development. Private foundations, as well as the federal government through the National Science Foundation and the U.S. Office of Education, suddenly released millions of dollars to encourage imaginative change. Almost overnight, available funds increased a hundredfold, and the increasing availability of funds has not yet leveled off. Further, this availability of funds has stimulated undiminished amounts of experimentation in education and encouraged innovations.

Still another factor in improving the educational enterprise is that it is now becoming big business and, as such, is beginning to adopt some of the practices of industry. One of the more significant of these practices is what is known as the systems approach to planning and organization. This trend is only in its infancy; much greater emphasis can be expected in this area in the next few years.

For many years, industry has been aware of the need for the systems approach in organizing and conducting the many aspects of the business enterprise. As systems analysis is applied to education, it becomes apparent that many modifications can be introduced that will accelerate change and improve the quality of instruction. This will be discussed later in this chapter.

Specialists in behavioral psychology have become increasingly interested in children as learners—a sixth factor in producing rapid change. They are finding that learning problems are extremely complex and that there are no simple, easy answers to many of the questions they are asked. Their efforts have already paid ample dividends. Their insistence on expressing objectives in behavioral terms has made teachers re-examine what they really wish to accomplish in the courses they are teaching. As increased numbers of behavioral psychologists work with teachers, there will no doubt be great increases in the efficiency of instruction and improvement in student attitudes.

Finally, the most recent factor introduced into the educational enterprise is the emergence of several industrial "giants" concerned with producing educational materials. These industries will introduce new types of educational hardware into the classroom. The result may be major changes in educational techniques and the placing of greater emphasis on systems analysis. Just as the college and university professors exerted a major influence on curriculum change in the decade 1955-65, so industry may be expected to influence curriculum change and encourage new emphasis on techniques of learning in the next decade or more. One of the important changes will be greater reliance on self-instruction—placing much emphasis on the role of the individual in the learning process.

At present, the necessary hardware is available or is being developed rapidly. There is little doubt that different industries will compete for their share of the sales potential for educational hardware in the future. The missing ingredient, so essential to the educational process, is the software. This is the term used by industry to designate teaching materials and instructional programs that are prepared for use with the teaching devices. It is quite obvious that the quality of these materials is even more essential to an educational program than are the machines themselves. The quality of the software that will be available for use is less obvious, but it is the responsibility of the science supervisor to study new equipment and new ideas critically to avoid poor-quality materials being introduced into the schools. He must also see that new and innovative materials are not neglected because they are different or have not been examined.

THE PRESENT STATUS OF SCIENCE EDUCATION

Before discussing trends and change, it might be well to examine the present status of science education, which ranges from extremely traditional courses to experimental courses that are completely laboratory oriented and do not use a textbook or have a fixed course of study. The majority of courses may be classified as either traditional, textbook-centered courses, using the laboratory or demonstrations to verify known principles or laws, or as laboratory-centered courses, typified by the new "alphabet" courses and others of a similar nature.

Present efforts at curriculum reform, as typified by the "alphabet" courses, have placed greater emphasis on understanding scientific concepts. An attempt has been made to eliminate textbook errors, and to introduce new content rather than ask students to memorize a mass of scientific facts and to learn the mechanical solution of selected problems. The new courses are more student-centered and place greater emphasis on the processes of science. They have stressed experimental laboratory work—something that was largely neglected in the more traditional courses. The individuals who assisted in building these courses, which were pretested in classroom situations, found that it was necessary to develop many teaching aids and items of laboratory equipment in order to insure an effective learning environment.

The introduction of these courses has produced major changes in both course content and teaching techniques in many classrooms. Also, many changes in commercial textbooks, as well as in courses of study that have been developed at the local level, may be traced to the influence of the course materials. Most of the new materials have been classroom tested before being produced.

THE TENDENCY TOWARD EDUCATIONAL OBSOLESCENCE

Education is a process that can never be completed. The more rapid the changes in education and in society, the more rapid is the rate at which obsolesence occurs or inadequacies become apparent. Many of the new course materials—even some of those still on the drawing boards and not yet released—are already inadequate in the face of the recognized need for a continuing K-12 program woven together by the major conceptual schemes and processes of science.[2]

The tendency toward obsolescence or inadequacy can be attributed to five major weaknesses in planning and developing the materials:

1. Most of the materials are oriented to a one-grade, one-discipline approach. Little, if any, attempt has been made in the senior high school courses to develop an integration of the various subject fields. The artificial framework of single subjects was preserved, often resulting in duplication of materials using a vocabulary that obscured the fact that the duplication existed. A good example of this is the failure to use the same constant in chemistry and physics when dealing with the same phenomenon.
2. There is a lack of articulation among the new courses. Most of them were developed independently of each other, resulting in gaps and repetitions from one course to the next. Some attempts are now being made to develop continuing programs, from K-12 and beyond, but most of these lack the amount of

[2] *Theory Into Action in Science Curriculum Development* (National Science Teachers Association, Washington, D.C., 1964) is one presentation of this type of approach, which is also followed by some commercial publishers and some curriculum groups.

support given to projects dealing with the more traditional single-subject courses.

3. Most of the courses have not given adequate attention to the statement and evaluation of the educational goals of the courses of study. Often, the goals have been unstated or have been expressed in general terms that do not provide an adequate basis for evaluation. In one case, the individuals developing the program stated that there was little attempt to coordinate the course materials to work toward the achievement of the stated goals. Another project made no attempt to state program objectives. In most of the projects the evaluation instruments did not determine the extent of achievement of the stated goals.
4. Most, if not all of the courses present science as a "one-sided" subject, avoiding the introduction of technology along with "pure" science. In some of the courses this is considered a virtue rather than a lack in the development of the course. As a result, the student is left with the impression that "pure" science is a study apart from, and superior to, technology. The actual condition is that the two are inseparable.
5. The courses that have been developed are used primarily by college-bound students in middle- and upper-middle-class communities. Part of the reason for this is that the courses were developed in cooperation with university professors and the more outstanding science teachers, the better known of whom have gravitated to the suburban and private schools in the more affluent districts surrounding industrially developed areas. This has resulted largely in the neglect of average and below-average students. However, there are several encouraging exceptions to this trend, and it is hoped that more courses designed for average students will become available.

THE SYSTEMS APPROACH

One of the more encouraging trends in science education is the attempt in some districts to develop a science program using the systems approach; that is, considering the entire curriculum in other areas as well as science, and in all grade levels, in developing a program. Another aspect of the systems approach is the opening of channels of communication, both upwards and downwards. Most school systems have developed relatively efficient methods of communication down the educational ladder—from school board to superintendent to principal to teacher to pupil.

However, the reverse lines of communication are more closed. Pupils were not encouraged to make suggestions to teachers, teachers to principals, and so on up the line. Fortunately, there is a tendency to develop more open communication lines in this direction.

Another important aspect of the systems approach is the attention given to developing an educational atmosphere which emphasizes learning, rather than teaching. In the traditional school program the teacher plans for and teaches the average pupil, while the above-average pupil is allowed to "coast along," or, even worse, is held back, and while the slow student is prodded in an effort to make him keep up with his more academically fortunate companions. Grades are often assigned "on the curve," and a "cut-off point" is established beyond which promotion is denied. If the "cut-off point" is not reached, the student must repeat a full semester or even a year of a course. As far as the individual student is concerned, a more vicious educational technique could hardly be devised.

It is a relatively common practice to blame student failures either on the teacher's lack of ability or the pupil's ineptness, depending upon who is assigning the blame. Because courses are organized on a fixed-time basis, it is not possible for rapid learners to progress faster than the average student, and the slow learner soon finds himself hopelessly lost in his attempt to "keep up with the class."

IMPLICATIONS FOR CONTENT AND TEACHING

If present trends become more pronounced, there will be major changes in curriculum and teaching practices in the next decade or more. The tendency will be toward more individualized instruction, both in the selection of the content and in the pacing of the learning rate, with the teacher playing a far different role. Some of the changes that may be anticipated are summarized in Table I.

THE CHANGING ROLE OF THE TEACHER

Teachers will face many changes in their assigned duties and responsibilities. As greater emphasis is placed on learning, which is an individual process, there will be greater need for encouraging students to work "on their own" and a corresponding decrease in emphasis on group study. At the same time, the teacher

TABLE I. Implications for content and teaching

EXTENSION OF EMERGING TRENDS	PRESENT PRACTICES
Emphasis on learning as an individual process:	*Emphasis on teaching as a group process:*
provision for individual differences	tendency toward standarization
motivation from interest	motivation to "get a grade"
teacher to become director of activities	teacher as the authority
curriculum designed for the pupil	coursework decreed
student-planned laboratory experiences	"cookbook" laboratory exercises
Comprehensive curriculum plans:	*Curriculum on a grade-by-grade basis:*
integrated content	subject-matter orientation
wide variety of learing aids and resource materials	textbook-centered courses
understanding of mathematics	mastery of computational skills and mechanical manipulations
teacher with time and freedom to teach	teacher with many nonteaching duties
flexible learning schedules (time, content, sequencing)	rigid schedules
student failure: fault of program	student failure: fault of teacher or student
self-pacing: promotion when competence is attained	annual promotion by grade
feedback from students and teachers	little or no feedback
cooperative planning by community groups	outside suggestions discouraged by administration

must be able to provide more individual assistance to students who need help in learning. Some of the anticipated changes in teacher responsibilities are shown in Table II.

IMPLICATIONS FOR TEACHERS

In the more innovative districts, where perceptive and informed leadership prevails, teachers are now being freed from many of the routine duties which have occupied much of their time in the past. If present trends continue, the role of the teacher will be radically changed, involving different duties and

TABLE II. The changing role of the teacher

WHAT THE TEACHER WILL NOT DO:

Machines will:

take and report attendance
make out report cards
grade examinations
conduct routine drill work
teach specific knowledge
teach some types of laboratory exercises
present group lectures and demonstrations (with some exceptions)

Other nonprofessional personnel will:

assist with clerical and secretarial work
patrol corridors and lunch rooms
load buses

WHAT THE TEACHER WILL DO:

With students:

Carefully prepare lectures and demonstrations for large numbers of students or closed circuit TV
Work intensively with small discussion groups
Guide students in (1) experimentation, (2) retrieval of information, (3) hypothesizing and designing investigations, (4) gathering, collating, and interpreting data
Assist students when they ask for help
Outline and organize student learning sequences
Evaluate student progress and diagnose difficulties

With other professionals and individuals:

Design new course materials
Work with teacher teams in planning and revising curriculum
Develop evaluating instruments.
Experiment with new ideas and practices
Continually read and study to obtain new information and ideas
Exchange new ideas and knowledge with co-workers

responsibilities from those that are presently required. Computers and office machines are capable of taking over many of the duties presently assigned to teachers. There is no possible justification for requiring a professionally prepared individual to perform such tasks as reporting attendance and balancing attendance registers, making out report cards, and grading objective tests.

With modern technology, it is possible to program materials to handle routine drill work and teach specific bits of knowledge, and to direct the students in performing routine laboratory exercises more efficiently and in a more interesting manner than the way most teachers now perform these tasks. Also, there is no justification for using the teacher's time to show a film or TV program to several small classes at different times. Lectures can be better prepared and given in a more interesting fashion if the more talented teachers are freed from other duties and given the time to prepare good presentations for large groups, using closed-circuit TV or other mass media.

IMPLICATIONS FOR FACILITIES AND EQUIPMENT

These changes in educational practices will require equally drastic changes in the school environment. One of the major handicaps to present change is that the curriculum is often dictated by the school facilities, rather than having school facilities and equipment designed to provide an optimum learning environment. It is possible that the classroom, as we know it, will soon disappear. In its place there may be large meeting rooms with comfortable chairs, where speakers can talk to large groups, films can be shown, and closed-circuit TV facilities will be available. The laboratory will be the center of the science program, but will be more individualized. No longer will 30 students perform the same ritual experiment at the same time; rather, individuals and small groups will be working on specific investigations suited to their immediate learning needs.

The traditionally neglected library will be expanded into an instructional materials center. A student can go there and find almost immediate access to films, filmstrips, tapes, records, and, most important, books and periodicals related to any topic with which he is immediately concerned. The equipment will be there, and available—something that is often not true in present school systems. Schools will have teaching machines and remote computer consoles, so that the student can obtain help with single problems or complete subjects, depending upon his immediate need. It is even possible that remote units may be placed in the home, particularly when a student is unable to attend regular school sessions.

If all this sounds a bit idealistic and "up in the clouds," the reader should be reminded that the first satellite was launched less than a decade ago, and that more money is now being spent in education *each year* than has been spent on the space program during an entire decade.

IMPLICATIONS FOR SCIENCE SUPERVISORS

What are the implications for the science supervisor? How can he assist the teachers in his responsibility, to prepare for these changes? This is the challenge that we will all face in the years ahead. In meeting these challenges, the supervisor should consider the validity of the following assumptions:

> Inservice education will become continuing education, and teachers must be provided with the necessary time and materials for keeping up to date with the rapid changes that lie ahead.
>
> These changes will be cooperative ventures. Teachers must be led, rather than pushed into them. The entire school system, even the entire community, must be involved in the evolution.
>
> The role of the supervisor will change from the present role of administration, bookkeeping, and paper work, to one of leadership that will challenge all the knowledge and initiative that he has.
>
> There will be an increasing need to adjust state and national projects to fill local needs, and conversely, the need to encourage local programs to broaden their interests and adapt or adopt new ideas.
>
> Leadership will be rewarded by advancement and promotion involving premium pay for outstanding effort and ability, rather than promotion by a change of duties.
>
> There will always be room at the top for educators with imaginative and innovative ideas, and there will be more adequate funds for promoting imaginative experimentation and change.

In adjusting his activities to fill his changing role, the supervisor will face new obligations and responsibilities, together with a need for a continuing revision of some of his existing duties. Increasingly, he will be a link between the public schools and the universities. He will be expected to work closely with college and university educators, to suggest ways in which college courses could be designed or adapted to meet the changing needs for continuing education for teachers. At the same time, he will ask college personnel to assist in evaluating and revising elementary and secondary school science courses.

Also, the science supervisor will have greater responsibility in working with the local curriculum committee and the school faculty in maintaining a dynamic curriculum plan. He will have to resist the proliferation of paper work and red tape that tends to accompany new programs and practices, without damaging the exchange of information and closing channels of communication. He will need to develop both the image and the substance of professional leadership. It will require real qualities of leadership to change the role of many supervisors from that of statistician and clerk to a professional—a leader in curriculum development and implementation. In order to strengthen his professional role, the science supervisor must convince his superiors that he is entitled to adequate assistance and persuade them to employ the necessary staff to aid him in discharging the duties for which he is responsible. Increasing responsibilities and changing conditions will provide a real challenge to the ambitious science supervisor for many years to come.

Tactics for Curriculum Change

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The author acknowledges material supplied by LeRoy G. Moore and Walter E. Steidle which has been incorporated into this chapter, as well as ideas by the other chapter authors and editors.

EFFECTIVE curriculum development and the articulation of the science program constitute important facets of supervision, well worth skillful, constant, and thoughtful effort. Such processes are not bandwagon operations: Every aspect of the contemplated change must be studied carefully; there must be sound and valid reasons for any curriculum changes to be advocated or undertaken.

The supervisor must be deeply involved in inspiring, planning, coordinating, and implementing curriculum change. But how does he go about this? What is his role in the process of curriculum development and implementation? How does the new supervisor learn the techniques that he must use to coordinate the overall work of many groups? How does he gain the broad viewpoint required for dealing with curriculum?

THE SUPERVISOR'S ROLE IN INSTIGATING CHANGE

A special word needs to be said here for the new supervisor. Often, he has worked as a classroom teacher, or perhaps as a department head. In this role he has been largely responsible for his own courses, for ordering laboratory equipment, and possibly for holding informal meetings of science teachers in which some degree of consensus concerning the aims and course content for science teaching was achieved. When such an individual moves into a position as science supervisor, he may find it difficult to assume a leadership role with the teachers whom he has previously known as classroom associates.

Despite the special problems, the supervisor newly promoted "from the ranks" is in an ideal position to make the step to leadership if he is aware of the need and will take advantage of his opportunities as soon as he is established in his new position. He already has the confidence of and a close acquaintance with his former associates and he is in a position in which he can communicate more effectively with the administrative staff. Since effective curriculum change cannot be mandated, but must be developed through the cooperation of everyone concerned, the opening of new lines of communication can be extremely important in initiating change.

However, improving communication is only one factor in a complex problem. The supervisor is in the middle of a chain of organization that is responsible for three aspects of education: policy making, decision making, and communication:

Community → Administrator → Supervisor → Teacher → Student

In the past, communication along the chain has been largely in one direction. It is the responsibility of the supervisor to make the flow travel in both directions.

Major decisions with far-reaching implications are often made early in a program for curriculum development. For example, the decision to move toward one or the other of the educational philosophies reported in Berkheimer's A and B categories (see the following chapter) has often been firmly established before the supervisor begins plans for curriculum development. Such a decision has profound implications for every aspect of the curriculum. Effecting a change in philosophy after the decision has been made is always more difficult than establishing it in the first place. When this fact is coupled with the supervisor's well-established habit of following policy rather than of trying to establish it, the new supervisor is often faced with major leadership responsibilities as soon as he has moved into his position.

This emphasizes a major decision that the supervisor must make. Does he wish to follow trends and implement suggestions made by the administration, and the faculty, or does he wish to provide leadership into new fields and develop new ideas that will provide the trends of the future? Very few supervisors can fill the latter role, but if they are capable of this type of leadership, they should not shirk this responsibility. For *someone* must pioneer, *someone* must innovate, while others will follow trends that have been established by the more imaginative and the more courageous.

An equally important role of the supervisor is to maintain momentum in a curriculum project. It is relatively easy to "ride the crest" of a wave and to create enthusiasm for new ideas, but it is a different matter to carry these ideas through the long, discouraging weeks from initial suggestion to final implementation. Every good idea has required the efforts of a single individual or, at the most, a small core of interested and dedicated individuals who will persevere through the disinterest and discouragement that faces any innovation between the enthusiastic initial publicity and support, and the relatively quiet completion of a project. It is in this role that the supervisor can play his most effective role in improving science education.

He cannot play this role alone. And he cannot depend upon everyone to give him undivided, wholehearted support. His first job must be to identify those individuals in his community who understand and are in sympathy with his project and enlist their support. Anywhere and everywhere he may find such persons: imaginative administrators, understanding reporters, enthusiastic teachers, and dedicated citizens.

PLANNING A PROGRAM OF CURRICULUM DEVELOPMENT

A program of curriculum development does not spring, ready-made, from a Sourcebook for Science Supervisors. It must be developed through careful, thorough planning by an interested and willing group of individuals, sometimes called a science committee. Such a group should not be composed of a single, homogeneous segment of the community. A dedicated group of teachers cannot do this job alone. A curriculum committee should be composed of a cross section of the community, representing teachers, administrators, laymen, and industrial leaders. While is it desirable that the science committee represent a variety of community positions and interests, individuals should be selected for the unique contribution they can give to the group and for their interest in and understanding of science education. A group that is selected on the basis of other criteria is apt to be a disappointment.

If the science committee is composed of a group of individuals with varied backgrounds and interests, some time must be spent in orienting them to the role they have been asked to fill. After one or two sessions, at which the primary objective is to brief the group on current trends and practices, both local and national, the committee should be in a position to begin to evaluate the present program and suggest new steps that should be taken.

In filling his leadership role with the group, the supervisor must keep himself well-informed of all the trends in science education. He will read the pertinent literature and study new courses that have been developed by other groups. He will be responsible for providing the bridge between the mass of published material and the local committee, interpreting trends and pointing out significant items that should be considered in making plans for curriculum improvement.

He must also develop skill and perception in the processes of group action. In building curriculum, the choices will rarely be clear-cut alternatives on which a vote may be taken. Many groups have found it more helpful to proceed on a consensus basis, rather than on the basis of majority opinions. Excellent results are often obtained by permitting the group to talk out their differences until agreement is reached. If the differences of opinion are irreconcilable, it may be an indication that there is a need for obtaining further data before a final decision is reached.

The classroom teachers should be involved with the process of curriculum development from the beginning. The supervisor and the curriculum committee should not expect to hand a fully developed final edition of a new curriculum to the teachers and expect them to accept it enthusiastically and without question. To achieve acceptance of a new curriculum, teachers should be fully informed of the philosophy and planning that lies behind the program, and should have the opportunity to react to the material at various stages in its development. If the curriculum is to be effectively implemented by the teachers, they must feel that it was developed by *their* curriculum committee and that it reflects their ideas and interests. Interested teachers who can be encouraged to contribute "bits and pieces" to the project will be much more receptive to new ideas and to curriculum change when it is introduced.

In addition to enlisting the support of the teachers, the supervisor will need the cooperation and backing of the administration. A good superintendent will clearly delineate the supervisor's responsibilities and then provide him the support he needs in order to develop and carry out a program. In return, the administrator must be kept informed of curriculum plans as they are formulated. Adequate funding is the life blood of curriculum change—the supervisor must depend upon the administrator to work with the school board, the leaders in the community, the federal government, and other agencies to see that the funds are available when they are needed. This is not a simple task, and close cooperation between the supervisor and administrators is essential for effective results.

The administration also provides the link between the supervisor and the community. Since the core of every effective curriculum project must include a well-planned program of public relations, such a program must be worked out with the cooperation and approval of the administrator. Also, he will provide a buffer for differences of opinion. It is important to develop an attitude of openness and frankness throughout the development of the new program of instruction. Many differences of opinion will arise—differences related to the relative importance of subjects, time allocations for teaching, teacher loads, and financing. In every instance, the supervisor will have to depend upon the administrator to smooth over conflicts and resolve differences of opinion.

Both the administrators and the science supervisor must be continually alert to possibilities to involve the community in curriculum development. This community approach can function in many ways. For example, LeRoy Moore reports that in Portland, Oregon, a Science Articulation Committee chaired by Donald Stotler, Supervisor of Science for Portland Public Schools, meets periodically to "brainstorm" ideas for continued curriculum innovation. This committee is composed of teachers from the primary grades through high school, local college professors, Oregon Museum of Science and Industry staff, the zoo staff, and curriculum personnel from the State Department of Education. Representation also comes from local chapters of professional engineers.

One of the important considerations for all groups and committees involved in curriculum development is the extent to which the curriculum should conform to national trends and the extent to which it should strive to meet local needs. A prime consideration in making this decision is the amount of mobility in the local community. Some communities may experience a large exodus of talented youth who move to more promising fields of employment. This may be affected by the school curriculum, and such migrations may be reduced by greater school-community cooperation. Many school systems encounter a turnover of 20 percent, while in some communities it is over 100 percent. Other communities are quite self-contained, with most of the high school graduates remaining in the community to work and live.

HOW TO MAKE CHANGES OPERATIONAL

Curriculum development is relatively easy when compared with implementation. Teachers are often individualists and do not accept orders without offering resistance. Many of the older teachers have been through several cycles of ineffective curriculum revision, and have developed a quiet, but firm attitude of passive resistance when curriculum changes are planned. For this reason, the supervisor should consider the problem of implementing curriculum change as a selling job, rather than attempting to take an authoritative approach. A curriculum plan needs style and character in order to win the cooperation of the teachers and the community. Any worthwhile goals require continuing, cooperative effort, and it will take a well-planned, carefully structured program to obtain the continuing cooperation that is essential for the success of any project.

An effective curriculum program cannot be made operational without adequate inservice education for the teachers who must implement the program. In planning such a program, the supervisor should avoid the "cut and dried," ineffective inservice sessions that are sometimes thrust upon teachers. A good inservice program must be an action program, in which teachers take an active part in learning about the goals of the project, and have the opportunity to suggest ways of improving and implementing it. To be most effective, the inservice program should parallel, and not follow, the curriculum development project. So that the teachers will be placed in the same type of learning situation that they will be expected to use in their own classrooms, techniques that may be used are suggested in the chapter "Providing the Teaching Environment."

A valuable adjunct to inservice training as well as to curriculum development and improvement of the science facilities within a school system is the pilot center for science curriculum improvement. Many schools have opportunities to establish such experimental centers. The value accruing to school districts which become pilot centers for improvement projects cannot be overemphasized. There are many rewards for participating teachers and districts. The local tryout teachers are often asked by the national projects to become advisors or writers at project summer conferences. Another benefit is the prestige which comes to a teacher who is asked to participate in a local tryout center or in a national summer writing conference. As a result of the conference experience the teacher feels more competent in his field and thereby adds more to his profession. A small but important benefit derived from the involvement of a school or district as a pilot or experimental center is the free equipment or materials the district receives for use in evaluating the curriculum. This may range from a few dollars worth of materials to equipment worth several thousands of dollars.

A curriculum center—whether it be part of a pilot project or a permanent feature of the school district—with a well-equipped workshop in which teachers, college professors, and scientists work together in curriculum improvement facilitates the moving forward of the whole science program. See also the chapter "University, College, and Other Institutional Resources."

EVALUATION

Any goal worth listing as a basis for curriculum development is worth evaluating. And goals are not often reached if no attempt is made at evaluation. An effective evaluation program must be planned as an integral part of the improvement project if there is any expectation of achieving the goals that have been set. This is probably the place where the most productive work can be done, but it is one of the more difficult areas in which to work.

As the supervisor encounters these forbidding difficulties, he may be tempted to give up and take the easy way out. He can build a cozy but ineffectual place for himself by adopting the motto, "Don't rock the boat," and attempting to maintain the status quo. But most supervisors will not be satisfied to follow the path of least resistance—they will wish to push forward to better and more exciting things. Innovation is more demanding and more difficult, but it is also more rewarding.

The report of research that follows shows what supervisors are now doing or what they think they should be doing. It is a very revealing analysis of the courses of action that supervisors are found to be using in response to the philosophies of their school systems.

Implementing Varying Types of Science Programs: Report of a Study

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THE SCIENCE supervisor has the responsibility of and plays a key role in the implementation of science programs in today's schools. Few guidelines, however, have been established to aid him in fulfilling this responsibility, and the existing guidelines [1,3,4] are usually expressed in general terms in order to cover a wide variety of situations. Although helpful, these guidelines provide inadequate direction for the science supervisor who must interpret and apply them to a series of specific situations to accomplish his goals.

Attempts to describe science supervisory behavior without taking into account the type of science programs being implemented have contributed to the confusion as to the role of the science supervisor. The research study [2] which will be described here applied statistical tests to data collected from a national sample of science supervisors and teachers. It strongly indicates that science supervisory activities in implementing one type of science curriculum material are significantly different from those activities used in implementing another type of science curriculum material. This same research shows that science supervisors and teachers implementing one type of material view the objective of science education differently than do those using another type of science curriculum materials. In addition, the science supervisors' activities in implementing science curriculum materials at the elementary school level are significantly different from activities at the secondary school level. These findings have direct implications for clarifying the role of the science supervisor through analyzing his activities in relation to the type of science curriculum materials or science program being implemented and to the elementary or secondary school level.

A study of available science curriculum materials indicates that two major types of programs are emerging. One type, labeled Type A for the purposes of this paper, emphasizes science concepts, the theoretical nature of science, contemporary science, scientific inquiry, the elements of the scientific methods, mathematics to study relationships, and the investigative or laboratory approach to the learning of science. In contrast, the other type of science program, Type B, emphasizes teacher demonstrations or group experiences, science content topics, facts and science principles, qualitative observations and explanations to study relationships, and the practical nature of science or technology.

Not all science curriculum materials can be easily classified, and some materials apparently are in a transitional phase as revealed by a study of successive editions of the materials. A discussion of the science supervisory activities related to each of the two types of programs offers more precise guidelines to science supervisors than do general guidelines which assume that the same activities are equally important in implementing both types of programs.

It is essential that each science supervisor, together with his teachers, clarify local objectives of science education and select and implement those materials which most nearly meet their particular objectives. Although the science supervisor should adapt his activities to the local situation in implementing any science program, guidelines can be specified based on the type of science curriculum materials being used. If, for example, the science supervisor and teachers agree on objectives and select materials similar to Type A, the science supervisor will usually find it necessary to assume a more vigorous leadership role than would be necessary with Type B materials. This more forceful leadership role may be required to guide teachers away from teaching familiar topics as they did in the past, to help teachers learn science content, and to aid teachers to become effective in using the investigation approach in teaching of science.

Science supervisors implementing Type A science curriculum materials at both the elementary and secondary school level should:

1. Support teachers who try new curriculum materials
2. Encourage teachers to use individual laboratory experiences with pupils

3. Encourage teachers to experiment with new ideas and practices in teaching science
4. Develop an intensive inservice teacher training program to aid teachers in learning science content, in comprehending objectives of modern science education, in using individual laboratory experiences as the primary source of learning, and in using science equipment and supplies effectively in the teaching of science
5. Arrange for released time to enable teachers to attend inservice programs
6. Arrange for adequate science facilities, equipment, and supplies in necessary quantities for sufficient individual pupil laboratory experiences
7. Help teachers develop effective storage and retrieval systems for laboratory equipment and supplies
8. Aid teachers in systematizing the preparation of equipment and supplies for individual laboratory experiences
9. Conduct meetings with parents to explain the new approach to science teaching

Science supervisors implementing Type B science curriculum materials at both the elementary- and secondary-school level should:

1. Encourage teachers to use science demonstrations
2. Aid teachers in evaluating films, filmstrips, and other instructional aids
3. Develop an inservice teacher training program to aid teachers in learning science facts and principles, in developing effective science demonstration techniques, and in helping teachers to keep abreast of current developments in science and technology
4. Coordinate the use of demonstration equipment from central storage
5. Arrange for adequate science demonstration facilities, equipment, and supplies

Some supervisory activities in implementing elementary-school science curriculum materials are different from the activities at the secondary-school level. Listing the elementary and secondary activities separately, therefore, will aid in clarifying the science supervisor's role.

Most elementary teachers are not well grounded in science content, the nature of science, effective techniques in science demonstrations, or the procedures for conducting individual laboratory experiences with children, especially where these experiences are related to equipment and supply problems. Science supervisory activities, therefore, should be designed to give the elementary school teacher as much specific help as possible.

Science supervisors implementing elementary-school Type A science curriculum materials should:

1. Give teachers considerable guidance in selection of science curriculum materials
2. Help teachers comprehend the investigative approach to the teaching of science by conducting a series of demonstration lessons
3. Conduct inservice meetings specifically designed for the particular grade level and the science curriculum materials used at that grade level
4. Make use of school laboratories as instructional centers for inservice education
5. Conduct workshops or conferences in science content and in the effective use of instructional materials
6. Aid teachers in the selection and procurement of science equipment and supplies
7. Collect, analyze, and interpret research findings in elementary-school science education and inform the teachers of pertinent conclusions drawn from this research
8. Maintain a science instructional materials center

Science supervisors implementing elementary-school Type B materials should:

1. Conduct inservice teacher training programs to aid teachers in learning science facts and principles, and in developing techniques for effective demonstrations
2. Conduct workshops or conferences on the effective use of equipment and supplies in the teaching of science
3. Coordinate the use of equipment from central storage
4. Arrange for facilities such as a portable laboratory table or demonstration table suitable for science demonstrations and for necessary equipment and supplies

Although secondary-school science teachers are much more familiar with science content than are elementary teachers, they probably have studied science materials that are more like Type B than like Type A. As a result, many secondary-school teachers, even though they have accumulated considerable credit in science courses, will need help in implementing Type A programs. Science supervisors implementing secondary-school Type A materials, therefore, should:

1. Make arrangements with a college or university to give college credit for the successful completion of inservice courses or programs
2. Help teachers comprehend the objectives of the program
3. Aid teachers in the effective use of the investigative or laboratory approach to the teaching of science
4. Arrange for inservice programs that are directly related to the program used with pupils
5. Arrange for additional salary increments for teachers who successfully complete inservice programs
6. Help teachers plan for changes in equipment, supplies, and resources to correspond to changes in the curriculum
7. Arrange for facilities which are adequate and suitable for science experimentation by pupils

Science supervisors implementing secondary-school science Type B materials should:

1. Help teachers develop their own demonstrations unique to their situation and to increase the total number of effective demonstrations they do each year
2. Aid teachers in the preparation, storage, and repair of demonstration equipment
3. Help teachers increase their competence in science content as related to their subject area specialty
4. Help teachers keep abreast of current science, technology, and methods of teaching science

In our nation's elementary and secondary schools today, science supervisors are playing a key role in the implementation of two types of science programs. The type of science curriculum materials used and the science supervisory activities vary with the local science education objectives. Because of these differences, it is essential that science supervisors clarify their local objectives of science education and use them as criteria in the selection and implementation of science curriculum materials. They, then, can intelligently plan supervisory activities that have a high probability of being effective in developing science programs to meet the local objectives.

Science supervisors implementing science programs that emphasize contemporary. science, mathematics to study relationships, the investigative or laboratory approach to the learning of science, and the theoretical nature of science should assume a more dynamic leadership role and develop a more intensive in-service teacher training program than should science supervisors implementing science programs that emphasize science facts and principles, qualitative observations and explanations to study relationships, teacher demonstrations or group experiences, and the practical nature of science or technology.

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section iii

THE CONTINUING EDUCATION OF THE SUPERVISOR

Graduate Education

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MUCH has been said and written about recent changes in science instruction in the elementary and secondary schools. Relatively little, however, has been written about the changes in structure and organization of the schools themselves during this same period. The changes in science programs did not occur in isolation but rather occurred in conjunction with changes in other areas of instruction and in the schools themselves.

While public attention has been drawn to the revamping of course work in math, science, English, reading, and other instructional areas, the manner in which a school system organizes itself for presenting these courses has also undergone major revision. One reason for this reorganization involves a need for a greater depth of specialized knowledge in a subject field. Formerly a general supervisor at the secondary level could pretty well handle most of the common subject fields (English, math, science, and social studies); now it has become a practical impossibility for any one person to keep abreast of the developments in each of these fields. With structural linguistics, new mathematics, the "alphabet" courses in science, and more new programs coming all the time, the days of the general supervisor are becoming more difficult. It takes a trained, experienced, and dedicated supervisor to handle any one of these areas. The realization of this has led school systems to move toward more and more subject-matter supervisors.

Such shifting and retraining of personnel by the schools would not have been possible, however, without another major change—

money! Although, before 1958, some schools had begun to move in the direction of additional supervisory personnel, it wasn't until the National Defense Education Act of 1958 that this trend became widespread; and it really got rolling with the Elementary and Secondary Education Act of 1965. The era in which only large city school systems could afford subject-matter supervisors is over. School systems, both large and small, employ more supervisors in relation to the size of the faculties than ever before, and this trend is likely to increase rather than decrease.

THE SUPERVISOR IN SCIENCE

There has not been a corresponding increase in trained personnel to accompany the rapid change in proportion of supervisory positions. The solution reached by most schools is to draft classroom teachers to fill these slots. There are those who would argue that this is not a sound practice, but the fact remains that this is commonly what is being done. If this is the case, then let us strive to improve the practice, while awaiting the developments necessary for improving the situation.

The first step for a school system is to decide whether it has a justifiable need for a science supervisor. In making this decision, it must by necessity provide a job description of the role of the science supervisor. This job description will provide guidelines for the selection of the kind of person to be employed and the nature of additional training required for this individual.

The supervisory needs in science will necessarily vary with the size and nature of the school system. A large urban system may have a complete staff of science personnel, both elementary and secondary, while a small system may have only one person in science (or even one person in both science and mathematics), covering a K-12 program. The selection of appropriate personnel in these two extremes would differ markedly to fit the needs of the particular case. The nature of additional training and graduate work would also vary depending upon the background of the individual and the duties of the office to be assumed.

ADDITIONAL TRAINING FOR THE SCIENCE SUPERVISOR

There are three major areas of consideration that should be examined before determining the nature and extent of formalized graduate training for the potential or recently employed science supervisor. These are: (1) the role of the science supervisor in the school, (2) the previous training and experience of the individual, and (3) the availability of appropriate courses and training programs to which the individual might reasonably have access. Let's examine these areas one at a time.

The role of the science supervisor in the school. Previous chapters in this book have been devoted to spelling out in detail the various roles of the science supervisor. This role will necessarily vary with the size and organization of the school system, but there are some basic expectancies that may be applied across the board and which have applicability no matter what the structure of the school. These expectancies take the form of three basic abilities:

1. The ability to establish a rapport with the classroom teacher so that a working relationship can be developed
2. The ability to grasp and project a basic philosophy in regard to science teaching that raises it above the level of just a technically oriented subject-matter course
3. The ability to command the respect of the teachers in subject-matter knowledge

Given the need for these three abilities, we might make the comparison to that of a three-legged stool. A defect of any one leg makes the stool unstable. A lack of ability in any one of the three categories named above would make the work of the supervisor much more difficult.

Most of us have seen highly trained, experienced personnel who simply could not relate with others in the group. We have seen teachers of whom we would say, they belong in a one-teacher school. Such persons could meet two of the criteria, but obviously would not meet the first one; or, to state it positively: A supervisor should be the kind of person that, as a teacher, his peers would generally look to him for ideas, suggestions, and leadership. He should have a kind of tactful aggressiveness, the ability to lead through inference and indirection. His is a sales effort. He is selling ideas, methods, a philosophy.

In regard to the second criterion—the basic philosophy one holds about science teaching—we find ourselves faced with a new approach in purpose and methodology, one that is not too well understood by many science teachers. We have talked much the past few years about learning through discovery. We have reorganized our math courses on a discovery, inductive basis. However, it seems evident that many teachers follow the textbook and curriculum guides with this new approach, but never really sense the philosophy underlying it. Unless a teacher has a clear purpose of discovery and exploration in mind, he will defeat the purpose of the new type of material and activity organization.

We want to develop the science program through a spirit of inquiry rather than as a program for accumulation of facts. With the development of new methods of science teaching that we have had in the past few years, such a statement should be unnecessary. However, the fact remains that much of our science teaching is still being carried on in the traditional way. If a supervisor is to be successful in bringing about change, he must be an enthusiastic apostle of the new approach.

The third criterion states that a supervisor should have enough technical knowledge of the subject matter to command the respect of the teachers. He will not get far with the teachers unless they feel that he knows science. A curriculum director or general consultant can set up workshops, bring in consultants, and guide the study and development of a science program. But when a person is designated as *science* consultant, he is expected to know science.

If we accept the need for these three abilities on the part of the science supervisor, then there are obvious implications for the kind of graduate training necessary to increase the likelihood of their presence or attainment. A thorough knowledge of science along a broad base with a high degree of expertise in at least one area should be a reasonable expectation. This broad base of knowledge must necessarily be up to date and reflect the rapid gains being made in the sciences. In at least one field of specialization the supervisor should have a demonstrated depth of knowledge roughly equivalent to a master's degree, including, if possible, some independent research. This does not mean that the supervisor must be an authority in every field of science, but he should be able to converse intelligently with all science teachers and have demonstrated the ability to go beyond superficial knowledge by work in his own field.

These suggested criteria imply recent and continuous schooling. The college science courses taken 15 or even 10 years ago are not sufficient to equip the supervisor to communicate effectively with today's college graduates. Refresher courses, whether by inservice work, National Science Foundation institutes, extension courses, or just plain summer school, are a must for those who have not been back to school within the last five years.

Included in a graduate program should be courses other than just subject matter. There is a large change in perspective in moving from the classroom to a supervisory position. The supervisor must understand the total school program and how the science curriculum articulates with that program. Even if he is to work only with the secondary schools, a thorough knowledge of the K-12 program is essential in order to understand the background of the student before he appears in the high school science courses. This would suggest course work which focused on science at the elementary school level and on problems of curriculum in general. It quite possibly might include a course on early childhood development, particularly if only adolescent development had been included in the undergraduate training. If there is to be much administrative work involved, a course in educational administration would be most helpful.

If possible, a graduate seminar in science education, in which the methods and philosophies of the new science programs are emphasized, would be particularly useful. Certainly some work with the new science programs, both elementary and secondary, should be taken.

Just as practice teaching is usually of immense value to a beginning teacher, so an internship in supervision can be of immeasurable value to a prospective supervisor. While a course in group dynamics may give theoretical orientation to working with others, supervised practice in applying these principles under capable guidance would be highly desirable. However, there are other considerations which must be taken into account before we set up an idealized model of a graduate program.

The previous training and experience of the individual. In all probability the person designated to assume a supervisory position in science will be selected from the secondary school science teaching staff. It is hoped that this individual will have had as broad a background as possible both in terms of subject-matter knowledge and teaching experience. Not all teachers are suited for such a position. J. Darrell Barnard, writing in *The Science Teacher* in April 1966, states this nicely:

> We are assuming that one who would become a supervisor must first have been a teacher. Further, that all science teachers will not, should not, become supervisors; that the prerequisites for becoming a supervisor involve more than being a teacher.[1]

[1] Barnard, J. Darrell. "Educating the Science Supervisor." *The Science Teacher*, 33; April 1966. pp. 15-17.

Quite naturally the projected educational program one would design for the teacher-turned-supervisor would vary with the person's previous training. If, for instance, a teacher has a heavy concentration in biology, but little chemistry or physics, then supplementary work in the physical sciences is a must. If the person has a broad background in the sciences but little depth in any, then appropriate courses to raise the level of competence in a particular field would be required. If the person is particularly adept at working with other people, then more course work could be directed toward other areas, such as tests and measurement, research design and statistics, advanced educational psychology, or teaching-aids and audio-visual techniques.

These are just examples of how the background and experience of the individual must necessarily become a consideration in planning a graduate program. However, there is another important, practical matter which is often overlooked, but it may be an important determinant in planning further studies.

The availability of appropriate courses and training programs to which an individual might reasonably have access. It is quite easy to construct a theoretical program of graduate studies for the fledgling science supervisor and piously announce that this work constitutes the minimum standards of acceptability. It is quite another matter, however, to provide the necessary means for meeting these standards.

As was mentioned earlier, more and more smaller schools are hiring science supervisors; and, whereas, the larger urban centers may afford several institutions offering appropriate graduate work, such is not the case when the school is located some distance from these centers. Quite typically, also, the tendency in smaller systems is for more of the classroom teachers, who form the pool of potential supervisory personnel, to be married and have family responsibilities. It is not easy to demand long commuting drives at night or summers away from home to attend special programs or institutes.

These and other factors must be considered when mapping out an idealized training program for the supervisor. It may mean a longer period of time than we would like in order to upgrade the individual to what we consider an acceptable level. It may mean some changes and readjustments in course work to fit those offered at a local or nearby state college which may not offer as extensive a curriculum as we would desire. It may mean paying for, or partially defraying, the cost of summer work if it is felt necessary in order to fulfill the obligations of the job. Moreover, there is also the matter of certification practices at the local and state level which may be a factor in planning a graduate program.

In summary, there are no hard and fast rules for training a science supervisor—no blueprint for success. Each case must be considered separately, and individual strengths or weaknesses must be evaluated in terms of the demands of the position.

Let us not forget the quality and "growth potential" of the person himself. The self-starters will always find ways to upgrade and develop themselves, with or without our recommended graduate courses. Minimum expectations to be partially met through graduate study should include: a thorough, up-to-date science background; an understanding of the total school science program, including the philosophy of the new science courses; and a demonstrated ability to relate to others at all levels in a school setting.

Informal Education

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SCIENCE supervision has, as its broadest definition, the improvement in science instruction. The charge is that of serving as a catalyst, of working with and through the administration and faculty in a given system toward bringing about articulation of program, effective curriculum practices in science, and the wise selection and use of equipment and materials requisite to effective instruction.

This description of responsibility sets forth a number of broad areas, each of which involves a self-education effort on the part of the supervisor. These areas apply to all levels of supervision; it is the extent of application which varies with the responsibility.

Vital to all supervision is the factor of human relations. Since supervisors work *with and through* people, it is vital that they fully understand group processes. They should try to take a close look at themselves and examine their idiosyncrasies, strengths, and weaknesses. Effective supervision requires an understanding of group process, knowledge of the background and capabilities of those with whom the supervisor will work, and a respect for the individual. Literature which deals with dynamic group process as well as a study of what constitutes the effective interview are integral to effective supervision.

As a catalyst, the supervisor causes a situation to come about—to be the prime mover yet to create a feeling in the teacher that this was an effort on his part. To do this, the supervisor must know thoroughly the subject area with which he is working. He should have had experience teaching the subject, as well as an up-to-date knowledge of the changes that have occurred or are occurring in that subject area. Such information may be obtained through journals which are available for all subject areas. Too, all states have some publications which are of value to the supervisor and which represent studies or guides which are in use in that state.

An up-to-date source of new science and mathematics curriculums and projects may be found in the latest *Report of the International Clearinghouse on Science and Mathematics Curricular Developments*.[1]

These data are only vehicles through which the responsibilities of the supervisor may be met. He must know his potential leaders—his teachers. He must know them well enough to bring effective supervision through their activities. He must know their backgrounds, encourage them to attempt action research, and supply them with the opportunities, materials, and data which will facilitate such efforts. An opportunity to publish, recognition at a meeting or convention, the reading of a paper, recommendation for further study or increased responsibility as well as other such devices which the supervisor may deem appropriate may be used.

Whatever the size of the local educational agency, it is vital for the supervisor to be a leader who is professionally active. He must be a doer and attend those functions that involve his field. This is necessary if he is to encourage his teachers to do likewise.

Articulation of effort by teachers is only as successful as the administration through which it is directed. This requires an adequate knowledge of the administrative staff; it includes active membership in local, state, and national organizations. Often, efforts are crowned with success through active pressure by organizations such as the Rotary or Kiwanis Club, scientific societies, and other organizations connected with education.

Effective curriculum development and the articulation of the science program constitute a second facet of supervision in which the supervisor must constantly "learn on the job." The chapter "Tactics for Curriculum Change" discusses a variety of activities for implementing new science curriculum. Here, the supervisor must indeed look beyond himself for self-improvement. He must put himself firmly in the communication channels for news of

[1] Single copies of the 1967 report will be furnished free to an individual as long as the supply lasts. Address Dr. J. David Lockard, Director, International Clearinghouse on Science and Mathematics Curricular Developments, Science Teaching Center, University of Maryland, College Park, Maryland 20740.

curriculum improvement activities by asking to be placed on mailing lists of organized projects, by scanning local, area, and national newsletters, periodicals, and other publications that report curriculum efforts. His reading and attendance at conference programs should not only keep him abreast of the curriculum efforts, but—even more importantly—help him to evaluate present viewpoints and philosophies and, eventually, to build a sound, forward-looking philosophy of his own. Once he has a good view of general activity in the area of curriculum development and feels secure in his own viewpoint and goals, he is able to draw upon the practical experience of colleagues.

The selection of equipment and materials to encourage and implement science instruction requires much effort and self-briefing by the supervisor of science. This situation has been made even more important by the federal programs which provide funds for equipment and materials. The National Defense Education Act (NDEA), Title III, and the Elementary and Secondary Education Act (ESEA), Titles I, II, III, and IV have forced a careful look at the total picture so that the choice will be directed toward the most efficient use of such funds. The continual revision of the guidelines and regulations governing these programs has resulted in this becoming a continuing effort. To cite an example, NDEA, Title III, will permit the purchase of audio-visual equipment, films, filmstrips, records, and reference books related to the enrichment of science instruction on a dollar-matching basis. ESEA, Title II, provides unmatched funds for reference books, films, filmstrips, and records; audio-visual equipment, however, is ineligible. Through careful analysis and knowledge of the various programs, the funds available to a local agency could be extended. Wise use of federal surplus properties is also helpful in stretching the school dollar and offers a real challenge to the inventive teacher of science.

Because of the increased emphasis on individualization of instruction, science equipment manufacturers have expanded at a rapid pace. This has necessitated a most careful look at available equipment and the publication of a purchase guide by the Council of Chief State School Officers which describes specifications for items of equipment.[2] The supervisor has the responsibility of knowing what is on the market and what is effective. As a result

[2] *1965 Purchase Guide for Programs in Science and Mathematics.* Prepared by the Council of Chief State School Officers, with the assistance of the National Science Foundation and others. 1965, $4.50. Order from Ginn and Co., New York.

of this, he must work with salesmen and assay the value of their products. Attendance at state and national conventions is most necessary here, both to see what is available and to encourage manufacturers to produce items which are needed in the science classrooms.

Science kits have also received much attention. They are assemblages which range from something very sophisticated which may cost several thousands of dollars to a simple collection of nails, paper clips, and other items that are intended for use with a textbook. It is important that the supervisor assess these packages. Will they do the job or should these items be purchased and distributed through an inservice workshop? Action research and teacher committees should be used to decide.

Equipment is only as effective as the person who uses it. An expenditure on overhead projectors is justifiable only if they are used effectively. It is necessary, therefore, that the science supervisor be thoroughly versed in the use and versatility of equipment, lest they become "black boxes" which are placed on a shelf and never used. The supervisor must see to it that the equipment in a school is thoroughly understood by the teaching staff through actual use in inservice work. Too, the techniques of ordering equipment, manufacturing guarantees, setting delivery times, and other relevant factors should be obtained from salesmen and made known to administration and faculty. I remember well an instance where a school system had a piece of equipment installed which had never worked. I investigated at the request of the school system and found that the item had not worked from the day it was installed because the wiring had been put in incorrectly. It turned out that one company had built the equipment and another had done the wiring. This appears unusual, but it happens because people do not know the policies of manufacturers. This problem was immediately resolved by the company, which replaced the equipment at no charge.

Attendance of staff at summer institutes is often a fertile source of leadership in the use of equipment. Teachers who become excited about new methods of using equipment must be recognized.

Research is gradually assuming the position of importance it should have. Because of this, the supervisor of science should be aware of what is taking place by participating in activities that emphasize this movement. He should be aware of how to interpret research data and of such publications as Gage's *Handbook of Research on Teaching* and the Third Edition of the *Encyclo-*

pedia of Educational Research. [1, 2] Federal efforts are evidenced through the Educational Research Information Center (ERIC) and ESEA, Title III projects for the Advancement of Creativity in Education (PACE), and ESEA, Title IV. The supervisor of science should know what these programs are and how he may use them in carrying out his responsibilities.

The focus on science has produced considerable activity on the part of industry and philanthropic organizations. To take advantage of this, it is necessary for the supervisor to identify these programs and determine the values which could accrue from them. These include scholarships, assembly programs, films, recognition awards for teachers and students, as well as other benefits too numerous to mention.

The area of legislation must not be left out of the picture. This is necessary to enforce such areas as use and care of animals, use of radioactive materials, classroom safety, and other matters which are pertinent to the safety of children while they are in the school building. Teachers are often unaware of such laws in the state in which they teach; these should be absolutely clear to the supervisor and should be clearly transmitted to all science teachers. I have seen chemical storage rooms located above the heating plant, explosive chemicals stored in glass bottles, and rooms without fire extinguishers or adequate ventilation. To talk about what should be done and not do it in your own school is hypocritical. It is the task of the supervisor to investigate these areas, recommend and urge changes that correct any shortcomings.

The responsibilities of the science supervisor toward expanding his own understanding of his work are legion. The good supervisor will be engaged in a never-ending process of improving his effectiveness in the classroom by engaging in many if not all of the activities that have been described above. As he becomes more effective, his activities will increase. It is a magnificent challenge, there is no field which offers more excitement, more promise and . . . more work!!

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section iv

RESOURCES FOR THE SUPERVISOR

Federal Programs

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THE IMPROVEMENT of education in the United States has become a major concern of both the legislative and executive branches of our federal government. Because of this concern, unprecedented sums of money have been made available to educational agencies and institutions through a bewildering variety of acts, special titles, and amendments to prior legislation. It is as a result of the funds made available by the Congress that a large proportion of science supervisors have been employed at state and local levels. Indeed, a primary responsibility of these supervisors is to provide leadership in the development of programs for the improvement of science education using the federal funds made available. Thus, supervisors must not only know the current status of the important federal programs and their purposes, but also how to plan projects which will win the necessary approval to qualify for funding.

At the end of this chapter is a representative list of programs currently administered by the U.S. Office of Education and the National Science Foundation. These are not, however, the only programs administered by federal agencies. Activities related to science education are supported or operated by the National Aeronautics and Space Administration, each of the Armed Services, the National Institutes of Health, the Public Health Service, The Smithsonian Institution, and many others. The continual addition of new programs and revision or dropping of old programs make it nearly impossible to provide at any given time a truly comprehensive and accurate list of all available federal resources. The supervisor must be constantly alert to announcements, news releases, and publications that describe the activities of the various departments and agencies.

Many federal programs may seem, at first glance, to have no direct bearing on science education. It is well to keep in mind, however, that knowledge about non-science-oriented programs can often make it possible to prevent diversion of state or local funds from science education activities. For example, special titles of certain acts provide funds for the purchase of library materials and audio-visual aid equipment. When funds are available from these sources, it would be well to reserve NDEA funds for other purposes.

One of the most important functions of the science supervisor, whether at the state or local level, is to assist in the planning of projects for which funds from one or more federal programs will be requested. In most cases, the formal request is made in the form of a proposal which details the project, provides its rationale, and includes an estimated budget. While each federal program requires certain unique features and formats for proposals, it is possible to suggest a few general guidelines. By applying these guidelines, where appropriate, the supervisor can save much time and should have a reasonable proportion of projects approved. For ease in adaptation, the suggested guidelines are here provided in the form of questions. These are the kinds of questions which should be asked by the supervisor as he works with school administrators, committees, and other groups actively planning projects.

1. *Will the proposed project really result in some kind of improvement?*

   It is not safe to merely assume that any project, regardless of how well organized, will result in an improvement in instruction, facilities, equipment, or whatever its principal objective. Remember, the federal programs were enacted to provide assurance of improvement, not the continuation of the status quo. Neither were any of the programs enacted to improve science education at the expense of other major areas of the school program. A good proposal must include evidence of change in a positive direction for the science program while not, at the same time, adversely affecting other areas of the school program.
2. *Has the project been based on a realistic delineation of the needs it has been designed to meet?*

   Oftentimes proposals are prepared which seek funds for overcoming problems which are really quite peripheral. No amount of equipment, for example, will overcome the lack of an effective program or the lack of well-qualified teachers or other personnel. Neither will any inservice training program for science teachers be effective where there is no provision or assurance that the results of the training will be supported in terms of program, facilities, and equipment.

3. *Does the project make use of available resources?*

   Resources include not only facilities and equipment, but also personnel. It would be patently absurd, for example, to expect support for a proposal to improve an elementary school science program which did not provide for the involvement of individuals having recognized competency in elementary school science. Often, the competencies of such individuals are not recognized within their own school systems. When such is the case, the sincerity behind the proposal, or its real intent, can be seriously questioned. In other words, the proposal should demonstrate that the services of all appropriate and competent personnel within the district or agency have been used in its preparation.

4. *Is the proposed project economically efficient?*

   Federal funds for the improvement of education are made available through the representatives of the voting public. This public takes a dim view of tax-supported activities which seem, at least on the surface, to be excessively costly. Proposals must provide assurance that the results of the project will merit its cost.

5. *Does the proposal have internal consistency?*

   Such an obvious guideline, perhaps, should not be mentioned here. Yet, the lack of it is one of the major reasons proposals fail. As proposals are planned and put into writing, a continual check should be made to be sure that objectives, project activities, method of evaluation, review of related projects, organizational structure, and estimated budget have direct relationship with one another.

The federal programs are now so broad in their total scope that the science supervisor should find his effectiveness limited only by his creative imagination and by the leadership he chooses to exercise. It is, after all, imagination and leadership that will provide assurance that the millions of dollars appropriated will be used for the improvement of science teaching—the purpose for which the money was intended.

Federal Money for Education:

TYPE OF ASSISTANCE	AUTHORIZATION	PURPOSE
GROUP I: For construction		
Educational television	P.L. 87-447, amending Communications Act of 1934	Aid in the acquisition and installation of transmitting and production equipment for ETV broadcasting
Area vocational schools	Vocational Education Act of 1963	Construct or improve area vocational education school facilities
Public libraries	Library Services and Construction Act—Title II	Aid construction of public libraries
Educational laboratories	Cooperative Research Act (amend. by ESEA—Title IV)	Construct and equip national and regional rearch facilities
GROUP II: For programs, instruction, and administration		
Strengthening instruction in critical subjects in public schools	National Defense Education Act—Title III	Strengthen instruction in science, mathematics, modern foreign languages, and other critical subjects
Strengthening instruction in nonpublic schools	National Defense Education Act—Title III	Loans to private schools to improve instruction in critical subjects
Programs for the disadvantaged	Elementary and Secondary Ed. Act—Title I	Support educational programs in areas having high concentrations of low-income families
School library resources and instructional materials	Elementary and Secondary Ed. Act—Title II	Support provision of school library resources, textbooks, and other instructional materials
Supplementary centers	Elementary and Secondary Ed. Act—Title III	Support supplementary educational centers and services
Pilot youth programs in science	Science clubs (P.L. 85-875)	Encourage young people interested in science
Teacher institutes	National Defense Education Act—Title XI	Improve qualifications of elementary and secondary teachers and related specialists

Programs Administered by the U.S. Office of Education*

APPROPRIATION	WHO MAY APPLY	WHERE TO APPLY
$ 3,000,000	Nonprofit agencies, public colleges, State television agencies, education agencies	Assistant to the Assistant Secretary (Educational Television), Dept. of HEW, Washington, D. C. 20201
255,377,455 (part)	Public secondary and post-secondary schools providing education in 5 or more fields	State boards of vocational education (information from OE's Division of Voc.-Tech. Education)
40,000,000	State library administrative agencies	OE's Division of Library Services and Educational Facilities
12,400,000	Colleges, school systems, State education departments, industry	OE's Division of Laboratories and Research Development
79,200,000	Local school districts	State education agency
1,500,000	Nonprofit private elementary and secondary schools	OE's Division of Plans and Supplementary Centers
1,053,410,000	State education agencies	OE's Division of Compensatory Education
102,000,000	Local education agencies	OE's Division of Plans and Supplementary Centers
135,000,000	Local education agencies	OE's Division of Plans and Supplementary Centers
50,000	Colleges and universities, State education agencies	OE's Division of Plans and Supplementary Centers
30,000,000	Colleges and universities	OE's Division of Educational Personnel Training

* Fiscal year 1967

Federal Programs (continued)

TYPE OF ASSISTANCE	AUTHORIZATION	PURPOSE
Experienced teacher fellowships	Higher Education Act of 1965—Title V-C	Improve the quality of education of elementary and secondary teachers and related personnel
Talent search	Higher Education Act of 1965—Title IV-A	Assist in identifying and encouraging promising high school graduates
Supervision and instruction	National Defense Education Act—Title III	Strengthen supervision and administration in State education agencies
Researcher training	Cooperative Research Act (amend. by ESEA–Title IV)	Develop and strengthen programs for training educational researchers
GROUP III: For teacher training and student assistance		
Experienced teacher fellowships	Higher Education Act of 1965—Title V-C	Improve the quality of education of elementary and secondary teachers and related personnel
Teacher training grants (institutes)	National Defense Education Act—Title XI	Improve the quality of teachers, school librarians, other specialists
Teacher exchange	Mutual Educational and Cultural Exchange Act	Improve and strengthen relations between U.S. and foreign nations by exchange of teachers
GROUP IV: For research		
Curriculum research (general) (arts and humanities)	Cooperative Research Act	Support research on the improvement of curriculum, including arts and humanities at all levels
Curriculum research (demonstration and development)	Cooperative Research Act	Support research — demonstration and development — on school curriculum improvement
Curriculum research (dissemination)	Cooperative Research Act	Support dissemination of research to improve curriculum
Educational media research	National Defense Education Act—Title VII	Support research on educational uses of television, radio, motion pictures, other media
Research and Development Centers	Cooperative Research Act (amend by ESEA—Title IV)	Support research on the major problems of education

APPROPRIATION	WHO MAY APPLY	WHERE TO APPLY
$12,500,000	Institutions of higher education offering graduate programs	OE's Division of Educational Personnel Training
2,500,000	State, local education agencies, public or nonprofit organizations	OE's Division of Student Financial Aid
7,500,000	State education agencies	OE's Division of Plans and Supplementary Centers
6,500,000 (part)	State education agencies, institutions and organizations	OE's Division of Research Training and Dissemination

12,500,000 (part)	Experienced teachers planning to continue in elementary and secondary teaching careers	Local school boards or participating institutions (information from OE's Div. of Ed'l Personnel Training)
30,000,000 (part)	Teachers, teacher trainers, and supervisors in 12 areas	Participating institutions (information, OE's Div. of Ed'l. Pers. Traing.)
350,000	Elementary and secondary teachers, college instructors and assistant professors	OE's Teacher Exchange Section, International Exchange and Training Branch

16,085,000	Colleges, universities, State education agencies, private or public groups, or individuals	OE's Div. of Elementary and Secondary Research (Arts-Humanities: Div. of Labs. & Research Dvlpt.)
3,000,000	(same as above)	OE's Division of Elementary and Secondary Research
2,415,000	(same as above)	OE's Division of Elementary and Secondary Research
4,400,000	Grants: public or nonprofit institutions, individuals; contracts: public agencies, individuals	OE's Division of Research Training and Dissemination
29,600,000	Colleges and universities, agencies, and organizations	OE's Division of Laboratories and Research Development

Professional Organizations

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INTRODUCTION

Among the major contributors to successful science teaching in the United States must be included the professional organizations that give outstanding service and support to science teachers in the classroom. These organizations range in size and interests from the all-encompassing National Science Teachers Association to the small local groups of science educators who meet on an irregular basis in their own school districts. What these groups all have in common is their joint effort in improving science teaching by affording the members contact with other teachers and scientists. In this chapter an attempt will be made to summarize the activities of these professional organizations and the services they render to their members as well as to education as a whole.

THE ORGANIZATIONS

In this gregarious society of ours we all seem to feel a need of "belonging," be it to family or friends, school or community. The science teacher is not normally an exception to this pattern. He desires a kind of "togetherness" with those of like mind, and the professional organizations give this need a solid framework on which to build. Here is a natural forum where one can share his hopes and desires, and in some instances, his innermost thoughts on what he is about and why. The real substance of professional organizations, then, is in their individual members, be they card-carrying or peripheral. Joining is usually just a matter of expressing an interest and offering to contribute in whatever manner the organizational structure feels is important. The larger organizations[1] with interest in this area and having general membership include the:

American Association for the Advancement of Science (AAAS)
American Association of Physics Teachers (AAPT)
American Chemical Society (ACS)
American Institute of Biological Sciences (AIBS)
American Nature Study Society (ANSS)
Association for Supervision and Curriculum Development (ASCD), a department of the National Education Association
Central Association of Science and Mathematics Teachers (CASMT)
National Association of Biology Teachers (NABT)
National Association of Geology Teachers (NAGT)
National Association for Research in Science Teaching (NARST)
National Science Teachers Association (NSTA), a department of the National Education Association, and its sections:
  Association for the Education of Teachers in Science (AETS)
  Council for Elementary Science International (CESI)
  National Association for Industry-Education Cooperation (NAIEC)
  National Science Supervisors Association (NSSA)

In addition to these more or less "national" organizations that have membership by choice, there is the Council of State Science Supervisors, restricted to those that hold just such positions. An organization that also makes major contributions to science teachers and students is the non-profit Science Service, Inc. In addition to all of these are the regional, state, and local groups that make major contributions "close to home" such as the state academies of science.

Science teachers and supervisors should be aware of the value of membership in such organizations as the American Museum of Natural History or The Smithsonian Institution. These pro-

[1] Addresses of the associations are on page 144.

vide a broad scope of information through their publications and other features.

CONVENTIONS AND CONFERENCES

If an important role of the professional societies is getting science teachers together in one spot to share their ideas and activities, then the conventions and conferences these groups hold have special significance. All the groups have at least one annual gathering of their membership, and several have regional conferences in addition. These sessions feature major addresses given by eminent scientists and science educators, science seminars, panel discussions, contributed papers, exhibits of science teaching materials and equipment, displays of curriculum materials and science facilities, teacher demonstrations, field trips to scientific institutions and industries, science teaching films, recognition of outstanding science educators, and ample opportunity for meeting one's professional colleagues in informal social activities.

The largest single such annual gathering designed especially for science teachers is the annual convention of the NSTA. This is held in March or April in some major United States city on such a rotating manner that the geographical concerns are also met. Over 6,000 persons may attend an NSTA convention, allowing interactions between individuals that are not available in any other way. Cooperative conventions with a number of societies joining in the planning are also held, and the major one of this type is that organized under the general auspices of the AAAS. This meeting occurs during the Christmas holidays and not only allows frequent exchange between teacher and teacher but also between teachers and scientists since this is the only annual meeting that brings together scientists from all major disciplines. CASMT holds a meeting in the Chicago area each Thanksgiving time. Most of the societies that are affiliates of a parent organization of professional scientists hold special sessions in conjunction with the annual meetings of that scientific group.

PUBLICATIONS

Of primary concern to all educators is the ability to communicate with fellow teachers and to know what is occurring throughout the land. A major contribution professional organizations make to bring this about is the production and distribution of numerous publications. Of major importance are the journals that the societies[2] issue. These would include:

Journal of Chemical Education (ACS)
Journal of Geological Education (NAGT)
Journal of Research in Science Teaching (NARST)
School Science and Mathematics (CASMT)
Science (AAAS)
Science and Children (NSTA)
Science Education News (AAAS)
The American Biology Teacher (NABT)
The Physics Teacher (AAPT)
The Science Teacher (NSTA)

These professional journals contain papers from outstanding scientists and science educators on subject-matter topics as well as how-to-teach-it aspects. Major addresses given at the conventions are printed, and even short courses are summarized on the printed page. Announcements and reports on the constantly occurring meetings are given not only in one field but in related disciplines also, bringing about better understanding on what "science" really is. Reviews of books, science teaching materials, and professional articles are regular features along with the highly important advertising that also keeps science teachers informed on the latest items available to them.

In addition to the journals, which are usually released monthly throughout the academic year, are the association newsletters giving newsworthy items of a more current nature. The newsletter form is frequently used by the regional, state, and local science teaching groups and keeps readers closely attuned to items of area interest.

From time to time, the larger associations release books and booklets on specific topics which go into more depth than is possible with periodicals. NABT, for example, has published a handbook on conservation and NSTA a detailed book on school science facilities. Even complete series, such as the VISTAS OF SCIENCE ® books from NSTA, have been published. Frequently the reports from special committeees are printed and distributed at a nominal cost. Only a well-managed professional organization can handle such a vast printing and distribution operation.

[2] See page 144 for addresses.

REVIEW ACTIVITIES

Since literally thousands of individual items designed for science teaching are produced each year, commercially and otherwise, the professional organizations have found it quite valuable to their members to evaluate these materials critically. These reviews, done by highly competent evaluators, both in the classroom and in the laboratory, help control the quality of the products and insure the purchaser that he is getting the best for his money. Items evaluated include texts, reference books, audio-visual and science laboratory equipment, teaching aids, and even articles in other journals. Frequently the information is in the form of a succinctly written brief giving all the pertinent information but pointing out the appropriate strengths and weaknesses. These reviews usually appear as a regular feature in each of the journals and thus not only preview the latest items but facilitate sound selection by teachers and administrators.

PACKET SERVICES

In addition to reviewing the printed material as it is released, several of the societies actually select particularly good items and mail them without charge to their members. A special committee of classroom teachers sifts through the hundreds of items produced each month and decides on a very few highly valuable items that individual teachers should have in their classrooms. Considerable time is saved in this manner and the "wheat is separated from the chaff" before being put in the mill.

REFRESHER COURSES

Since one of the most difficult tasks for a science teacher is keeping up to date with the rapid changes in the subject matter of the dynamic fields of science, several of the professional organizations have developed refresher courses taught by the best in their field. Some programs are only a few hours long while others last three or four days. Such groups as the National Science Foundation (NSF) have supported these courses financially in addition to the kinds of help they give through the academic year, inservice, and summer institutes.

SPECIAL COMMITTEE STUDIES

As important problems arise within the academic community that involve science education, the professional societies appoint special committees with top leadership and go into intensive studies of possible solutions.

Topics, such as legal proceedings affecting teachers or institutions, may involve the profession particularly or they may be long-range topics, such as development of curricular projects that need a major group to coordinate the effort or supply the manpower. Affiliation with such study groups not only helps the profession as a whole, but the teachers directly involved get experiences and opportunities that would not otherwise come their way.

CAREER GUIDANCE AND YOUTH ACTIVITIES

Stimulation of students to go into science careers and science teaching has long been a concern of the professional science educators, and through their associations considerable steps have been made to aid students. Club programs, such as NSTA's Future Scientists of America program and Science Service's Science Clubs of America, have been developed and give early help and stimulation to students. Science project competitions have been used to get student involvement in scientific investigations, such as the Ford-Future Scientists of America awards program of NSTA and the International Science Fair and Westinghouse Science Talent Search of Science Service. Career brochures have been produced, and in some instances funds have been found for the more promising students. NSTA has published two booklets for young people about careers.[3]

BUSINESS-INDUSTRY COOPERATION

To insure coordination with the commercial groups that aid the teaching profession, special sections of the associations have been established and working arrangements developed. Industry is helped by learning of the priority needs of science education, and the teachers get better materials with which to work.

CONCLUSION

In this brief summary of some of the many services professional organizations render to their members and the profession as a whole, an attempt has been made to show the need for supervisors to avail themselves of these services and to become personally involved in their activities.

[3] *Keys to Careers in Science and Technology—1967 Edition,* a bibliography (471-14524, $1) and *A Career for You as a Science Teacher* (1966) (471-14340, 25¢). National Science Teachers Association, Washington, D.C. Order both from NEA Publications Sales, 1201 16th St., N.W., Washington, D.C. 20036. Payment must accompany orders of $2 or less.

The Academic-Industry Interface

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SOME schools are turning to the many automated systems now becoming available for promoting the teaching-learning process. Perhaps many answers to educational problems can be found here. However, assistance also may be found in the local community. To uncover it, initiative and imagination are needed. The science teacher cannot confine his teaching to the textbook or the laboratory manual. He must turn to outside sources for technical assistance, various types of equipment, and fresh ideas that represent new approaches. How does a teacher find these resources and how can they best be utilized?

UNIQUE CAPABILITIES OF INDUSTRY

Few school systems are located in areas completely devoid of industry. No matter how seemingly unrelated an industry may be to science instruction, many relationships can be found if one closely examines the local industries.

When approaching companies, a basic concept should be remembered. Inherently, they must show a profit in order to exist. Therefore, their decisions to assist or not to assist a school will be somewhat tempered by this factor. Nevertheless, industry, for the most part, has a very long-range view of education. Future employees, potential buyers of products, and future goodwill ambassadors are found in the schools. Moreover, companies are interested in the schools out of a basic desire to assist education.

The unique capabilities of industry and their potential usefulness to the schools fall in several categories:

Source of technical manpower. Many companies employ technically trained people in one or more fields of science. These employees are often eager to assist schools in various ways—by giving talks to classes, providing career counseling, assisting with science projects, obtaining equipment or chemicals, and discussing some of the newer advances in a particular science. This source of technical manpower is an important one to cultivate. The right kind of cooperation here will pay big dividends.

The industrial plant. A company's plant can have real educational values. The proper approach to a company can often open the way to plant tours, conferences with students, and access to scientific equipment. Do not overlook these and other possibilities.

Excess equipment. The field of science moves so rapidly that science equipment often becomes outdated. This does not necessarily mean that the equipment is entirely useless. It may be of considerable value in the classroom. Often, if companies know that schools are interested in such equipment, they are pleased to collect and deliver it to the school. Usually, their only request is that it be used.

The equipment does not have to be exotic or complex. It may be equipment that, after long use, is ready to be replaced. It can vary from test tubes, test-tube racks, animal cages, and culture dishes to pH meters and other more elaborate equipment. Not only is the equipment itself useful, but it also demonstrates to students that the equipment used in the classroom laboratory is the same as that used in the industrial laboratory.

Source of funds. Quite often, a company has more than a passing interest in the schools. If a company is made aware of a real need, it may gladly give the school financial assistance. A company may provide a personal grant to a teacher or support some specific program that might be established.

A subject-field relationship. It should be perfectly clear that the teacher is a professional person. He is not only a professional educator but also is professionally oriented in a particular field. As a professional in an academic area, the teacher should attempt to keep abreast of new events in his subject area. This can be partially accomplished by reading journals and books and attending professional meetings. However, teachers often are handicapped because the schools usually do not defray the cost of travel to professional meetings. Assistance, however, often may be obtained from industry.

Many companies understand the need for updating the technical competence of teachers and are willing to aid teachers in this endeavor. If the teacher expresses such a need, a local company may find a way to subsidize either part or all of his travel expenses to a professional meeting. The teacher should use careful judgment in approaching a company for help and should have valid, convincing reasons for going. The company might not only give financial help but might also provide some of its scientists as substitute teachers while the regular teachers are attending professional meetings.

THE WORKING RELATIONSHIPS

American industries today probably represent some of the most efficiently run operations in the world. Not only do they employ top people in their managerial and administrative positions, but they are continually searching for newer, more efficient methods. Therefore, schools, teachers, and science supervisors will make serious mistakes if they approach an industry in a haphazard and poorly organized manner. Industry respects a well-planned, well-thought-out attack on a problem. The teacher or science supervisor who has a problem that he thinks industry can help to solve will fail to achieve his objective if his presentation is not well conceived. Once the schools demonstrate to industry that they are thinking and planning carefully, a mutual respect can be developed and much can be accomplished.

INHERENT DANGERS AND POTENTIAL JOYS

The school-industry relationship has certain dangers. As was mentioned earlier, American companies, through the free-enterprise system, are in business to make a profit. The educator should become familiar with industry and know its policies and goals.

The educator should also realize that, in most communities, several companies can be involved in various ways with school programs. Educators can get into great difficulty if they approach one industry and not another, or if they approach one company in a certain field but not another in the same field.

Again, the educator must do his homework carefully before approaching industry. Also, clearance for such approaches should come through the principal, science supervisor, or superintendent to make sure that the schools develop a good working relationship with the industry in a local community.

The gains to be achieved by such a relationship are great. Industry might represent a virtually untapped source of aid to the teacher and to the schools. In the past, industries have attempted to assist the schools in various ways. Often, however, they are not aware of how they can best help. Some companies, for example, have made films intended to be educational. Actually, in many cases, these films are unsuitable for classroom use. Companies need advice from educators on how films might be better presented. A joint advisory committee of local educators and company representatives could help improve the quality and usefulness of educational films. Once a company has been approached properly and good cooperation is developed, there is no stronger educational ally in the community.

The National Association for Industry-Education Cooperation (NAIEC), a section of NSTA, provides avenues of communication between education and industry informing each of the other's needs, ideas, and resources. NAIEC provides guidelines on the preparation of materials that will conform to high educational standards, advises on an NSTA packet exchange enabling members to see what other companies provide to schools, and maintains close association with organizations with mutual interests.

EXAMPLES OF GOOD COOPERATION

Many examples could be cited of how companies have cooperated with the schools. Each instance would reveal a relationship that was developed through mutual respect and through proper planning on the part of both groups. Here are examples:

> A local company annually discarded many animal cages that were still in good repair and quite usable. However, for various reasons, it chose to buy a number of new ones each year. Without knowing that the schools might have an interest in the old ones, a local junk company was called, and the cages were given away. When the schools learned of this, they were told by the junk dealer that they would have to purchase them. However, when the proper approach was made to the company, an arrangement was set up so that each year all of the discarded animal cages were given to the schools. As a result, the schools no longer had to buy animal cages.
>
> Advanced and exceptionally capable students often represent problems for teachers. Insufficient time when teachers can assist and inadequate equipment often limit the progress of these students. When the proper approach was made to a

local company, a good personal relationship between a student and a company scientist was initiated. Also, students experimenting beyond the normal high school level and needing certain types of equipment were given limited access, under proper supervision, to various pieces of company equipment.

Plant tours normally offered by many companies can be rather routine and pedestrian. Frequently, students get the wrong impression of industry when these tours are their only exposures to the industrial world. A good teacher or science supervisor can develop a working relationship with an industry so that not every student is taken on a plant tour but only selected students interested in science. Such tours are planned with the company so that fewer students are assigned to each group, the tour guides have proper technical backgrounds, certain areas of the plant not normally shown to the public are included in the tour, and special conferences are held prior to the tour to explain what the company is doing and point out the value of its research. After the tour, a second conference is held to allow the students to ask questions about what they have seen. This kind of arrangement has been worked out with many companies, and the results have been highly commendable.

Local industries, when approached in the proper way, have released some of their technical people to take over every science class in a school system, so that the teachers could attend a professional meeting for two or three days. This arrangement, besides benefiting the teacher, gives the student an actual view of a scientist in action. Moreover, it gives the scientist and the company a greater appreciation of the schools.

Many such relationships and opportunities to cooperate at the interface between education and industry can be developed. All one needs to do is to make the proper approach, demonstrate a real need, and present a well-developed plan for meeting it. The opportunities and satisfactions of a mutually beneficial relationship are thus within reach.

University, College, and Other Institutional Resources

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DURING the past decade or so there has been a remarkable growth in the number and quality of science education centers and departments in universities, colleges, and certain other institutions. This growth has come about because of clearly recognized national needs and the provision of the financial resources necessary for the establishment of facilities and programs and the hiring of competent personnel. Obviously, the purposes of the departments and centers can only be fully achieved as science supervisors make use of the available services, take an active role in program development, and cooperate in the research and development efforts designed to improve and move science education into a new era of excellence.

Before delineating some of the resource potentials of institutions of higher education and of other educational commitment, it is well to point out one important consideration which should be kept in mind. Those who have had long experience in supervision have learned to distinguish between the institutional policies and goals and the private interests of the individuals with whom they deal. This is not to imply that a private interest, such as a new series of books on the market, is bad. Rather, it is to point out that when working with or using the services of individuals representing resource institutions, it is well to know whether they are representing the institution or themselves.

Effective use of institutional resources involves a three-way relationship between them and the science supervisor. First, science centers, departments, and similar organizations can serve as a *source* of ideas, materials, advice, and even programs to the supervisor. To serve as an effective source over a period of time, however, the second relationship must also exist. The supervisor should serve as a *source* of information about the status and problems of science education in the district, region, or state he serves. Most important of the relationships, however, is the third which is more than just the merging of the first two. Both the institutional resources and those of the supervisor should be combined in the development and testing of imaginative ideas and in the establishment of demonstrations of those which offer promise of viability in a rapidly changing educational context.

SOURCES OF INFORMATION

Science supervisors have many responsibilities which have been discussed elsewhere in this sourcebook. Many of these responsibilities, as well as a large number of activities which go beyond what is usually spelled out in job descriptions, require that the supervisor *actively* seek out the assistance of those most knowledgeable about the content and methods of science, effective teaching techniques, curriculum development, teacher training and enrichment, use of educational media, and a wide variety of other topics of immediate and long-range concern. Departments of science education, science centers, and specialized institutions devoted to science education (e.g., museums, nonprofit and commercial research organizations, etc.), and certain governmental agencies are the best sources of such personnel. All of these, as well as many publishers and other concerns dealing with science education products provide printed and other kinds of materials as well as advisory services. Whatever the supervisor's need, it is important that he properlv evaluate the purposes for which the assistance is provided.

Universities and colleges are a primary source of help in planning and carrying out "for credit" inservice training programs for teachers. Teacher enrichment programs, not always "for credit" are often developed with the assistance of science museums and research organizations not directly involved with higher education. The proper role of the supervisor is not just to get on the mailing lists for announcements of the institutions in his region, but to plan actively with them the kinds of inservice and enrichment programs which will be most meaningful to the teachers and to the programs for which he is responsible.

Personnel of local school systems often attempt to develop science curricula and courses of study on an introspective basis.

That is, they feel that they would compromise themselves as professional personnel if they sought assistance from outside. Science supervisors should be ready, willing, and able to point out (diplomatically, of course) that professionalism implies the full realization that no one individual or group has the best or last answer for most questions to which curriculum committees must address themselves. But more importantly, the supervisor should have at his command knowledge of the best sources of assistance available to local school districts.

Here are only a few of the kinds of services available from universities, colleges, and other institutions which a science supervisor can help arrange for the schools and teachers within his jurisdiction:

Help in planning inservice and enrichment programs for teachers

Actual carrying on of inservice and enrichment programs for teachers

Help in planning and carrying on programs for special groups of elementary and secondary school pupils (i.e., lower and upper ability groups)

Demonstrations of new teaching techniques

Demonstrations of new curricular materials

Evaluations of existing programs

Evaluations of new equipment and materials

Instructional and learning materials to be directly used by teachers with their pupils

Support for seeking additional funds for new facilities, equipment, and materials from administrators, boards of education, the voting public, and governmental and other agencies.

THE SUPERVISOR AS A SOURCE OF INFORMATION

All of the above and many other kinds of services would soon become outmoded if the resource institutions did not have a variety of sources of knowledge about what is happening in the schools. The increasing number of science supervisors acting as sources of information should make it increasingly possible for institutions to provide services which reflect actual needs.

Most institutions of higher education and other science-education-oriented organizations provide services to broad regions and usually do not limit themselves to a single school district or even a single state. Thus, effective program development on their part requires the joint cooperation of all of the science supervisors in the broad region served. Just as importantly, the failure of a single supervisor of a major school system in a region to cooperate with the others could seriously affect the value of the resource programs made available. It is for these reasons especially that committees, councils, and other advisory groups of science supervisors are formed. A request to serve as a member of such a group should be considered not only an honor but also a very distinct responsibility.

Science supervisors, acting either individually or in concert with others, can help resource institutions plan more effective programs by gathering and supplying such items of information as the following:

Current science enrollments
Anticipated trends in science enrollments
Anticipated needs for new teachers
Inservice training needs for existing staff
Instructional materials needs
Anticipated changes in school organization having implications for science education programs
Availability of new educational media
Changes in characteristics of pupil population

JOINT RESPONSIBILITIES OF SUPERVISORS AND INSTITUTIONS

Effective planning for the continued improvement of science education requires the establishment of a close working arrangement between resource institutions and science supervisors. Neither can do the job alone. Were resource institutions to try to develop programs and train teachers without the active participation of the school leadership, the programs would rapidly diverge from actual needs. Teachers would be trained for jobs bearing only coincidental resemblance to those available in the schools. Were supervisors to attempt to develop programs without the participation of the resource institutions, an inordinate provincialism would soon develop. Graduates from such programs would find themselves ill-prepared to meet the demands of further education or modern industry.

Following are just a few of the many kinds of activities requiring joint involvement of resource institutions and supervisors:

Field testing of new instructional techniques
Field testing of new learning materials
Carrying out of inservice training programs
Testing of research hypotheses requiring pupil involvement
Evaluation of ongoing instructional programs
Evaluation of new facilities and equipment

It is as the supervisor exercises generalship in marshaling all available resources for the improvement of his science education program that he adequately fulfills his leadership responsibilities.

Community Resources

ELVA BAILEY *

COMMUNITY resources are all the people, places, and things which make up the local school environment. The selection and utilization of these resources for the improved education of our youth is a worthy challenge for all teachers and administrators. It is also a challenge that the citizens of the community will accept and support.

The utilization of community resources should not be regarded as an educational panacea any more than educational films, radio, television, teaching machines, or computerized instruction. None of these will fully satisfy the educational needs of our youth if used alone or without the guidance of properly motivated and capable teachers working within the framework of a sound educational curriculum.

The literature on this subject provides ample evidence that community resources are powerful educational tools, but that they are frequently overlooked or disregarded tools. How can this be? Has there been a decrease in emphasis on the interrelationships of the school and the community? A study by Olsen of 50 educational journals showed that the number of articles concerned with community study and participation increased 986 percent between 1930 and 1941 [6]. The *Education Index* reveals that during the period of June 1955 through June 1966 more than 125 articles on the subject of community resource utilization were published.

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PUSHING BACK THE WALLS

But even with this emphasis, intensive efforts to push back the four walls of a classroom are still limited to progressive little islands across our land. Why? Perhaps it is built into our system of preparing teachers. The colleges and universities provide us with teachers who have mastered subject matter, pedagogy, sociology, psychology, and many other essential skills required by the professional. However, the knowledge and understanding of the school and its community must be acquired on the job.

Apparently there exists at the local system and school level a great need for more teacher-community orientation and more leadership dedicated to improving this facet of the school program. This is not meant to imply that the great majority of our teachers are ignoring their community resources. The writer's own experience, every day, indicates that hundreds of teachers do know of, and make use of, their community resources. The appeal is for less random and more comprehensive utilization of available resources.

The problem of insuring satisfactory utilization of the resources of our communities for the betterment of education is complex, but even modest programs produce dramatic results. Each teacher can have at his or her disposal millions of dollars worth of talent and expertise. One study expresses it as "50 Teachers to a Classroom." [1]

The immediate responsibility of the reader of this book is the improvement of science education, presumably from K through 12. Let us then direct our attention to this area, while keeping in mind that programs of community resource utilization initiated to improve science education will have applications and "fallout" benefits for other subject areas.

INVOLVING THE COMMUNITY

Only three steps are involved in using community resources in teaching: (1) surveying the community to locate the resources; (2) enlisting these resources for use in a learning situation for teachers and/or students; and (3) programing carefully selected resources into the curriculum at the appropriate time and place. These are steps which are simply stated but far from simple to

[1] *Fifty Teachers to a Classroom.* Committee on Human Resources of the Metropolitan School Study Council. The Macmillan Company, New York. 1950.

achieve. All communities, even the smallest, are complex, and each is different—as varied and different as people. This is not a one-man task. Many people must be involved, both teachers and the general public. People, to become involved, must first become motivated. Motivating people is not easy. They have lived a long time and have had many experiences which sometimes limit their receptiveness to new ideas. If there is any logic to the solution of this motivation problem, it must involve convincing people of the need for action and the practicality of the motivator's suggested solution. Any motivator must be convincing and enthusiastic. He must also be patient enough to consider alternate solutions and accept temporary setbacks. Some of his colleagues will be convinced only by firsthand experiences. The writer spent several years in the classroom followed by several years in industry and government before fully realizing the enormous educational potential of readily available resources which surround teachers.

I now know that industry and government agencies feel a definite responsibility to the schools of the communities in which they are located. I know that their employees take great pride in their work and that many are teachers at heart. They feel that their work is significant, and with a little guidance from the professional educator they can make it meaningful to students. Although the employer is willing to spend money to tell the educational significance of his effort, and the employee is willing to give freely of his time, very little assistance will be offered without request. These people have a high regard for the school, the administration, and the teacher. Most do not realize that they could make a sound educational contribution. Many persons in industry have said to me or my co-workers that they have never been approached for assistance by the schools in their communities. Although the industries and government agencies of the community probably cannot provide financial grants to the schools, they are usually most willing to share human talent and physical facilities. The people exist; the places exist. They can be utilized.

DEVELOPING THE BLUEPRINT

Where do you start in developing a program to achieve maximum use of the available science resources in your community? The experts in this area emphasize that you should begin slowly. Organize a small, well-knit group of interested teachers and community-oriented citizens. This will be the "spark plug" or "trailblazer" group. Begin by establishing a high goal, but don't set up a crash program for achieving it in a few months. Something on the order of a "Five-Year Plan" would seem reasonable. What could a group hope to accomplish during an extended period such as this? The following is suggested:

A science resources directory for each science teacher (loose-leaf notebooks containing an inventory of the resources and maps showing their locations)

A science resources file card system in each school building

A variety of research units developed by teachers to illustrate how the wealth of community resources can be used to achieve better science education at the various grade levels

To achieve these objectives, begin with a small program in the most hospitable areas. Consider the "pilot project" approach. Begin with one school or select a specific grade level at several different schools. The first job of the "trailblazer" group will be to give a great deal of thought to the specifics of the long-range goal. Think of the goal as the blueprint for the house that is to be built. As in construction, the better the blueprint, the fewer costly changes during or following construction. Establish procedures of operation and a timetable. This will help assure a maximum return for efforts expended over subsequent years and enable the original group and new groups that move in to gauge accomplishments.

A voluminous amount of information will be collected in developing a successful community resources utilization program for science, with much of it laboriously obtained through hundreds of personal interviews. Therefore, great care should be exercised in developing suitable forms and filing procedures. The book *Teaching Tools* by Harold R. Bottrell [2] contains sample forms for the resources inventory and model file cards for the index. In fact, this book provides a comprehensive treatment of all phases of the problem of utilizing community resources and should be studied by each member of the "trailblazer" group.

APPROACHES TO IMPLEMENTATION

The group doesn't have to start from scratch in developing the inventory. Much work has probably already been done. Most of the teachers in the system will have some experience utilizing community resources. Find out about the people, places, and things outside the classroom which have already been used by the teachers. Make use of such sources of community information as the telephone book, city directories, Chamber of Commerce files, census reports, civic clubs, community histories, school records, historical societies, government agencies, and industrial publications.

The group should be divided into subcommittees and assigned the task of developing inventories in the following areas:

field trips and walking tours
resource persons for the classroom
industry- and government-sponsored materials of instruction

A few suggestions relating to each of these areas is provided in the following:

1. FIELD TRIPS AND WALKING TOURS

The field trip is one of the most obvious and frequently used procedures for pushing back the four walls of the classroom. Through this firsthand experience students will be able to relate the elements of their science curriculum to the "real life" work of science and technology.

Field trips need not always involve the whole class. Flexible or modular scheduling now practiced in many schools makes it easier to involve small groups in outside activities. A few students who are interested in a specialized science topic would probably receive a more complete tour of a facility than would a class of 30 to 40. Students in smaller groups have greater opportunities to ask questions and become involved. Also, there are many organizations which cannot accommodate a large group but would be quite willing to explain their operation to a limited number of students.

When listing community facilities do not miss nature areas, especially woods, ponds, and meadows near the schools. Even vacant lots and the school grounds provide a source for observing, collecting, and studying the relationships of living things to their environment.

Many of the youngsters' learning experiences occur at home with their parents and friends. Community resources can be utilized by the family to provide a bit of enjoyable educational togetherness. There are some facilities which are not practical for school visits because of distance, group size, cost, or seasonal availability. These visits can be described in a booklet of week-end family field trips. A copy of the booklet containing detailed information and maps could then be distributed to each family in the school community. This would be an excellent project to share with a PTA or a community service group.

2. RESOURCE PERSONS FOR THE CLASSROOM

There are many individuals in the community who have hobbies or interests of a scientific nature such as flying, ham radio, astronomy, photography, hunting, fishing, gardening, model rocketry, optics, rock collecting, inventing, tropical fish, model building, auto mechanics, sailing, or breeding animals. Occupations directly related to a scientific field might include anyone from a police fingerprint expert to a computer programer. Even within the school, a custodian could explain the heating plant, electrical system, or specialized tools which are examples of applied science principles. The cafeteria manager could demonstrate scientific principles used in baking and cooking or relate recipe measurement to mathematics, and menus to nutrition. There would be an opportunity to discuss the care of food to prevent spoilage. Many adults have had science-related military experience which they can share in the classroom. Former radarmen, navigators, ordnance and chemical technicians, sonarmen, pilots, hospital corpsmen, and aviation mechanics are but a few of these potential resource persons. In addition to the knowledge that resource people bring to the classroom, many have slides, films, and collections to supplement their presentations. Perhaps classes and small groups might visit the home of the individual to learn more about a topic.

These people can be contacted through a questionnaire or personal interviews or both. Field-trip inventories are best developed through on-site interviews with the person in charge of handling visitors to the facility. These individuals can also be of assistance in obtaining information about employees who would be willing and available for local classroom visits. These on-site interviews insure contact with persons who work in the community but live outside the community. The people who reside in the community can be located through questionnaires distributed by students, PTA groups, and service clubs.

An astonishing number of human resource capabilities will be uncovered in building the resource persons file. So many, perhaps, that it will be impossible to make use of all of them in a single school year. Follow-up contact with all resource people should be made at least once each year to keep the file active. If the resource is not utilized, a note thanking the individuals for making their services available will help to insure future participation. Many resources not related to science will be discovered, and they should be shared with the English, social studies, art, music, and other departments.

Now the important task of evaluating the resource remains. When a resource person is first contacted to make a presentation, the teacher should describe in as detailed a manner as possible the kind of information the class hopes to gain from the experience. It will eliminate misunderstandings if the expectations of all parties are compatible. This will also give the resource person an opportunity to prepare adequately for the classroom visit. As each resource person is utilized, comments by the teacher regarding effectiveness should be recorded.

3. INDUSTRY- AND GOVERNMENT-SPONSORED MATERIALS OF INSTRUCTION

Today students studying almost any unit of science instruction will have questions which are not adequately or correctly answered in the textbook, encyclopedias, or readily available periodicals. Publications and audio-visual aids produced by industry and government, as well as those produced by institutions and foundations can be used to help bridge the information gap.

Teachers, however, are frequently overwhelmed with the volume of available material and have little time to evaluate it for educational merit. Other material never leaves its source of production because teachers are unaware of its availability; and even if it arrives at a school, the material may sit in a storeroom awaiting organization. Proper utilization requires a clearinghouse manned by professionals who can review the material to select what is most usable.

After a comprehensive survey of community resources is completed and documented, it is of little value unless it is used. Any plan or goal which fails to measure progress in terms of utilization of the resources by the teachers and in terms of improvements in the quality of science education cannot succeed.

Ours is an age of rapid change. Advances in research and technology spawn new science disciplines almost overnight. How can we keep our young people in tune with these accelerating changes and aware of their significance? Many of the answers can be found right in our own home town through intensive utilization of our own resources.

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Organization and Function of a Science Council: One County's Experience

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SINCE 1951, Sacramento County, in California, has had a science council that functions in a supportive role to the science classes in the schools. The Council began during a three-day meeting planned by the general and special subject consultants of the Sacramento County Superintendent of Schools Office for the purpose of planning strategy for science education improvement. The Sacramento County Science Steering Committee, organized in 1951, has been in continuous operation since then, though its name has been changed to Sacramento County Science Council. It is composed of elementary and secondary teachers, elementary and secondary administrators, junior college science teachers, lay representatives, and retired teachers. The Council comes together three or four times annually to plan various kinds of science inservice activities for the teachers of our area.

Members of the Science Council, as well as other teachers in the county, have cooperated in experimenting with a variety of science curricula as sponsored by the National Science Foundation. Some of these have been: *Animal Coloration*, written by Robert C. Stebbins, University of California at Berkeley; *Time, Space, and Matter*, Physical Science Program, Princeton University; Elementary School Science Program (astronomy education), University of Illinois, Urbana; and the Earth Science Curriculum Project, Boulder, Colorado. Teachers have cooperated with various institutions of higher learning and with the National Science Foundation from one- to four-year periods during these experimental group sessions.

Another Council committee—the "Committee of Concern"—has as its primary function conservation education and natural history education and is now assuming a responsibility of education for natural beauty. This committee is composed of educators and lay public who have worked on various kinds of programs for children and teachers. One successful part of the program has been inservice training activities for teachers in natural history and the appreciation for the out-of-doors. Committee members have held a variety of workshops for the last two or three years for the teachers of our area and have taken thousands of children into the natural area which has been set aside by the Sacramento County Parks and Recreation Department. We have a 40-acre plot of ground, which is commonly known as the "Deterding Woods," located in Ancil Hoffman Park, Carmichael, Sacramento County, on the American River. During the fall of the year salmon and steelhead can be seen from the Deterding Woods natural area, and children receive a new insight on the development of life as they see these huge salmon spawning on the sand bar adjacent to Deterding Woods. The remainder of the salmon continue up the American River and are taken from the river at the Nimbus Fish Hatchery.

Another concern of this Committee is a one-day training session for legislators of the California State Legislature. The tentative plans are to invite a given number of members of the American Association of University Women and a given number of the state legislators, particularly those who have a responsibility in education and conservation, to an all-day conservation program. This will be a field excursion which will take them into the schools of the Sacramento County area which are developing programs in conservation and the out-of-doors.

One such site has been developed by Norman Marsh, a member of the Sacramento Science Council and a member of the Committee of Concern, on the grounds of the Bowling Green School. This one-acre natural area was constructed by parents and children of that K-6 school. It offers a place to visit and to become acquainted with birds, wildlife, and plants, both native and imported. Children wander through this natural area and have begun to feel familiar with the bushes and trees and birds.

Another project that originated with the Committee of Concern was an outdoor education program. We have attempted to establish a sixth-grade camping program for the children of Sacramento County and vicinity through a related organization commonly known as the John Day Foundation. Members of the Committee were instrumental in interesting other people as well as committee members in the need for an outdoor education program for the sixth-grade students of our area. The Foundation is acquiring a site and a program for sixth-grade camping education.

Members of the Committee of Concern appeared at the joint hearing of the Senate Fact-Finding Committee on Natural Resources and the Senate Committee on Education during the spring of 1966 and made a plea for additional conservation education in the public schools of California. A consultant in conservation education in the State Department of Education is one of the possible outgrowths of this hearing.

During the last 15 years, the Council itself has developed a variety of field trips for teachers to acquaint them with some of the community resources related to science. The Council has also arranged visits to scientific institutions and various kinds of industries that involve science technology. It also takes advantage of unusual or timely events to emphasize conservation education. An example was the flooding of much of the central valley of California in the winter of 1955-56. The Science Council, along with the Office of Superintendent of Sacramento County Schools, sponsored a variety of water-conservation field trips and workshops related to conservation education, particularly aspects of the wide use of water and flood control.

PUBLICATIONS

A few years ago members of the Council realized the need for a natural history guide for teachers in this area. Various members of the Council, life science instructors at the American River Junior College and Sacramento State College, produced a volume titled *The Natural History Guide for the Sacramento Region.* This is a nontechnical, profusely illustrated publication designed primarily for teachers.

Another publication which has been quite successful is one titled *Guide to Community Resources.* It is a composite resource book for people who come to the classroom and speak on science subjects and for teachers planning science field trips for students of elementary- and secondary-school level. The *Guide,* which is now on needle-sort cards, includes not only science, but also social studies, art, music, health, physical education, and all the areas of curriculum. It now has about 325 tested resources for the classroom teacher. Concise information that a teacher needs for a resource speaker or a study trip is easily found in the *Guide,* and items can be added or deleted without affecting the other entries.

section V

SELF-EVALUATION FOR THE SUPERVISOR

A Checklist for Supervisors

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THIS less than profound set of questions is designed to help you to look at your performance as a supervisor. The questions are more important for the implications they suggest than for their answers. Consistently low evaluations may lead you to explore the professional opportunities to be found in beachcombing. Rate yourself on each question by placing a circle around the number in the 10-0 line under each question that you honestly feel is appropriate. Connect the dots with a line and estimate your Z.Z. Score. (Zig-zaggedness)

The format for this evaluation scale was borrowed with permission from the Cornell Evaluation Scale for Teachers (1963 edition) developed under the direction of Philip G. Johnson, Professor of Science Education, Cornell University, Ithaca, New York.

CHECKLIST

1. *Does your administrator depend on you for advice about needed changes in the science program?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0

we plan changes together	I report changes, he applauds	he tells me what should be done

The supervisor needs to be knowledgeable. A record of good informed judgement will build the administrator's confidence in you.

2. *How does your administrator usually react to your projected budget?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0

we agree on additions and cuts	I'm expected to fight for it	we don't discuss it

He should expect you to have clearly stated justification for each item. You should expect that adjustments will occur as the science budget is placed within the total budget. Defend vigorously and adjust gracefully.

3. *To what degree are your present facilities and equipment being used?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0

lab work included, and equipment accessible	most teachers are using some equipment, others are learning	some labs not used; some equipment still packed

Unused equipment may reflect poor purchasing choices or a need for inservice programs. Unused equipment sitting on shelves is upsetting to administrators.

4. *Has there been a noticeable change in the amount or kind of science taught in the district during your tenure?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0

yes, after study and deliberation	we're thinking and talking about changes	dramatic changes every year

The degree of desirable change is different in every case, but absence of change denotes apathy or complacency. Rapid fire change denotes irresponsibility.

5. *How many teachers attended the last general group meeting you scheduled?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0

50 percent signed up; 70 percent came	less than 50 percent signed up. Some dropouts	attendance is required

Watch your objectivity when evaluating meetings with attendance required. Do teachers really drop out for dentist appointments?

6. *What has been your response to teachers' requests for discussions or inservice sessions?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0

two or more requested; two held — haven't had time to schedule them — none requested

Only a really enthusiastic staff will ask for meetings. Even then requests are few. Don't fail to meet them.

7. *Can you show tangible evidence that the last meeting you held for science teachers was profitable?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0

a 20 percent increase in individual requests for more information — when meeting is mentioned, teachers say, "what meeting?" — I think so, let's see....

Constant follow up and careful evaluation should be made, at least mentally, after group and individual work with teachers.

8. *How many different science teachers have invited you to visit their classrooms this year?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0

40 percent of total — 20 percent of total — none

You'll be invited if teachers feel you add something good to the instructional program or the classroom atmosphere and if they think you are interested in coming.

9. *Have you been asked to help interview and evaluate candidates for positions on the staff?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0

yes — sometimes — no

If your administrator feels that you are a working, contributing, member of the school services team, you will be consulted in personnel matters.

10. *Do you like and respect most of the people on the staff in your school system?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0

yes, we work hard and play hard together — I like them, but not socially — we have many weak, ineffective people

The amount of friendliness, support, and interest you give to others is often mirrored back to you.

11. *How many really enjoyable days did you have at work this week?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0
4½ days — 3 days — forget it

We win some and lose some, but should be looking forward to going to work at least .... percent of the time.
(you decide)

12. *When was the last time you participated with other staff members in a facetious semantic duel or some other mutually enjoyable nonsense?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0
yesterday — six months ago — what do you mean? I don't understand

If your score is low, is it because you don't enjoy oneupmanship? A sense of humor is an effective catalyst for rapport and cooperation.

13. *Do you think your work is usually more efficient and effective than the work done by other staff members?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0
we have a good staff — I have strengths and weaknesses — yes

A low score here should make you re-examine yourself for the presence of cockiness and the danger of self-tripupmanship.

14. *When you lack needed information or don't know how to do something, what course of action do you take?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0
hunt something or someone to help — act blase and bluff it through — abandon the project

Leave the omnipotence to God.

15. *When you commit a blunder in judgment or action, what do you do?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0
announce it and ask forgiveness — proceed cautiously to cover up — blame someone else

Teachers and administrators will generally forgive a humble soul when they know he has good intentions. Just don't let careless thinking cause you to outlive their forbearance.

16. *How many of the teachers under your direction have had a good or novel idea for teaching science this year?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0
several **few** **none**

Be sure that the teachers with good ideas have a chance to share them and get some recognition for them. If you had all the good ideas, where did you get them?

17. *How recently have you tried to work directly with students on a regularly scheduled basis?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0
this semester **haven't thought of doing it** **have forgotten how to do it**

It's important that teachers know that you can teach and that you know how it feels to take classroom responsibilities.

18. *When was the last time you took a science content course, either credit or non-credit?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0
this semester **less than three years ago** **more than five years ago**

Informal reading and study is some help in keeping up with new findings in science, but will not suffice indefinitely.

19. *How recent is your training in statistics, theory of learning, and educational research?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0
this semester **less than three years ago** **more than five years ago**

Again, informal reading and study help but are not guaranteed to give you the new skills needed to practice new techniques.

20. *How often do you read abstracts of research being done in the area of your scientific interest or in education?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0
weekly **seldom** **don't know where to find them**

Membership in AAAS, AIBS, and other such organizations will give you access to journals. AERA and NARST report research findings. Check the journals available in local libraries.

21. *When was the last time you checked in your school libraries for the science books students could use?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0

last week	last year	never get to it

The librarian will welcome your help in book selection. You need to know what is available for students and teachers.

22. *When do you preview science films, filmstrips, programed learning, tapes, and new products?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0

before selection is made by A-V director	after selection is made by A-V director	only on request by a teacher

The supervisor needs to exert some leadership and responsibility in the acquisition of these products. Poor selection can seriously compromise the purposes of the science program.

23. *When was the last time you submitted an article for publication in a professional journal or the public press?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0

this year	two years ago	never thought of doing it

Journals need your viewpoints and experiences. Writing about your program forces clarification of thought. Authorship brings professional status.

24. *When was the last time you coordinated a joint school-community learning situation for students or staff?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0

last semester	we don't interrupt the teaching schedule	I'm not acquainted with resources here

Science programs that have no room for current events in science or programs devoted to special interests are not likely to sustain student interest. Most schools need resource people to fill gaps in content or knowhow.

25. *To what degree do you participate in the activities of professional associations?*

10 ... 9 ... 8 ... 7 ... 6 ... 5 ... 4 ... 3 ... 2 ... 1 ... 0

seek opportunities for committee and program participation	attend state and national meetings	no time or money for this activity

Professional isolationism and good supervision are inconsistent.

26. *Are you planning and carrying out a program for personal professional advancement?*

10 . . . 9 . . . 8 . . . 7 . . . 6 . . . 5 . . . 4 . . . 3 . . . 2 . . . 1 . . . 0

looking for advancement as qualifications increase	expect to be advanced as competence increases	seniority will provide advancement

Advancement comes to those who know how to identify opportunities or to make the opportunities themselves. For example, as the use of the systems approach in education continues to grow, the prepared and imaginative supervisor can advance in many directions. He has the choice.

RATING YOURSELF

For your score, total the numbers you have circled.

250-230 .... See question 13

220-190 .... Survival and improvement can be expected

75-50 .... Have you tried beachcombing?

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The current catalog listing the National Education Association's publications is always available from NEA headquarters, 1201 Sixteenth Street, N.W., Washington, D.C. 20036.

Government publications in the field of education are listed in a special catalog available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

PROFESSIONAL SOCIETIES FOR SCIENCE TEACHERS AND SUPERVISORS

The following is a list of names and addresses of the associations listed on p. 107.

American Association for the Advancement of Science
1515 Massachusetts Avenue, N.W., Washington, D.C. 20005

American Association of Physics Teachers
335 E. 45th Street, New York 10017

American Chemical Society—Chemical Education Division
1155 Sixteenth Street, N.W., Washington, D.C. 20036

American Institute of Biological Sciences
3900 Wisconsin Avenue, Washington, D.C. 20016

American Nature Study Society
no permanent headquarters; current officers listed in *Nature Teaching Tips*

Association for Supervision and Curriculum Development
1201 Sixteenth Street, N.W., Washington, D.C. 20036

Central Association of Science and Mathematics Teachers
no permanent headquarters; current officers listed in *School Science and Mathematics*

National Association of Biology Teachers
1420 N Street, N.W., Washington, D.C. 20005

National Association of Geology Teachers
no permanent headquarters; officers listed in *Journal of Geological Education*

National Association for Research in Science Teaching
no permanent headquarters

National Science Teachers Association
1201 Sixteenth Street, N.W., Washington, D.C. 20036