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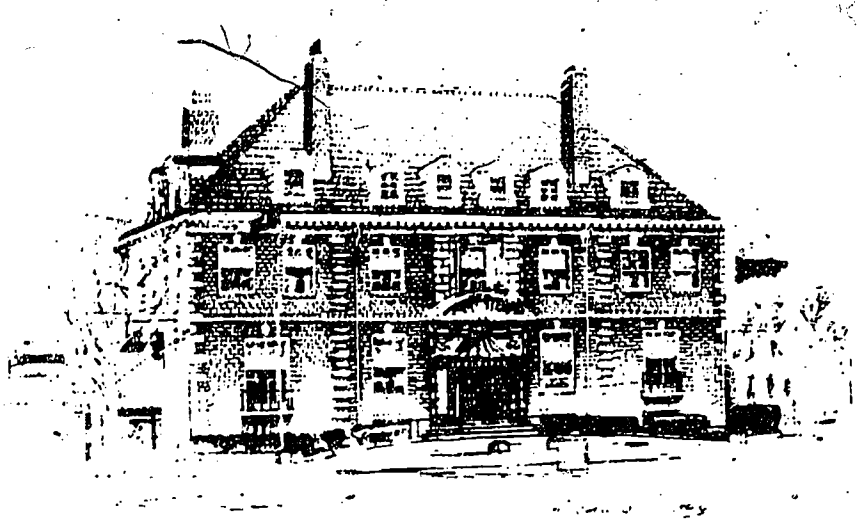
ABSTRACT

This handbook is designed to assist elementary school principals in improving and maintaining quality science education programs, while strengthening their role as science curriculum leaders. The handbook can be used as a resource for disseminators as they prepare for meetings with principals' groups and as a reference that can be used by principals in the day-to-day operation of their schools. Major emphasis is on the role of the principal as a: science leader; science curriculum analyst; force in selecting/developing new science curricula; provider of inservice instruction; monitor of science program progress; and as a troubleshooter. In addition, the importance of principals, importance of science, and relationship of science and principals are considered. Recommendations to improve the principal's leadership role in science are included. Some, like letting teachers know that the principal is interested in science, can be done easily. Others, like visiting classrooms to observe science teaching/learning, take time. And, still others, like ensuring that children have science supplies/materials to work with, cost money. While it may not be possible for principals to try all suggestions, if they begin with one or two that seem to have the most promise for success, the result could be an improved science curriculum. (JN)

HANDBOOK II

THE PRINCIPAL'S ROLE IN ELEMENTARY SCHOOL SCIENCE



Project for Promoting Science
Among Elementary School Principals

National Science Teachers Association
1742 Connecticut Avenue, NW
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KENNETH R. MECHLING and DONNA L. OLIVER

HANDBOOK II

THE PRINCIPAL'S ROLE IN ELEMENTARY SCHOOL SCIENCE

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There is a Chinese proverb: one generation plants the trees...another gets the shade. In this project, trees were planted with the help of many people. It is our hope that elementary school children all over the United States will benefit from the shade.

The project, Promoting Science Among Elementary School Principals, began as an idea at the meeting of the board of directors of the National Science Teachers Association (NSTA), held in Dayton, Ohio in 1980. It was conceived as a joint effort of NSTA and the Council for Elementary Science International (CESI). We are grateful for the foresight, encouragement, and leadership of Don McCurdy, then president of NSTA.

Many people shared in the development of the project. Their efforts and ideas deserve our sincere appreciation. They include:

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PREFACE

This handbook is part of a National Science Teacher Association project titled, "Promoting Science Among Elementary School Principals." There are four handbooks in the series: Handbook I titled Science Teaches Basic Skills; Handbook II, The Principal's Role in Elementary School Science; Handbook III, Characteristics of a Good Elementary Science Program; and Handbook IV, What Research Says About Elementary School Science.

The Principal's Role in Elementary School Science is designed to assist elementary school principals to improve and maintain quality science education programs, while strengthening their roles as science curriculum leaders.

The handbook can be used in two ways: (1) as a resource for disseminators as they prepare for meetings with principals' groups; and (2) as a reference that can be used by principals in the day-to-day operation of their schools.

The recommendations can improve a principal's leadership role in science. Some recommendations, like letting the teachers know that the principal is interested in science, can be done easily. Others, like visiting classrooms to see science teaching and learning in action, take time.. And, still others, like ensuring that children have science supplies and materials to work with, cost money. While it may not be possible for a principal to try all of our suggestions, if he or she were to begin with one, two, or three that seem to have the most promise for success, the result could be an improved science curriculum.

Handbook II recognizes the principal as the key to a good science program. With their leadership, encouragement, and support, science curricula in schools can be improved. And, through the collective action of thousands of principals around the country, science education in our nation's schools can be improved. Principals must become visable promoters of science. Science education needs their help, and it needs it now.

Ken Mechling
Donna Oliver

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I. Principals Are Important!

The principal is the key factor in the success or failure of an elementary school. Evidence of the principal's importance comes from organizational statements, from the literature, and from research. Although their influence on schools and curricula is pivotal, principals appear to have been neglected in our national efforts to improve science education, and our programs have suffered because of this neglect.

II. Science is Important!

Science is important because it can help meet children's personal needs while preparing them to live successfully in an increasingly technological world. It can help them become informed citizens prepared to deal responsibly with societal issues. It can help them learn about the world around them. It can help develop their thinking skills. And, it can help them make informed decisions about careers related to science and technology.

III. Science and the Principal

While principals are responsible for providing top-quality science experiences for the children who attend their schools, many feel that they aren't well qualified to supervise science instruction. And, for many, science ranks low on the totem pole in comparison with other subjects. Though principals are curriculum leaders, they certainly are not required to be experts in science to be effective. By applying a few simple leadership techniques, science teaching and learning in their schools can be improved.

IV. The Role of the Principal

A. The Principal as a Science Leader

Principals are urged to show leadership in science, to demonstrate positive attitudes toward science, and to communicate their interest in science to teachers and others.

Principals can demonstrate leadership in science by

1. Discussing science with their teachers
2. Visiting classrooms when science lessons are taught

3. Sharing science success stories as models for teachers to emulate

4. Devoting PTA meetings to science

5. Mounting a publicity campaign for science

6. Organizing public expositions of pupil science projects

7. Identifying community resources which can enhance science instruction

8. Insisting that science be taught for specified amounts of time

9. Assisting colleges and universities to improve teacher preparation programs in science

B. The Principal as a Curriculum Analyst

Principals need to find out about their own science programs--the goals, the teaching strategies used by teachers, typical learning experiences, evaluation procedures, and so on.

Principals can learn more about their programs by

1. Checking state and local regulations to determine science requirements

2. Examining the school's goals for science education

3. Surveying teachers

4. Asking children

5. Conducting inventories of equipment and supplies

C. The Principal as a Force in the Selection or Development of a New Science Curriculum

Principals should provide leadership in the selection or development of a new science curriculum. They should be the driving force, the catalyst, to get the process going and keep it on track.

Principals can contribute to curriculum selection by

1. Identifying a committee of teachers and others to help

2. Charging the committee with a task and a target date for completion

3. Insisting upon the establishment of goals and objectives for science and criteria for program selection

4. Considering options for curriculum selection

5. Securing science curriculum materials for review and evaluation

6. Ensuring that all teachers who will use the program have a part in selecting it

D. The Principal as a Provider of the Wherewithal

An important role of the principal is to seek funds to purchase science supplies and equipment and cover costs of staff development.

Principals can ensure that funds will be available by

1. Budgeting for new and replacement science materials

2. Providing a petty-cash fund for the purchase of inexpensive, local supplies

3. Anticipating costs related to program selection and teacher attendance at conventions

4. Making allowances for costs related to science inservice programs

E. The Principal as a Provider of Inservice Instruction

Principals must take the lead in providing inservice experiences in science for their teachers.

Principals can contribute to the inservice education of their teachers by

1. Designing programs to pump new life into old science curricula

2. Providing in-depth inservice training programs when new science curricula are adopted or developed

3. Arranging for colleges and universities to provide inservice science instruction for credit
4. Participating, actively, in inservice programs themselves

F. The Principal as a Monitor of Progress in Science Programs

Principals must give their science programs periodic checkups to determine their vitality and continuing effectiveness.

Principals can monitor their science programs by

1. Periodically reviewing the science curriculum
2. Evaluating teachers' performance as science teachers
3. Examining students' performance on science tests

G. The Principal as a Troubleshooter

Principals must be able to deal effectively with problems that arise in the science curriculum--problems such as teachers sloughing off their science teaching responsibility, over-reliance on reading as a method of teaching science, and classroom noise.

Principals can combat problems related to the science curriculum by

1. Letting teachers know that science is important and that they must teach it
2. Ensuring that children have opportunities to "do" science
3. Hiring teachers who are well-prepared to teach science and confident in their ability to teach it
4. Letting teachers know that a reasonable amount of "educational noise" is OK
5. Adopting a grading system that fits an activity-centered science program and meets with the approval of teachers and parents

V. Summary

With support, encouragement, and leadership from the principal, the science curriculum will probably flourish and grow. Without the principal's support, it may wither and die. To improve science curricula principals must zero in on those roles which will most likely succeed and must take the necessary action.

I. PRINCIPALS ARE IMPORTANT!

Comedian Rodney Dangerfield's favorite line is, "I don't get no respect." Obviously, that line does not apply to elementary school principals. You are respected. You are important. Our own experiences and the literature of education are replete with examples of the principal's important role.

In a series of National Science Foundation (NSF)(1) case studies done in schools around the United States, researchers described the role of a typical elementary school principal: "The principal serves a unique role of boss, shepherd, and manager all rolled into one. He or she is usually the major factor in the school's operation...."

The National Congress of Parents and Teachers (PTA)(2) says that the principal is the "key factor" in the success or failure of a school. They tell us that teachers need someone they can turn to for help in a number of important areas--someone to assist with selection of textbooks and other resources, someone to design inservice programs that sharpen teaching skills, and someone to provide time for curriculum planning. That someone is you, the school principal.

A recent article in the Phi Delta Kappan by Shoemaker and Fraser(3), reviewed ten studies of effective schooling. All ten clearly demonstrated that principals were important in determining the effectiveness of schools. Principals in the higher-achieving schools were stronger instructional leaders. They were assertive. They led. They made the difference.

When it comes to curriculum change, principals are in a position to initiate it or retard it. As Henry Brickell(4) said:

> The administrator may promote--or prevent innovation. He cannot stand aside or be ignored. He is powerful, not because he has the monopoly on imagination, creativity, or interest in change--the opposite is common--but simply because he has the authority to precipitate a decision.

The National Academy of Sciences(5) agrees: "Principals . . . are the key agents for educational change or for maintaining the status quo."

While the principal's important role has been cited repeatedly, one might ask what effect it has had on the way science is taught and learned in schools. Many would say, not much. During the past twenty years, the federal government has spent millions of dollars to improve science education. The results have

been less successful than everyone had hoped. In their NSF-supported study, Stake and Easley(6) sum up the situation with this dreary assessment:

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

If what Stake and Easley say is true, it would seem that principals have had little impact on the teaching and learning of science. The truth is that little has been done to help principals achieve better science programs.

Frankly, we think you have been ignored. We want to change that. We want to assist you, the elementary school principal, to improve your science program in your school. That's what this presentation is about.

II. SCIENCE IS IMPORTANT!

Most schools accept science as a part of the elementary school curriculum. By law, tradition, or conviction, science is regarded as something which should be taught and learned. Unfortunately, it is often taken for granted, perceived as just another subject, something less than basic. Little thought is given to why science is important and what applications it can have to children's lives. Project Synthesis, a National Science Teachers Association project supported by the National Science Foundation, helps answer the question "What's science good for?" by giving four good reasons(7).

First, science can help meet children's personal needs while preparing them to live successfully in an increasingly technological world. Keeping healthy, making "smart" consumer choices, living in harmony with the environment, being able to gather and use knowledge for making decisions and solving problems--all are good reasons for learning science. Moreover, children's fascination with microcomputers, calculators, and video games reminds us that we are in the throes of a technological revolution--a revolution which will bear fruits all during the lives of those children. Why be concerned? As one scientist warns:

> The world of micro-electronics, telecommunications, genetic engineering...is going to be bewildering for those who are untutored in

> modern sciences and technology...so much of our life has a science ingredient to it that one can't be expected to understand, to appreciate, the nature of life without, some scientific understanding(8).

Second, science can help children become informed citizens prepared to deal responsibly with societal issues. From local concerns, such as waste disposal and stream pollution, to global problems, such as energy availability and population control, science instruction can prepare children to make wise decisions, participate in responsible community action, and vote intelligently.

Third, through the study of concepts in the life, earth, and physical sciences, science can help children learn about the world around them. It can help them apply the processes of science to their own lives. Learning about the solar system, electricity, air and weather, and ecology, not only help children to better understand the world, it also provides a basis for further study of science, both in school and in the later years of life.

But, science is more than facts, concepts, and principles. It is a procedure for asking and answering questions, a method of inquiry, a way of thinking. Through science experiences, children can develop and sharpen their skills of observing, classifying, inferring, communicating, measuring, predicting, formulating and testing hypotheses, designing experiments, identifying and controlling variables, and interpreting data. Such skills have application to other curricular areas, including language arts, mathematics, and social studies. And, perhaps most importantly, they are the same skills that, once learned, will enable children to keep on learning throughout their lives.

Fourth, science can prepare children to make informed decisions about careers related to science and technology. Learning about the work of scientists, engineers, technicians, and computer specialists, and science-related jobs in agriculture, medicine, nutrition, conservation, and mining can help children become aware of the many possible roles and jobs available in science and technology. Science can lay the foundation for rewarding and productive careers later on in life.

Science is important because it can help children better understand themselves and their environment. It can help them develop thinking skills that are needed throughout their lives. It can help raise their curiosity and enthusiasm for learning. It can help them learn to learn. (For a more extensive coverage of the value of learning science, see Science Teaches Basic Skills, Handbook I in this series.)

III. SCIENCE AND THE PRINCIPAL

We know that elementary principals are busy people. You have many responsibilities--from ensuring that the kids get on the right buses, to picking your way through a maze of paperwork. We also know that you are curriculum leaders. You are responsible for providing top-quality learning experiences for the children who attend your schools--learning experiences that include science.

Many principals feel uncomfortable, even inadequate, with science. About one-fourth of the principals surveyed in a recent NSF study(9) felt "not well qualified" to supervise science education. Relatively few, 11 percent, had majored in science. Most had majored in reading, language arts, English, or social studies--those areas which seem to get a bigger bite of the elementary school curriculum(10). For many principals, science is low on the totem pole in comparison with other "more basic" subjects.

While many principals want to improve science in their school's curriculum, they wonder how and where to begin. In this presentation, we will try to help you. We have identified various roles which we believe a principal must play in a successful science program. Expertise in science is not one of the requirements for effective leadership. Rather, by applying a few simple techniques, science teaching and learning can be improved. Many of you may already be doing some of what we recommend. We applaud you. Others may have ideas in addition to those we present. We hope you will share them with us.

IV. THE ROLE OF THE PRINCIPAL

A. The Principal as a Science Leader

We believe that teachers and kids will take their science cues from you. If you are excited about science, they will be excited about science. If you are interested, they will be interested. If you think it's important, they will think it's important. We urge you to take a leadership role. Be an advocate for science.

In a recent survey among elementary principals in Pennsylvania, the need most often mentioned was for "demonstrating a positive attitude toward science." Principals felt that they had to show leadership--in effect, be the "prime movers" for science, accentuating their own interest in the science curriculum(11).

In a study of student achievement funded by the U.S. Office of Education, there was consistent evidence that improved achievement was more likely to be found in schools where principals felt strongly about instruction and effectively communicated their viewpoints to teachers, through principal-teacher discussions, reviews of teaching performance, etc.(12).

Here are some ways in which you can show your leadership.

1. Talk to your teachers about their science teaching. Ask about their science lessons. Do the children like science? Has the class taken any field trips this year? Do the children show evidence of increased interest, curiosity, responsibility, persistence? How can we help you teach science more effectively? Questions like these will help to show your interest in science, and interest is contagious. If you show it, they'll catch it.

2. Ask your teachers if you can visit their classrooms when the children are involved in a science lesson. Remember that many teachers will be uptight about your visit. A good way to put everyone at ease is to participate in the science activities with the children. A visit such as this is not an evaluative visit--it is one to demonstrate your interest in science.

3. After visiting science classes, share success stories with other teachers. Tell them about science teaching techniques or student behavior that you believe is exemplary. Anecdotes about children who shout, "I did it, I did it," while constructing simple electrical circuits or a teacher who used clay models to show the relative sizes of planets in the solar system, can serve as resource ideas or, better yet, as models of success for others to emulate.

4. Devote a PTA meeting to science. Such meetings can be particularly effective if the parents are involved in science activities similar to those that their children have done. For example, challenge the parents to light a bulb by using a cell, a bulb, and a wire. Or, have them predict and measure their heartbeat and breath rates before and after exercise. It

is important to have the parents do science. Enlist the aid of teachers and/or children to plan and guide the activities.

5. Start a public relations campaign for science. Focus on some interesting aspects of your science program and highlight it in your school newspaper or a community newspaper. Perhaps some teachers are already doing science with the children, or taking the children on field trips, or doing interesting or unusual activities in their classrooms. Newspapers are generally cooperative in photographing and putting together human interest stories that highlight school activities. Publicity is a good way to show that science is important in your school.

6. Suggest and help organize a public exposition of pupil science experiments or demonstrations. Pittsburgh's North Hills School District recently held a "Science is Super" program at a local shopping mall. For several days, elementary school children displayed and demonstrated their science projects for the mall visitors. The program was capped with an evening of recognition awards for the participating children. Hundreds of parents and friends turned out for the ceremonies. Judging from the enthusiasm and interest of children and parents, science really was super in that school district!

7. Identify community resources that can enhance your usual science curriculum and present the names, addresses, and telephone numbers to your teachers. Persons such as horticulturalists, beekeepers, research scientists, engineers, and others are often willing, even anxious, to visit schools and can liven science classes.

   If transportation is available, you may wish to suggest class visits to sites such as electrical power plants, nature trails, zoos, or science centers. Your initiative lets the teachers know that you are interested in science.

8. Science should be a regular part of the curriculum. For many reasons in many schools, it is not. Let the teachers know how much time per week should be spent on science and encourage them to keep on schedule. Remember that science activities may often take longer

than the daily time allotted. Teachers can be encouraged to adjust their schedules to achieve flexibility. Spending a little more time on science today means spending a little less on it tomorrow. Two 50-minute classes per week may be more productive than five 20-minute classes.

If the teachers are concerned that they may be devoting too much time to science, suggest that they integrate science with other subject areas like reading, language arts, mathematics, and social science, or integrate these areas with science. Not only can the skills in these curricular areas reinforce each other, but integration can result in an economy of time. For a thorough discussion of the topic, refer to the companion handbook in this series, Science Teaches Basic Skills.

9. Take an active role in advising colleges and universities about their teacher preparation programs in science. If your school has student teachers, are they well-prepared to teach science? Are the new teachers you hire and supervise well-prepared to teach science? You can serve the profession by analyzing the science teaching strengths and weaknesses of both student teachers and new teachers and reporting your observations to teacher educators. Feedback from the field is important in improving teacher education programs.

B. The Principal as a Science Curriculum Analyst

No doubt your school already has a science program. It may be textbook based; it may be a curriculum like the Science Curriculum Improvement Study (SCIS), the Elementary Science Study (ESS), or Science--A Process Approach (SAPA); or, it may be one that your staff has designed from scratch. Whatever its origins, some teachers are, in fact, teaching science and some children are involved in science experiences. But how much do you know about the teaching and learning of science in your school? What are the goals of the program? Who decided what they should be? Are they being achieved? Do the children like science? Are the teachers adhering to the science teaching schedule? Do they involve the children in science activities? Without answers to questions such as these, you could have the best, or worst, science program and not even know it. Before beginning to improve your science curriculum, it may be helpful to find out more

about it; what its goals are, whether or not the goals are being met, and how.

Following are some ideas which you can use to help you find out about your science program:

1. First, what are your state, county, local district, or building requirements for teaching science? Some states say simply that science shall be taught in the elementary grades. Others prescribe the number of minutes science shall be taught per week. It is important to check the pertinent regulations to determine what is required.

2. Goals should be examined as you analyze your science curriculum. Do you have goals? Where did they come from? Are they still valid? Goals give direction to your science program. They help you decide what knowledge, skills, and attitudes you want your students to achieve. Some states, like Pennsylvania, have goals. Several of Pennsylvania's Twelve Quality Goals for basic education are science-related(13). For instance, Goal #8 on Science and Technology states, "Quality education should help every student acquire knowledge, understanding, and appreciation of science and technology." And, Goal #4 on Analytical Thinking states, "Quality education should help every student develop analytical thinking skills." These are broad goals, and ones which certainly pertain to science. More often, schools set their own goals. Here are some examples of goals set by several school districts:

   The student will become more proficient in science process skills such as: observing, predicting, interpreting data, classifying, controlling variables, inferring, formulating hypotheses, experimenting, measuring, and formulating models.

   The student will cite examples of life cycles and life processes of living things.

   The student will learn certain scientific facts and concepts.

   The student will become scientifically literate.

   Students will demonstrate enthusiasm and positive self-concepts toward science experiences.

Pupils will be able to measure length, mass, and volume in metric units.

The student will describe the types of energy needed by humankind (global society), the sources of each kind, and their relative availability.

As principal, you should take the initiative to examine and formulate goals. If you wish, you could assign this task to a committee comprised of teachers, with input from parents and children. To paraphrase the words of Robert Mager(14), "Where do you want to go in science, how will you get there, and how will you know you've arrived?"--what are your goals, your methods for achieving those goals, and what's the evidence that you have achieved them.

Goals should not be statements in a curriculum guide that gathers dust on a shelf, They should be functional, clear, concise statements of what should be accomplished in science. Without them, your science program will have no rudder to steer it in the direction you wish it to go. As you consider your goals, remember too that you will want science instruction to be interesting and valuable to the lives of the children, now and into the future.

3. A good way to find out about your science program is to survey your teachers. A brief questionnaire can be constructed to get information about who teaches science, when it is taught, for what periods of time, the usual methods for instruction, how science classes are evaluated and graded, the amount of parental feedback, and the teachers' perceptions of their own science teaching performances. Such a survey can help you to identify what kinds of help teachers believe they need to improve science instruction. It can also assist you in identifying key teachers who can provide leadership in science. Of course, the results of the survey should by shared with the teachers, and they can be used as a basis for decisions about curriculum improvements.

4. One of the best barometers of your science program is the children. Do they like science? Are they learning? Are they involved in science activities? Do they talk about science at home? You may wish to develop a questionnaire to determine how the children feel about their science program.

5. A must in your curriculum analysis is an inventory of science texts, supplies, and equipment to determine what you have on hand and in what quantity, and condition. Obviously, your teachers will need to assist you in this task. You can easily develop a written form which can be used as a guide when teachers inventory the materials in their own classrooms.

Not only can such an inventory help you determine what items your teachers have on hand, but the quantities and quality of those items may be a good indicator of potential for hands-on participation by the children. Two magnets or one microscope do not provide much opportunity for hands-on experiences in a class of 30 children. If teachers indicate that certain items are not needed, then they can be returned to storage and made available to other teachers who may wish to use them.

C. <u>The Principal as a Force in the Selection or Development of a New Science Curriculum</u>

One of the principal's most important roles is to provide leadership in the selection or development of a new science curriculum. Once a decision has been made to try something new, the principal, in the words of many principals, "should be the driving force, the catalyst to get this process going and keep it on track." The decision to adopt or develop a new curriculum is especially important since it will have an impact on what is taught in science, how it's taught, and how children will be evaluated. Further, once a curriculum is selected or developed, the school will probably continue using it for a long time--perhaps ten to fifteen years. What is the principal's role in this process?

1. Obviously, principals need help. A committee can be appointed or selected to assist. The committee should be small enough to be manageable, yet large enough to be representative of the broad interests of the school. Nine or ten persons should be maximum; fewer would be desirable.

There are many ways the committee can be structured. One way might be to select teachers or get volunteers from each grade level. Another may be to have two or three persons representing the primary grades and two or three representing intermediate grades.

In the selection of these persons, it is a common practice to select persons who are "science prone," teachers who have been identified as science-oriented, who like to teach science, and who are good at it. While it is necessary to have such persons on the committee, it is also advisable to invite persons who are not science-oriented, teachers who do not enjoy teaching science or feel that science is not one of their strengths. A merit of adding "science shy" teachers to the committee is that they may represent a substantial number of teachers who will be affected by the curriculum decision. Since all teachers of science will be affected, it is important to get input from those who are least qualified or interested in teaching science.

You may also want to consider adding several other persons to the science curriculum committee. A representative from the middle school, the junior high school, or high school science area can help assure continuity and articulation of science experiences throughout a student's school years. If your school has a science supervisor or science department chairperson, that person would be a valuable addition to the committee and could be expected to provide leadership and technical advice. Some schools also include a reading specialist on their science curriculum committee to ensure that reading materials included in the science program are written at appropriate grade or reading levels.

Don't hesitate to allow or encourage members of your staff to assume leadership roles. Organization of staff for self-reliance is the key to getting things done. Greater involvement of your staff can assure "ownership" for the curricular decisions that are finally made.

Your role on the committee is crucial. Research findings indicate that teachers cannot bring about program change without the support and assistance of the school administration. Support from the principal of the school is a significant factor in achieving a successful program implementation(15). You will want to lead, assist, encourage, and question, without foisting your own views on the committee. The decision should be theirs. They will have to teach from the program and the choice should be one that they can live with comfortably.

2. You should give the committee a charge. Tell them what their task is and give them a target date for completion. You may want to provide time for them to meet, perhaps during inservice days, during the summer, or at times convenient for the group. You should determine very early in the process if your committee can be paid and, if so, where the money will come from. Practices range from no compensation to a full year's assignment with pay.

3. Many science curriculum committees begin by reviewing texts and other curriculum materials. A better way to begin is by establishing goals and objectives for your science program. Decide what science knowledge, skills, and attitudes the children should have upon the completion of elementary school--then look for the program or develop one that best meets those goals. It may be a good idea to survey your teachers to determine what they believe the goals for science should be and what content and experiences should be included in the science curriculum. Once goals have been decided upon, the committee can proceed to identify the criteria by which each science program will be measured. For example, the committee may decide that the program they select must include many opportunities for hands-on science experience. Or, they may decide that reading materials should be appropriate for each grade level, or that high-quality, durable science equipment and supplies be included, or that life science experiences be part of every level, or that the publishers or suppliers provide evaluation instruments. These criteria are the yardsticks that can be used to measure the science programs under consideration. They can be put in a list form and applied to each program. Remember, it is important that the criteria are identified before the actual curriculum review process begins.

4. Once goals and criteria have been set, it is important to consider options for curriculum selection. Should a program that is available commercially be adopted or should the school build its own science program? Of course, there are costs and benefits to both methods. A commercial textbook-based program by a publisher such as the Charles E. Merrill Publishing Company or D. C. Heath is a ready-made program. Just about everything one needs for

teaching science is available for purchase. If the program fits the school's goals and criteria, and is affordable, perhaps the commercial program should be selected. However, if commercial programs don't measure up, then the committee may wish to consider developing its own science curriculum. Many locally-developed science programs are excellent, but production takes time and expertise, more than most schools have to give. In practice, most schools purchase science programs from publishers. Some adapt them to meet local needs.

5. If your group decides to take the route of the commercial program, then request science curriculum materials for review and evaluation. Most principals obtain information and samples from publisher or educational company representatives. Sales representatives are generally very cooperative and helpful in supplying sample materials for review, and many will arrange to have their program presented to the committee for consideration.

Local, state, and national science conventions such as those of the National Science Teachers Association (NSTA), are excellent places to examine science programs. Exhibitors often provide samples for schools conducting serious curriculum reviews. You may wish to consider sending a committee representative or two to a convention for the specific purpose of gathering information on new curricula.

And, don't overlook journals, such as NSTA's Science and Children, which contain both ads and reviews of science curricula.

6. Once the committee has been selected, the goals and objectives set, the criteria identified, and the sample curriculum materials acquired, what remains is the pick-and-shovel work of the selection process. The committee examines each program, perhaps settling upon two or three as "finalists." In some schools, the committee goes back to the teacher-users, presenting an overview of the selections being considered, and seeks the teachers' advice. Although degrees of participation by teachers may vary, it is important to keep everyone informed of the committee's progress. All teachers must have a part in the selection process. An ancient

maxim Quod tangit omnes ab omnibus approbetur (let all approve what touches all), certainly applies here.

If you've gotten the idea that a well-conducted selection or development process takes time, you're right. Your committee will need time to organize, make plans, survey teachers, acquire and examine materials, think, and discuss. These processes require time--usually measured in months. So, when a curriculum decision is on the horizon, be sure to allow enough lead time for the committee to make a careful and rational decision.

When the final decision is made, the committee should summarize its work, presenting justifications for the decisions reached to all concerned--teachers, administrators, and parents. You may also wish to consider trying out the newly-selected program in one or more of your schools before you decide to adopt it for your entire system. If a pilot plan is decided upon, again, you and your committee should identify criteria by which the curriculum is to be judged during its trial period.

D. The Principal as a Provider of the Wherewithal

Science programs cost money. Science materials, supplies, equipment, and books are needed to keep a good science program going or to start one up. Equipment like dry cells, magnets, rulers, chemicals, and live organisms are as important to science instruction as books are to reading, pencils to writing, and instruments to music. An important role of the principal is to seek funds to support a good science program, to ensure that science needs are anticipated and included in the budget.

Following are some cost considerations:

1. Costs related to the normal operation of a science program can always be anticipated. Some items will need to be replenished and new ones obtained. The budget should always include provisions for these expenditures. Supplies, equipment, books, field trip costs, bus transportation, refill kits, audiovisual materials will all need to be considered.

2. Another important consideration is how to make it easy for teachers to purchase locally available items as they need them. Dry cells go dead, seeds must be replenished, vinegar supplies may run short. Teachers need to be able to make such local purchases. You, the principal, can design a petty-cash system and let teachers know how to use it. Some schools provide vouchers, others reimburse the teachers for their out-of-pocket expenses. Whatever system is used should not deter teachers from obtaining such items. And they must feel that a minimum of their own time, effort, and money has to be expended in obtaining supplies; otherwise few science learning experiences requiring locally-purchased items will be provided in their classrooms. Perhaps an interested person in each building could be designated to maintain the level of expendable supplies.

3. If you decide to select a new science program, you can anticipate additional costs related to the selection process. You may want teachers to visit schools which are using the science program that interests you most. Or, you may want them to attend conventions to learn about new programs. If the members of your committee are working on their own time, or if release time necessitates the hiring of substitute teachers, additional costs will be incurred. If committee members visit other schools or attend conventions or meetings to learn about new curricula, travel, lodging, subsistence, registration fees, and other expenses should be supported.

4. If a new science program is adopted, the inservice needs of the teachers should be considered in your budget. One of the most important parts of the adoption process is to provide all teachers who will use the program with instruction on how to use it. Most schools fail miserably here: they do too little, forcing teachers into a sink-or-swim situation. Costs for initial inservice programs must be considered, along with the costs for inservice programs related to routine program upkeep and the orientation of new teachers who come into the system.

E. The Principal as a Provider of Inservice Instruction

The principal has a key role in providing inservice experiences in science for his or her teachers. Whether you have an ongoing program which could use an infusion of new life, or you adopt an entirely new program, ongoing inservice training in science is critically important. Take the lead in providing such experiences.

Here are some things which you may wish to consider.

1. Pump some new blood into your old program. After a period of years, almost all programs, no matter how good they are, grow stale. Teachers grow tired of teaching "the same old thing." You may wish to have someone demonstrate how to use live critters in elementary school classrooms, or someone to show how to r[illegible]te science to other curricular areas, or someone to show how kids can be involved in experiences out-of-doors, or someone who can show children how they can investigate their own bodies by using stethoscopes or skin thermometers.

   In addition to the enthusiasm and interest such programs can create, they can also be designed to address certain problem areas in your science curriculum. It's a good idea to survey your teachers before the inservice program to find out what they perceive their problems to be and what kinds of inservice help they would like to have in science. Resource persons for conducting programs may be secured from area colleges, universities, governmental agencies, or from within your own school system. Ongoing inservice programs keep science programs current, help to meet changing needs, and train teachers new to your system.

2. Inservice education is especially important when you adopt a new science program. Before the program shows up in their classrooms, teachers will need to know what they are to teach and how they are to teach it. New curricula invariably include new science content, processes, and even teaching techniques. Teachers who are science shy, who lack confidence in their ability to teach science, and who have taught science mostly by telling or by having the children read, may be overwhelmed by a curriculum in which the children do science through participatory activities. They will need the help and encouragement that a good inservice program can provide.

Should you provide a one-day, two-day, or one-week training program? The length and nature of your program will, of course, depend upon many factors--for instance, the complexity of the program, the time available, your budget. Our experience has shown that most schools adopting new science programs don't do enough. Inservice programs, designed to prepare teachers for their new science teaching tasks, may be too short--or they may not exist at all. A good program will familiarize the teachers with the program objectives and materials, describe their expected roles, and involve them actively in as many experiences from the program as time allows. It is often very productive to involve the teachers in the same experiences with the same equipment that they themselves will be expected to use in their teaching.

Many schools have found it productive to have follow-up inservice programs after a new science program has been used for awhile. A session at mid-year can help answer the questions that teachers have after they have had experiences with a program. Inservice programs scheduled during the year can help work the bugs out of newly-adopted science programs.

3. Good staff development programs can take many forms. Although one or two-day inservice programs presented by visiting science curriculum specialists are currently popular, don't overlook other possibilities. Consider working with area colleges and universities to set up in-school science courses for credit. Weekend conferences may also be effective. Or, perhaps you will want to send some of your teachers to science conventions or to workshops where they can participate in experiences related to your science curriculum. Lastly, make sure that you discuss inservice education with the publisher or seller before you buy a particular program. Depending on the total cost of the sale, most publishers will arrange programs ranging in length from one day to one week to assist teachers in learning how to use the new program. These are generally provided at no cost to the school.

4. Your participation in the inservice programs is crucial to achieving success. Research supports a participatory role by you. A group of science

educators at Washington State University reported that when principals participated in inservice programs adopting innovative elementary science curricula, the program implementations were successful(16). Teachers will look for your leadership and your participation in inservice programs. Get involved.

F. The Principal as a Monitor of Science Program Progress

Many good elementary school science curricula fail because of sheer neglect. No one pays much attention to their continuing vitaltiy. No one checks on their health. No one reads their vital signs. As a result, many get sick and die right under our noses without our being aware of their gradual slide into morbidity. Science programs, like people, need periodic check-ups to see how they are doing--to check their vital signs. Here, again, the principal can play an important role. He or she can observe, poke, and ask questions to probe the program's health. What are some things that you, the principal, can do?

1. All major curriculum areas should be reviewed periodically. Each should be scrutinized to determine if the goals and objectives are still valid and if they are being met. Science is no exception. As principal, you can make sure that science undergoes a periodic curriculum review. For many schools this review cycle appears to be five years. For assistance in reviewing your science program you may wish to refer to Characteristics of a Good Elementary Science Program, Handbook III in this series.

   When the review is conducted, insist upon evidence that the science goals and objectives are being met. Insist upon hard data--student work, evaluative measures, written parental feedback, and other forms of documented evidence--to supplement your own visits to classrooms.

   You may also wish to survey your teachers. Ask how they feel about the science program you are using. Do the children appear interested? Are adequate equipment and materials provided? Is there evidence that the children are attaining the objectives?

2. Most principals are required to make periodic evaluations of teachers, perhaps as

many as two to four per year. These evaluative visits are excellent times for you to gauge the health of the science curriculum. Plan to visit the classroom when science is being taught and look for vital signs. Are the kids involved in science activities? Do they appear interested in the lesson? Do they have opportunities to investigate? Is there an emphasis on the development of problem-solving techniques, higher cognitive skills, and science processes? Is there evidence of on-going science activities? Are there science materials or projects around the room?

These evaluative visits can be multi-purposed. Not only can you evaluate the teacher's performance as you are required to do, but you can also assess the condition of the science curriculum. If 15 to 20 percent of your visits occurred during science classes, you would probably have a good idea of the quality of your science program. Visiting classes to observe science lessons also has the added advantage of letting teachers know you are interested in science.

3. You may wish to examine test results in science as a means of monitoring program quality. Whatever tests you use, make sure that they are designed to measure progress toward achieving the goals and objectives of your science program. Research on effective schooling shows that in the high-achieving schools, instructional objectives guide the programs, and testing and evaluation are given serious and deliberate attention(17).

Some schools construct their own criterion-referenced science tests, others use standardized science tests such as the Metropolitan Achievement Test, the Iowa Test of Basic Skills, or the Stanford Achievement Test. An advantage of standardized tests is that normative data is available to compare your pupils to others, usually a national sample, who have taken the same test. Your teachers may also wish to use test results for longitudinal comparisons of performance among classes.

An often-cited criticism of standardized tests is their failure to measure what is being taught. If they are used, they must be valid.

They must measure what your school believes is important in science. Evaluative instruments, including tests, can help you measure science program quality.

G. The Principal as a Troubleshooter

If you've been a principal for any length of time, you're probably already a good troubleshooter. Problems are always springing up, and if you're worth your salt, you deal with them effectively. There are many problems that can pop up in science programs. Here are some of them.

1. Many teachers slough off their science teaching responsibilities. Effective teachers often avoid science because they lack training and confidence in their ability to teach it, or because they don't like science, or because they "don't have time to teach science." Science is a basic discipline. It is an important part of the school curriculum. As principal, you have to let your teachers know, in whatever ways work for you, that science is important and that they must teach it. For a discussion of science and the basics, see the companion handbook in this series titled Science Teaches Basic Skills.

2. A lot of teachers equate science with reading. They think that science is learned best by reading. In their classes, kids get a steady diet of reading science texts. While reading and science are certainly compatible, most science educators and researchers believe that a science program built around textbooks alone is not effective. To learn science processes such as observation, measurement, prediction, inferring, formulating and testing hypotheses, and designing investigation, children must be actively involved in science experiences. A good science class is one where the children have an opportunity to do science--to explore, to investigate, to think, to talk, as well as to read and listen.

3. You can avoid a lot of problems if you hire teachers who are prepared to teach science and are confident about their ability to teach it. When you interview teachers, question them about their views on science teaching. The hiring process is a good time

for you to let the teacher know that science is an important part of the curriculum in your school.

4. When kids are involved in experiences which excite and interest them, they often become noisy. Noise, even if it is the sound of a working, enthusiastic class, is the object of considerable concern among many elementary teachers. Teachers are fearful that you folks, their principals, will think that their classes are out of control if there is the least bit of noise. Often they will shrink from science activities because noise levels go up. As one elementary teacher was overheard to say, "One of the reasons we don't do experiments is because they can't keep their mouths shut." Children who are engaged in an exciting activity will make noise. This is "educational noise," the sounds of an interested class in the process of learning.

If kids are on the job and the noise is not disturbing adjacent classes, teachers need to hear from you that it's OK for the children to be excited, interested, and enthused. Through your actions, as principal, you can let your teachers know that excitement about learning with the accompanying educational noise is expected, even desirable, in your school.

5. Giving grades in science is a problem for many teachers. Although a school has a grading system, maybe A, B, C, etc., many teachers find it difficult to assign grades except on the most arbitrary bases. This is particularly true if your program is an activity-centered program where it's hard to judge if someone gets a B or C in constructing and maintaining an aquarium, or an A or a B in observing a mealworm. As principal, you can help them, first by recognizing the difficulty, and secondly by examining alternative approaches to grading. Many schools have found criterion-referenced checklists effective. Others have moved science into a satisfactory-unsatisfactory system or some modification of it. It is important to lead your teachers into a grading system which they, the children, and the parents can live with.

V. SUMMARY

We have examined many of the roles that principals can play to improve science programs. We have not cited everything you could do, nor do we believe our suggestions will work for everyone. Because we think you are the people who can make or break the science programs in your schools, we have provided some ideas for you to think about, some techniques that have worked for some principals, some things you can try. With your leadership and your support, we believe the science curriculum in your school can be improved. If we can assist you in any way, please let us know.

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