

A COMPARISON OF ELEMENTARY SCIENCE OBJECTIVES,
SOME COURSES OF STUDY IN ELEMENTARY SCIENCE,
AND ELEMENTARY SCIENCE TEXTBOOKS WITH
THE DEVELOPMENTAL PATTERNS
OF ELEMENTARY SCHOOL
CHILDREN

BY

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Submitted to the faculty of the Graduate School of
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in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
May, 1957

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A handwritten signature in cursive script, appearing to read "James H. Lind", is written over a horizontal line. The signature is fluid and extends both above and below the line.

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ACKNOWLEDGEMENTS

The writer wishes to express his sincere gratitude and appreciation to Dr. James H. Zant, Professor of Mathematics and Director of the Supplementary Training Program for High School Science Teachers, for his help in gathering material for this report and for his extremely helpful criticism during the writing of the report.

The following publishers were very generous in their cooperation by supplying materials by which elementary science textbooks could be evaluated: Allyn Bacon, Inc., Charles Scribner's Sons, D. C. Heath and Company, Ginn and Company, J. B. Lippincott Company, Rand McNally Company, Row Peterson and Company, and The L. W. Singer Company, Inc.

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CHAPTER I

INTRODUCTION

It is generally agreed that science should be one of the major areas of experience for all boys and girls. Decisions of lasting importance which will affect their lives for years to come have been necessitated by scientific and technological advances. One need only scan records of proceedings of policy making bodies at the local, national, or international level to realize that problems concerning the control and more efficient use of newer sources of energy, the utilization of newer medicines and drugs, and the wiser use of our natural resources are occupying much time and effort on the part of these bodies. Thus, to give boys and girls the opportunity to experience scientific activity enhances their ability to become better citizens in our world.

The purpose of this report is to summarize the objectives of elementary science instruction, to summarize some courses of study in elementary science, to examine textbook material available, to summarize the developmental patterns of growth of elementary school children, and to then formulate a basis for evaluation of an elementary school science program. Through this report, the writer hopes to gain a better understanding of the problems involved in elementary school science instruction, and to gain a degree of insight into the problem of relating the subject matter of science to the developmental patterns of children.

The title of this report, A Comparison of Elementary Science Objectives, Some Courses of Study in Elementary Science, and Elementary Science Textbooks with The Developmental Patterns of Elementary School Children, bears definition in order to further clarify terms and to place reasonable limitations on the subject discussed. The definitions of major terms are as listed:

Elementary Science Objectives: Elementary science objectives shall be interpreted as being those commonly accepted objectives of science as it is taught in elementary grades one through six.

Courses of Study in Elementary Science: Courses of study in elementary science shall be interpreted as meaning outlines of aims, objective subject matter, and methods as prepared to aid the teacher in instructing boys and girls in the elementary school. This report will include two such courses of study; one as prepared for the instruction of science in the elementary schools of Oklahoma, and the other as prepared for the instruction of elementary science in Denver Public Schools, Denver, Colorado.

Elementary Science Textbooks: Elementary science textbooks shall be interpreted as meaning those textbooks that pertain directly to the teaching of science in the elementary grades. The number of such texts is limited to eight from the following publishers: Allyn Bacon, Inc., Charles Scribner's Sons, D. C. Heath and Company, Ginn and Company, J. B. Lippincott Company, Rand McNally Company, Row Peterson and Company, and The L. W. Singer Company, Inc.

Developmental Patterns: Developmental patterns shall be interpreted as meaning the patterns of growth and development of children as accepted from results in studies of child development.

Elementary School Children: Elementary school children shall mean those children of approximately five years of age to those eleven years of age. These are the ages of children composing the bulk of boys and girls attending Kindergarten through Grade Six.

This report is developed according to the following order. Chapter Two is a summary of developmental characteristics of children taken in chronological order from ages five through eleven. Chapter Three is a summarization of objectives of elementary science instruction. Chapter Four is a summary of courses of study and textbook material. Chapter Five is a presentation of a plan of evaluation of an elementary science program by comparing it with objectives, development patterns of boys and girls, and printed subject matter available in the form of textbooks. Chapter Five also includes the summary and conclusions of the report.

CHAPTER II

CHARACTERISTICS OF ELEMENTARY SCHOOL CHILDREN

Prior to the time of Rosseau the child was considered bad by nature, and of necessity, had to be changed into a different individual in order to become a desirable adult. Rosseau proposed a theory of so-called "naturalism" which stressed the fact that the child should be allowed to develop according to his own inclinations rather than be subjected to a process of total change. From this beginning of emphasis on natural development there evolved a movement referred to by some as the theory of "psychological developmentalism". Further investigation into "psychological developmentalism" resulted in our present day theories of child development based on the premise that children develop according to a definite pattern of growth.

The growth processes of children were then studied and attempts made to determine the various stages of physical, mental, and emotional development. The results of these studies are utilized in education by relating understandings and subject matter to the developmental stage of the pupil. The teacher, knowing something about the development of the pupils she teaches, will be less apt to desire comprehension by children of concepts sometimes found difficult by adults. It is thought the child will thus understand more of what he is being taught and will consider learning something about which to think rather than something which he must believe.

The precepts of child development theories are especially well adapted to the area of science education. The growth stages of children can be utilized to develop understandings of simple scientific concepts as well as simple methods of problem solving. For example, a pupil of primary school age can describe a simple phenomenon while one of intermediate school age can explain as well as describe the same phenomenon. Accepting the scientific concept that everything in the universe is in a constant state of change, the primary age pupil can describe a change while the intermediate age pupil can give a simple explanation of the cause for the change as well as a description of it.

Recently a dynamic psychology of science education has been developed which recognizes the interpretation of the physical environment as a natural facet of child growth and development. Hence it is becoming increasingly important that the growth and development characteristics of children be considered in an study relevant to an elementary science instruction program.

The growth and development characteristics of elementary school children are presented here in summary form and in chronological order beginning at age five and extending through age six. This includes the ages during which the average child will be in attendance at an elementary school.

THE FIVE-YEAR-OLD

The five-year-old is active in a strenuous way. He runs, jumps, and climbs. He is energetic rather than fidgety. He can sit still for short periods of time when he is interested. But Gesell and Ilg give a general description of the five-year-old. They have this to say.

Although he is by no means a finished product, he already gives token of the man (or the woman) he (or she) is to be. His capacities, talents temperamental qualities, and his distinctive modes of meeting the demands of development, have all declared themselves to a significant degree. He is already stamped with individuality.¹

He lives in a here and now day and world. He pretty well takes life as it comes because he is the center of his universe and whatever happens to him is interesting. He enjoys make-believe. He repeats things he likes. He makes the familiar more familiar.

He takes pride in his own possessions and has a definite sense of ownership. "My" is his favorite word. He must be made to feel that he should share, or he will share to please adults, not because he is a "generous little boy."

He worries a bit about his own ability to accomplish, and he demands adult help when he feels his own limitations. He is eager to know how to do things which lie within his capacity.

He can take part peaceably in small group activities without too much supervision. These are usually play or spontaneous dramatization activities. He can work, also, on a cooperative project but he is working as an individual, not as a group member. He may make a radio for the playhouse if he is on the "furniture committee" but it is his radio and he is the one to decide where it shall be placed. He feels no particular responsibility to the group.

He is positive about things, inclined to be a bit dogmatic. He is quite sure that there is one way to do a thing, one answer to a question. He likes to argue about it — "worry" it like a little dog with a bone.

He is a great talker. He piles up details as he talks; he says

¹Arnold Gesell and Frances L. Ilg, The Child from Five to Ten (New York, 1946), p. 62.

the same thing over and over, but his vocabulary increases at a great rate, so his eagerness to talk bears fruit.

He likes to hear stories and poems, and to be read to. He asks for his favorites over and over again.

He loves to work with materials. These help him to explore new opportunities in his world as well as to discover new abilities within himself.

He is becoming interested in numbers and words. He asks, "How many?" "How big?" Words are his friends. He asks, "What does it say?" "What is this letter?"

He enjoys routine and reacts best to a program which calls for varied activity and exercise, but within a fairly definite sequence and time schedule.

He is good -- not because he distinguishes right from wrong, nor because he is a naturally upright character, but because he wants to please, to oblige the grown-ups who seem to know how they want things done in this world where he still does not feel too much at home. When he was younger the world was all his. He is learning now that he must find his place in it and that many other people must be considered.

THE SIX-YEAR-OLD

"The sixth year brings fundamental changes, somatic and psychological. It is an age of transition."²

Six is an age of indecision as well as an age of transition. This is illustrated by a verse from Edna St. Vincent Millay:

²Ibid., p. 89.

Come along in then, little girl
 Or else stay out!
 But in the open door she stands
 And bites her lips and twists her hands
 And stares upon me trouble-eyed;
 "Mother," she says, "I can't decide!
 "I can't decide."

The six-year-old is active, almost constantly in motion, whether sitting or standing.

He goes to extremes, finding it hard to modulate or to compromise.

It is difficult for him to make decisions. He wants both alternatives, finding it hard to give up rival possibilities. Blue or violet? Come in or stay out? Paint or clay? He wants to do and to have everything.

He wants to be first, to win always, and to be loved best. He finds it hard to adjust his behavior in terms of what he wants to do and what he should do.

He identifies himself with everything, projecting his feelings and actions into all situations. He is the center of everything; he behaves, thinks, feels from the standpoint of himself and his own experiences. He is dramatic in this association of himself with all situations.

He clarifies meanings and relationships through personal participation and creative activities.

He is very sociable and likes to be with other children, with himself as planner, leader, and social arbiter. Six-year-olds are more like beads on a string than eggs in a cake.

He is keen to start individual or group projects but is unconcerned about finishing them. His six-year-old world is so full of a number of things, he does not have time or energy to do justice to each one. He

has an exploratory attitude; he must find out something about everything.

He turns to his teacher to give him confidence in this new world of school, where his needs for recognition and security are somewhat threatened. He craves praise and commendation and reacts badly to criticism.

He is a paradox. He reaches out for new things and scurries back for the old. He enjoys surprises, but he also clings to the ritual and conventions of daily living.

He likes to do things on a game basis.

He tends to have emotional explosions. These are brought on by the little things of life more often than basic demands which he can take in his stride.

He takes inordinate pleasure in gifts, both in receiving and giving them. He loves holidays, entering wholeheartedly into all phases of their celebration.

THE SEVEN-YEAR-OLD

Seven is an assimilative age.

There is a kind of quieting down at seven. The seven-year-old goes into lengthening periods of calmness and of self-absorption, during which he works his impressions over and over, oblivious to the outer world. It is an assimilative age, a time for salting down accumulated experiences and for relating new experiences to the old.³

Seven is a pleasant age. The seven-year-old takes in more than he gives out.

He is becoming more reflective, taking time to think. He can be reasoned with.

³Ibid., p. 5.

His personal relationships with his teacher and with other adults are very important to him. He is reaching out to them, and he needs assurance that he is liked and considered.

He is variable in his behavior and attitudes, assertive one day, amenable the next.

He is self-critical. He apologizes for his work and thinks that he can do better. Seven is the "eraser age."

He is a slow starter but cannot stop once he gets going. He does the things he wants to do, or has learned to do over and over without variation. This is because he lacks confidence in tackling something new.

He is serious about himself and about responsibility which may be given him.

He responds enthusiastically to praise and is crushed by criticism.

He has lost his six-year-old freshness. He is even polite and sympathetic most of the time and is capable of genuine affection.

THE EIGHT-YEAR-OLD

Eight is more of a person by adult standards and in terms of adult-child relationships. He is growing up and both he and you are aware of it. He is governed by a growing-up impulsion which brings him into a positive out-going contact with his environment, including his elders. He is less brooding and less inwardized than he was at seven. He is more centrifugal. He is also more rapid in his own responses, and more perceptive of the response of others.⁴

He is extremely active, both mentally and physically.

He is hungry for new experiences, reaching out for everything he can get. At the same time he is held back by worry over whether he can

⁴Ibid., p. 160.

cope with these new experiences.

He hides his great eagerness for approval behind an apologetic attitude toward his own work. "This paper doesn't look so good today, does it?" he says, even though he has struggled to make it perfect.

He needs an adult to rely upon, even though he is struggling for independence.

He is aggressive in his social relationships. He struggles to be as good as his peers. He battles for position. This is why the third grade play area is always the noisiest.

He wants to be in on everything -- plans, discussions, activities. He likes to be asked for suggestions.

He likes to work hard -- he will tackle anything -- and then evaluate his accomplishments critically. He is eager to add new skills and wider information.

He seeks a wide variety of interests, and is beginning to lean toward science. He wants to investigate anything new in his life from water guns to jet planes. He has so many interests to explore that he will pursue several at the same time.

He reaches out mentally in time and space, struggling to free himself from his immediate world. He is ready for new ideas but often interprets them in the light of his own experiences.

He is at a money conscious stage. He wants to earn money, to have it, to spend it.

He can now work with a fair degree of independence in a group provided there is a clear-cut purpose which calls for working together in the area of construction or expression.

THE NINE-YEAR-OLD

The nine-year-old begins to show signs of self-motivation.

But his best traits are authentic indicators of true growth trend.

These traits are his realism, his reasonableness, and his self-motivation. Functioning in favorable balance they make of him, on a juvenile side, a business-like, fair-minded, responsible individual. He is no longer a "mere" child. He is integrating his long past ⁵ not finally, but intermediately. He is trending toward the teens.⁵

He is developing personality, with marked abilities and interests of his own.

He is becoming self-motivated. He will carry on projects of his own devising, devoting much time and effort to them. His attention span is of gratifying length when he is doing the things a fourth grader likes to do.

He is open to instruction -- especially if it deals with facts and is presented in a forthright way. He collects facts as he does bottle tops. He likes to make inventories and lists, and dotes upon codes and emblems.

He is something of a perfectionist, like the seven-year-old, but has greater ability to improve skills and techniques on his own initiative. He is willing to do the same thing over and over again to fortify his security. He works definitely to develop skills in physical and creative activities, as well as in subject areas.

He has a broad range of reading interests, although reading abilities vary at this age level. The average nine-year-old is trying to widen his world and, if he reads well, he is able to do this through books and stories about other people and other places. He likes to

⁵Ibid., p. 197.

trace "from then to now" developments; the way people did it then -- the way we do it now; how language, inventions, and ideas have developed. He is interested too, in other parts of our country and of the world.

He is wholeheartedly entering the gang stage. What he says, does, eats, wears, plays is determined by what the other kids do. He is a conformist -- it is tragic to be different. His membership in a club or gang may be of short duration, but there is always another one to join -- or, preferably, to organize.

He is developing a strong sense of right and wrong and is beginning to be reasonable. He can be guided best by a reason for desirable behavior. The reason, however, must relate to his own experience and interest. It must be clear-cut and within his ability to grasp. He is trying to develop a few basic standards, and likes stories of people whose deeds give him something to steer by. He likes to talk things over.

THE TEN-YEAR-OLD

The age of ten, like the age of five, is a nodal age.

Ten is relaxed and casual, yet alert. He has himself and his skills in hand; he takes things in his stride; he works with executive speed and likes the challenge of mental arithmetic. He often shows a genuine capacity to budget his time and his energy. His general behavior, his demeanors, his orientation to the household are more modulated.⁶

That he is active, almost constantly in motion is as true of the ten-year-old as of the six-year-old. He has an organic need for physical activity because of his rapidly growing and developing body. His activity is on the strenuous order whenever he can get away with it.

⁶Ibid., p. 213.

He roughhouses, teases, and laughs without apparent reason.

He is wholeheartedly a peer among peers who set the pattern for each other in standards of speech, clothes, and manners. The ten-year-old turns to parents and teachers, however, to supply the values and standards which he is beginning to seek. These often lie in the field of racial relationships, religion, and morals.

He is a learner, not only eager for factual information and able to memorize easily, but he also shows desirable growth in aesthetic areas. He is an interesting combination of realism and imagination.

He devours books of adventure, explanations of how and why things work, and lives of scientists and adventurers. The ten-year-old who is not reading as rapidly as other members of his class may become increasingly discouraged.

He is ready for an introduction to history, for he has increasing ability to fit past events into proper sequence — not only acquiring facts, but putting them together as well. He is mainly interested in the adventure that has gone into the building of our country, not the political and industrial phases of its development.

He still needs learning experiences that involve participation and doing.

He likes discussion of social problems. He can now see different sides of a question and is developing definite ideas of property rights, fairness, honesty, and reliability. Dr. Gesell speaks of this as the social intelligence of the ten-year-old.

THE ELEVEN-YEAR-OLD

Almost anything can happen in the sixth grade. The eleven-year-

old is changing rapidly and sometimes appears to change for the "worse" as he grows older.

Recent investigators agree generally that eleven, particularly, is an age at which the child finds real conflict between peer and adult demands. Some beginnings of peer pressures were felt during the ages of nine and ten. At eleven it is difficult to maintain equilibrium between the two. The group makes real demands. Although outright rebellion to adult authority may not occur, continuous conflict and aggression are always at hand.⁷

The eleven-year-old is a lazybones or a dynamo, due to wide variation in physical growth at this age. Some eleven-year-olds are approaching puberty and they may frequently seem lazy. Those who are not nearing puberty are super-energetic. There is wide variation, too, between girls and boys, with girls usually maturing more rapidly than boys.

The eleven-year-old is somewhat variable in his moods and behavior.

He is still influenced widely by the peer group but is reaching out toward adults and wanting to share their world.

He is a bit over critical of adults, even when reaching out toward their world, but welcomes their leadership for the needed security it gives him. He is also getting to the "crush stage."

He is able to work with a group on extended projects which call for cooperation and pooled thinking. He works best with a congenial group organized on the basis of friendship and interests.

He wants recognition and approval, but these must be based upon real achievement.

He is growing in his ability to generalize, to see relationships, and to foresee probable results.

⁷Cecil V. Millard, School and Child (East Lansing, 1954), p. 65.

He is interested in people, communities, and the world. He is becoming interested in and concerned about people's ideas and beliefs. He wants to take part in drives and other community projects.

To summarize each age level briefly, the age of five can be thought of as a focal age; six, a dispersive age; seven, a pensive age; eight, an expansive age; nine, an age of extensiveness and of self-motivation; ten, a reorientation age; and eleven, very often an age of transition from childhood to adolescence.

CHAPTER III

OBJECTIVES OF ELEMENTARY SCHOOL SCIENCE

The task of determining objectives of elementary school science is somewhat like looking for the proverbial "needle in the haystack." Each specific philosophy of education seems to possess its own set of objectives, and each proponent of any single philosophy seems to be very desirous of adding his own personal beliefs to those objectives. Thus objectives are varied and sometimes meaningless. The major points of agreement seem to be that the science program should be fitted to the understanding of the child, and that the general objectives should coincide with the aims of the total elementary school program. Hence the task of formulating objectives for science instruction becomes one of applying general goals to a particular area of learning.

All kinds of educators have stated the objectives of elementary school experiences in all kinds of ways. Without unnecessary technicalities, the most important purpose might be phrased: to help children gain the ideals, understandings and skills essential to becoming good citizens.¹

The good science program, then, is one that relates itself to the achieving of the goals of the total elementary-school program. It must, as a consequence, deal with problems of concern to children and provide opportunity for the use of a wide variety of tools of learning.²

¹Glenn O. Blough and Albert J. Huggett, Elementary School Science and How to Teach It (New York, 1953), p. 10.

²Glenn O. Blough, "Science in the Elementary School," Science for Today's Children, ed. V. Carl Ilgen (Washington, D. C., 1953) p. 7.

Blough then proceeds with this definition of the study of science for children and these objectives for science instruction.

For children the study of science consists of exploring their world in order to learn about it and so to answer their questions, the better to enjoy and appreciate their surroundings.

Science exists only because it has certain contributions to make to what we intend to help girls and boys get from their entire school experience.

1. The study of science should help girls and boys come to know some generalizations or big meanings or science principles which they can use in solving problems in their environment.

2. Science should help pupils to grow in ability to solve problems effectively.

3. The study of science should develop in children a scientific attitude.

4. Science is supposed to create in children an interest in and an appreciation for the world in which they live.³

The term, scientific attitude, is used often in stating objectives of science instruction. Most generally this is interpreted as meaning that the pupil should learn to become open minded and be willing to change his mind in the face of reliable evidence, thus exhibiting respect for another's point of view. He should look at a matter from all sides before drawing a conclusion. He should go to reliable sources for evidence and check all evidence which appears to be questionable. He is not superstitious. He is curious, careful, and accurate in observations. He plans investigations carefully and then proceeds according to a well organized pattern.

Thus far, one might summarize the goals of science teaching in this manner: Science instruction should develop scientific-mindedness. It should develop critical abilities on the part of the pupil. It should help the pupil to interpret his expanding environment and contribute to his health and safety.

³Blough and Duggett, pp. 12 - 21.

The following statement of purposes for science teaching appears in a course of study:

The purpose of science instruction is to teach the pupil to live better in his environment or, more definitely, to guide the pupil during his school experience so that he will intelligently use the truths of the past to take a vantage of the opportunities of the future. This may be accomplished by a continuous program of scientific study through his school life.

The following specific aims or objectives are suggested as bases for good science instruction.

1. Science instruction should help create in pupils freedom from unfounded fears and superstitions; that is, to develop in the pupil security in thinking brought about by a testing of ideas for truth.

2. Science instruction should develop in the pupil the habit of seeking correct conclusions on the basis of the evidence at hand.

3. Science should develop in the pupil an understanding of his environment and his relationship to the physical world.

4. Science instruction at each pupil's level should be centered around his natural scientific interest and should evolve from one concept level to the next.

5. Science experiences at each concept level should have practical and cultural application.

6. Science teaching should instruct the pupil in how to make a wise choice and use of the products and by-products of science.

7. Science instruction should create in the pupil an understanding and use of scientific language of his concept level.

8. Science instruction should encourage hobbies as a means of spending leisure time profitably.

9. Science instruction should inspire in pupils an appreciation of the life and work of scientists.

10. Science instruction should emphasize cause and effect relationships.⁴

A science education textbook lists these purposes of science teaching

The five main points it makes are that instruction in science should help pupils to develop ability in solving problems and in critical thinking, to develop the disposition and the ability to maintain and use scientific attitudes of mind, to develop insight into the interrelationships and interdependence among living things and the physical world, to develop an understanding of attitudes and habits conducive to good personal and community health and safety, and to assist in the development of a wide range of interests and hobbies.⁵

⁴State of South Carolina, Department of Education, Suggestions for the Teaching of Science in the Twelve-Year School Program, (Columbia, 1946) pp. 10 - 11.

⁵Kenneth Freeman et al., Helping Children Understand Science (Philadelphia, 1954), p. 34.

A Summary of objectives as taken from a manual accompanying a series of elementary science textbooks states these:

1. To develop the scientific attitudes, among which is an attitude of curiosity to find the answers to personal questions and of a desire to check upon the answers by various means.
2. To stir the child to an interest in his environment and its impact upon him.
3. To help the child feel more at home in his environment because he has begun to understand it.
4. To acquaint the child on his level of development with materials and information of science.
5. To build, little by little, the generalizations that underlie the world of science.⁶

There is a close relationship between the reasons for teaching science and the objectives of science teaching. The following list of reasons for teaching science and the ensuing objectives will illustrate this relationship.

Here is another list of purposes that comes nearer to being a statement of reasons for teaching science. It is a series of traditional and clear statements made at different times by elementary-school teacher and in books and articles.

Science is universal.

Science is something we live with daily.

The understanding of science means a richer, happier and fuller life.

Science gives a background for a more informed person.

Facts of science can become practical for the individual.

Through science we learn how to live.

The teaching of science is the best way to develop scientific attitudes.

Scientific knowledge is the best means of combating false or questionable opinions and will help clarify ideas about many happenings in our environment.

Children show intense interest in the world about them.

Children's questions indicate a genuine interest in science.

Science offers an avenue for satisfying children's interests.

Science helps us to know about the kinds of inventions and discoveries and thereby helps us to live better lives.

Materials are easily obtained for the study of science.

A person who knows science becomes more critical.

Science opens to the child avenues for the pursuit of a vocation.

Science offers opportunities for desirable hobbies.

An early interest in science leads to more serious study and to

⁶Ibid., p. 35

useful inventions and discoveries.

Science tends to offer answers to questions that arise from man's inborn desire for knowledge and truth.

Science develops social attitudes and appreciations.

Science enables the individual to meet the problems of existence with the available knowledge and requisite skill.

The development of scientific attitudes is probably the best means democracy has for perpetuating itself.

It seems clear as one examines the statements of the reasons for teaching science that they are basic to the statements of purposes or objectives. The reasons for utilizing experiences in science in educating children can be summarized under such headings as these:

1. The universality of experiences in science.
2. The child's need to satisfy curiosity.
3. The child's need to gain the security which understanding can bring.
4. The vocational and leisure-time values of science.
5. The need to make improvements in living.
6. The value of using the scientific method in one's solving problems.⁷

The last of our lists of objectives of science instruction is a list published by the National Elementary Principal.

To summarize Chapter One, the students in my classes at George Peabody College for Teachers have helped me select and phrase nine good reasons for teaching science in the modern elementary school.

Science is taught in today's elementary schools:

1. To give practice in simple observations -- as background for future investigation and understanding of the environment.
2. To give practice in purposeful activity -- as background for future experimentation and constructive labor.
3. To give experience in combining the factual and the emotional (as caring for a well-loved pet or flower) -- as background for future appreciation of natural law and beauty.
4. To enlarge the vocabulary with the names of simple objects and processes -- as background for the future use of necessary technical terms.
5. To guide emotional responses away from the highly subjective and toward the objective -- as background for future sensible attitudes and desirable behavior.
6. To start habits of scientific thinking in simple matters -- as background for scientific thinking in important future decisions.
7. To start building attitudes toward the simple effects of science on society -- as background for future cooperation in community programs of health and welfare.

⁷Ibid., p. 35

8. To develop simple concepts such as cause and effect, balance of nature, cycles of nature, and the like — as background for future understanding of broad concepts like conservation of resources, the laws of learning, and even the sacredness of truth.

9. To develop a simple reverence for nature — as background for future appreciation of the wisdom and power of God.⁸

Since the foregoing objectives are in summary form, it is unnecessary to attempt further summarization for the purpose of this report. They point out the varied, and yet repetitious, character of science instruction objectives. Consequently, to accept these as a representative summarization of science education objectives at the elementary level, is our intent at this time.

⁸Haror A. Webb, "Nine Reasons Why," Science for Today's Children, ed. V. Carl Ilgen (Washington, D. C., 1953), p. 22.

CHAPTER IV

COURSES OF STUDY AND TEXTBOOKS FOR ELEMENTARY SCIENCE

The course of study occupies a position of importance in elementary education. It is from the course of study that objectives are indicated. It is in the course of study that the scope of subject matter is determined. It is also from the course of study that the teacher may be guided in classroom activity projects and from which she may locate other teaching resources for the area in which she is instructing.

Two courses of study were chosen for the purposes of this report. One is written at the state level of education and the other at the local level. By utilizing courses from different administrative levels, it is possible to compare them for adequacy of instruction as well as broaden the area for consideration in this report.

The general areas summarized for this report from the courses of study are: (1) the subject matter, and (2) the broad objectives. These were chosen primarily because it is by relating subject matter expectations and objectives to the developmental patterns of children that a reasonable evaluation of a course of study can be achieved. It is the belief of this writer that subject matter is of utmost importance. It is through the teaching of subject matter that the achievement of the objectives becomes apparent. It is subject matter and objective that must be fitted to the maturity level of the child. It is the maturity of the pupil that determines the degree to which the objective is

achieved and it is maturity of the child that determines the degree of comprehension of subject matter.

The summarization of the course of study for elementary science for the State of Oklahoma will be followed the summarization of a similar course of study for Denver Public Schools, Denver, Colorado. These summarizations shall be in outline form. Objectives shall be grouped under the grade level for which they are intended rather than listed as a part of the unit of study.

STATE OF OKLAHOMA

The course of study in elementary science for the State of Oklahoma is developed according to four main subject matter areas: (1) Health, (2) Energy, (3) Living Things, and (4) Earth and Sky. Each unit is listed under its subject matter area.

Grade One

HEALTH

How Can We Take Better Care of Ourselves?
My Body and How It Works
How Can I Keep Health?

ENERGY

The Sun and Its Influence on the Earth

LIVING THINGS

Plant Friends That Live Around Us
Animal Friends That Live Around Us
Holiday Plants and Animals
Plant Life in the Spring
Farm Animals and Their Babies

EARTH AND SKY

Land, Water, and Air
Weather and Seasons

OBJECTIVES

To help children understand and practice some of the rules for healthful living.
To develop an understanding that many plants, both helpful and harmful, share this world with us.
To develop an understanding that there are many kinds of animals in the world, some of which are useful to people.
To give children a simple understanding of the relation of land, water and air to the whole earth.

- To acquire a simple understanding of what is meant by the terms weather and season, and how they influence living things.
- To have children acquire a simple understanding of how the human body works.
- To gain a simple understanding of the nature of disease and thus help to be healthy.
- To get children to realize the tremendous importance of the sun to the earth and to living things.
- To get little children interested in gardening and to get them to observe how seeds grow.
- To become acquainted with plants in the springtime and to learn of many interesting changes that take place in the great outdoors.
- To stimulate children to notice the many kinds of birds, insects and other animals which appear in the spring and become acquainted with their ways of living.
- To acquaint children with the common farm animals and their habits.

Grade Two

HEALTH

- Health and Safety
- Living Things Need Food

ENERGY

- How do Machines Help Us do Our Work?

LIVING THINGS

- Flowers of Autumn
- Harvest Time and Seeds
- Homes of Living Things
- Winter Animals
- Gardening
- How Living Things Are Protected
- Some Spring Plants and Animals

EARTH AND SKY

- Our Home the Earth
- How do Weather and Seasons Affect Us?

OBJECTIVES

- To understand the importance of practicing good health and safety habits in every day living.
- To appreciate the beauty of fall flowers and to learn to recognize some of the more common ones.
- To learn that autumn brings harvest time and the maturing of many plants which provide seeds for next season's growth.
- To teach the child many interesting things about plant and animal homes and to stimulate his interest in learning more about them.
- To get the child to realize that the earth is our home and that the earth furnishes us with all the materials and foods which we use.
- To acquaint the child with some animals of the winter season, their habits and how they live through the cold weather.

- To learn how greatly our lives are influenced by the weather and the seasons and how in a small way we overcome bad weather conditions.
- To realize that all living things require food in order to grow and to remain alive and that good health depends largely upon the food we eat.
- To give a simple explanation of what machines are, what makes them run and how they are useful to man.
- To acquaint children with the conditions necessary to grow a garden.
- To develop the understanding that plants, animals and man have many ways and devices to protect themselves from enemies, from bad weather and from other dangers.
- To become acquainted with some of our common spring flowers and trees and to learn more about the lives of some common animals.

Grade Three

HEALTH

Care of Our Bodies and Prevention of Diseases
Health and Safety

ENERGY

Time and How It Is Measured

LIVING THINGS

Insects Around Us
Gifts of the Forest
Ways That Animals Have of Living with Each Other
Birds of Fall and Winter
Gardening
Gifts of the Sea
Knowing Our Spring Birds
Life on the Farm

EARTH AND SKY

The Earth and Sky
The Story of Fire and Light

OBJECTIVES

- To learn how to prevent accidents and to realize that accidents are caused, they seldom just happen.
- To acquaint the child with some common insects, how they grow, their habits and how they are helpful or harmful.
- To teach the many uses we make of trees and to develop an appreciation and love for them
- To learn that some animals live together in groups while some live alone; yet each seems equally successful in its struggle for existence.
- To open the eyes of children to the wonders of the earth and the sky by giving them interesting facts about heavenly bodies.
- To increase interest in bird life and greater recognition of fall and winter birds.
- To teach fascinatingly the story of fire and light and to stimulate interest in these two great forces in our world today.

- To learn that the body needs daily care in order to maintain good health and to prevent disease.
- To learn how we measure time and to become acquainted with early methods used to measure time.
- Gardening should be a continuing experience each spring, and thus constantly enlarge the child's experiences with plant life and its importance to us.
- To learn some of the interesting facts about life in the sea, including the usefulness of sea life to man.
- To awaken an appreciation of the wonders of bird life and to bring about the realization of the worth of bird life and the major role it plays in the welfare of mankind.
- Since most of our food and much of our clothing comes from the farm, it is important that children have a knowledge and an appreciation of farm work and farm products.

Grade Four

HEALTH

- How My Body is Built and How it Works
- Safety and First Aid

ENERGY

- What Makes Things Move?
- The Story of Oil and Coal

LIVING THINGS

- Animals of the Zoo
- How do Living Things Develop and Grow (includes gardening)?
- Learning to Know Our Spring Friends
- Nature's Scenic Wonders
- How Plants and Animals are Put Into Groups

EARTH AND SKY

- The Earth and Its Neighbors
- What is the Nature of Air and Water?

OBJECTIVES

- To familiarize the child with some of the famous scenic spots in our state and in our nation.
- To acquaint the child with the large groups into which plants and animals are classified and the methods used in placing them.
- To learn simple principles of first aid, and to be able to apply first aid in meeting common emergencies.
- To introduce children to the world of physical forces and to the fundamental idea of gravity, magnetism, electricity and heat as sources of energy.
- To acquaint the child with the story of oil and coal, and to lead the child to realize how these minerals have played an important part in the development of our state.
- To become acquainted with interesting properties of air and water, and to learn of the many ways air and water are useful to us.
- To develop an interest in zoos and to increase the child's knowledge of unusual animals of the world.

- To learn how the body is put together and to understand how the various systems of the body work.
- To learn about the solar system, the moon including the four phases, the cause of the seasons and the meaning of constellations.
- To give the child an understanding of how plants and animals begin life and how they grow into mature plants and animals.
- To further the child's acquaintance with the reawakening of life in the spring and to learn to identify our spring friends.

Grade Five

HEALTH

- Our Food and What It Does for Us
- Community Health

ENERGY

- What Are Things Made of?

LIVING THINGS

- Learning to Care for Our Pets
- Planning and Growing a Garden
- Friends and Foes of Our Gardens and Crops
- Getting Acquainted with Plants and Animals in the Fall
- How do Plants and Animals Prepare for Winter?

EARTH AND SKY

- The Seasons and The Weather They Bring Us
- Stories That Rocks Tell Us

OBJECTIVES

- To become acquainted with those plants and animals which we are more aware of during the fall months.
- To help children become aware of one of the great cycles of nature; the approach of winter and adaptations plants and animals utilize to prevent their destruction by cold weather.
- To learn how the community protects our health and safety; and to realize more fully that each individual has a responsibility to his community
- To acquaint the child with the nature of matter, the meaning of chemical changes and the importance of chemistry.
- To develop an interest in rocks and in the stories rocks have to tell about the past history of the earth.
- To teach children to care for their pets in the right manner; and to impress upon children that they assume responsibility in caring for animals.
- To become acquainted with the principles of nutrition and to realize how good health is dependent upon food we eat.
- To review the causes of seasons, and to know what causes our weather to change from day to day.
- To teach the value of a garden and give information and encouragement which will be an incentive enough to make pupils of this age want to make a garden.
- To make the child realize that our useful plants have both friends and foes and that we must wage a constant war

against the enemies and work to protect the friends.

Grade Six

HEALTH

Personal Health

How Does the Knowledge of Sound and Light Help Us to Take Better Care of Our Eyes and Ears?

ENERGY

What Is the Nature of Magnetism and Electricity?

LIVING THINGS

Fish and Wild Life

This Air Age of Ours

Why Should We Conserve Our Natural Resources?

Parade of the Animal Kingdom

Early Life on the Earth

EARTH AND SKY

What Is the Nature of the Sun, Moon, and Stars?

How Do Machines Help Us to Obtain and Use Raw Materials of the Earth?

OBJECTIVES

- To learn how animals around us are able to get along and survive in their environment.
- To acquaint the child with prehistoric life on the earth; how these forms differ with present day life and how they help us to learn more about the earth.
- To understand the nature of sound and light so we will better know how to care for our ears and eyes.
- To become acquainted with the characteristics of magnetism and electricity and to realize many benefits we have derived from their use.
- To realize that the comforts of ever day living depend largely upon machines and to gain understanding of simple machines.
- To become better acquainted with the great outdoors by learning the aesthetic, the economic and the recreational value of fish and wild life.
- To learn why we think, feel and act as we do; to realize self discipline and good health planning are necessary for a happy, energetic life.
- To acquaint children with the various heavenly bodies, their movements and their influence on the earth; to give children a realization that the universe is vast and the movements of heavenly bodies are orderly.
- To every boy and girl give a broad understanding of what makes an airplane fly, and an appreciation of the vital role aviation is playing in peace and war.
- To teach the great value of our natural resources, the importance of conserving them, and some ways in which we can help to do this.¹

¹State of Oklahoma, Department of Education, A Suggestive Guide in Elementary Science for Oklahoma, (Oklahoma City, 1946)

DENVER PUBLIC SCHOOLS
DENVER, COLORADO

The course of study in elementary science for Denver Public Schools is integrated with the Social Studies Program. Hence, some units may be taught which are of a scientific nature but which are developed in such a manner that the emphasis is also social. For our purposes only those topics which carry scientific emphasis are listed. Because of the nature of the program, contributions of science to social living shall be listed as well as objectives since this aids in interpretation of the extent of subject matter included. The subject matter areas are developed according to two main topics: (1) Natural Science, and (2) Physical Science. Each unit is listed under its subject matter area.

Grade One

NATURAL SCIENCE

Living Things Out-of-Doors

Animals

People

Plants

Needs

Pets

Their Care

Tricks

Habits

PHYSICAL SCIENCE

Toys

Kinds of toys

Care of toys

Sharing of toys

CONTRIBUTIONS OF SCIENCE TO SOCIAL LIVING

Ways to keep ourselves clean

Ways in which animals, birds, and plants add to the interest and comfort of living

Need of all living things for air and water

Ways that toys and equipment work

OBJECTIVES

To become aware that there is a great difference in the size, shape, and habits of living things.

To increase enjoyment of the simple things around one.

To find ways to answer one's own questions.

Grade Two

NATURAL SCIENCE

The World through Our Five Senses
How we learn about the world

PHYSICAL SCIENCE

Water

Where it comes from
What it does for us

CONTRIBUTIONS OF SCIENCE TO SOCIAL LIVING

Ways we relax and rest
Changes in the out-of-doors with the seasons
Causes of day and night; simple astronomy
Ways growing and living things adjust to weather and climate
Ways we use and enjoy living things
Water: where it comes from and what it does for us
Purification of water

OBJECTIVES

To stimulate and satisfy our natural curiosity about the world about us.
To appreciate and enjoy the world about us through awakened sensitivity.
To understand that there is a purpose and a reason for all happens in the natural world.
To become aware of the rhythm and order of the natural world.
To lay the foundations for the development of scientific habits and attitudes to the extent that one asks "why" and is willing to think through and find a solution for problems.

Grade Three

NATURAL SCIENCE

Animals Near and Far

Birds

Fur bearing animals

Reptiles

Parts of world and climates where animals live

Effects of seasonal changes

Learning about Plants

What plants need to grow

How man uses plants

Planting a garden

PHYSICAL SCIENCE

(No specific units listed)

CONTRIBUTIONS OF SCIENCE TO SOCIAL LIVING

Ways we safeguard our hearing
Part that living things -- plants, animals, birds, insects -- play in everyday life
Various kinds of animals over the world
How plants grow
Planting a garden

OBJECTIVES

- To develop an enjoyment and appreciation of one's environment.
- To overcome fears and superstitions regarding certain harmless animals.
- To realize the importance of animals in the everyday life of man.
- To build desirable attitudes, such as kindness, thoughtfulness, and consideration.

Grade Four

NATURAL SCIENCE

- Ancient Plants and Animals
 - Their appearance and habits
 - Causes for their change or extinction

PHYSICAL SCIENCE

- Physical Forces That Work for Man
 - Air, wind, steam, gravity, magnetism, electricity, mechanical forces
 - Fuels
 - Atomic energy
 - Safety in using forces

CONTRIBUTIONS OF SCIENCE TO SOCIAL LIVING

- Forces that have changed the earth's surface; weather, ice, wind, volcanoes, earthquakes
- Land and water areas of the world
- Forces that can work for man; gravity, electricity, wind, air, water, magnetism, fuels, atomic energy

OBJECTIVES

- To increase one's interest in and appreciation of the world.
- To understand and appreciate some of the forces that work for man.
- To develop skill in working together as a group and in getting along with others.
- To develop ability to solve simple problems of everyday life.
- To appreciate the importance of science in the life of man.

Grade Five

NATURAL SCIENCE

(No specific units listed)

PHYSICAL SCIENCE

- How Chemical Changes Affect Our Everyday Living
 - Common chemical changes in the home
 - Effects of soaps and detergents
 - Use of carbon dioxide in foods and cooking
 - Conservation practices to prevent or slow down destructive changes
 - Decay
 - Rust

CONTRIBUTIONS OF SCIENCE TO SOCIAL LIVING

Common chemical changes in the house

Conservation practices to prevent or retard rust and decay

OBJECTIVES

To understand the nature and composition of different kinds of matter.

To develop an appreciation of the part that chemistry plays in our everyday life.

To develop an ability to solve simple science problems.

To develop a scientific way of thinking.

To apply knowledge of chemistry to everyday affairs.

To appreciate the physical and natural world.

To increase interest in the study of science.

To experiment with chemical materials safely.

Grade Six

NATURAL SCIENCE

Growing up

PHYSICAL SCIENCE

Astronomy

The sun and planets

Stars

Phases of everyday living affected by the sun and rotation of the earth

CONTRIBUTIONS OF SCIENCE TO SOCIAL LIVING

Effect of environment on ways of living

Natural resources: their use and conservation

Properties of air

Man's use of air in transportation and communication

Astronomy

OBJECTIVES

To develop clear, simple understandings of the universe as a whole and of the earth's relationship to the universe.

To enjoy the opening of new avenues that stimulate and satisfy one's natural curiosity in the phenomena of the universe.

To gain a feeling for the vast expanse, beauty, and wonder of the universe.²

TEXTBOOKS

Controversy concerning the position of the textbook in elementary education has not resulted in the complete discrediting of its value in teaching, but has enhanced its position as an aid to adequate instruction

²Denver Public Schools, Denver Colorado, The Social Studies Program of the Denver Public Schools, (Denver, 1954).

More money is being spent by publishers than ever before in research to develop better texts. As a result, more and better texts are constantly being made available to the teacher.

The task of evaluating these texts could be endless. There is no particularly bad text since a text becomes good in proportion to the extent to which it can be adapted to a certain situation. It is not the purpose of this report to evaluate a specific text for a particular situation, but rather to generally observe and judge a text to see if it is adequate to meet the needs of a science program as indicated in a course of study. The following criteria is suggested as a basis:

Does the text follow the interest patterns of boys and girls?

Is the reading level of the text properly graduated to the grade level of boys and girls?

Is the subject matter indicated in the course of study covered in the text in readable form? Is the subject matter of the course of study found at the same grade level or at a lower grade level?

Can the objectives of science education as indicated in the course of study be achieved by use of the text?

Through the cooperation of textbook publishers it was possible to examine texts and extensive charts explaining texts. Practically all texts examined had subject matter distributed in the areas of nature study and physical sciences at all grade levels. Those which seemed most adaptable to the preceding courses of study and which met the criteria stated above were developed by the following publishers:

Allyn Bacon, Inc., Charles Scribner's Sons, D. C. Heath and Company, Ginn and Company, J. B. Lippincott Company, Rand McNally and Company, Row Peterson and Company, and The L. W. Singer Company, Inc.

In summary then, one may conclude that the choice of a science text at the elementary level can most wisely be made by the teacher. It is she who is most familiar with the course of study and she is the better judge of which text is adapted to her particular needs and manner of presentation.

CHAPTER V

CONCLUSION

The purpose of this report has been to summarize some of the related aspects of elementary science instruction, and to formulate a criteria for evaluating an elementary science program. The preceding chapters dealing with the developmental patterns of children, the objectives of elementary science, courses of study, and elementary science textbooks were summarized from available sources of information. These summarizations logically suggest the formulation of such a criteria.

The influence of the teacher on the success of an instructional program cannot be underestimated. However, within the scope of this report, observation of a science program in action was not feasible. Hence, in evaluating a program, it is necessary to make a calculated determination as to how well a course of study will adapt itself to the ingenuity of the teacher.

The criteria for evaluating an elementary science program then, follows logically from the preceding report. Such a criteria should be objective in nature and as free as possible from personal opinion. The limitations of a criteria of this nature are apparent since the human element in the person of the teacher, supervisor, and others involved in the instructional program may well determine finally the success or failure of a program as it concerns the pupil.

An elementary science program, then, might be examined in light of the following questions in order to formulate a brief evaluation of its adequacy:

1. Do the objectives of the program coincide with the objectives of the total elementary program of instruction?
2. Are the objectives attainable at the grade and age level for which they are intended?
3. Does the course of study clearly outline the objectives?
4. Does the course of study clearly outline the subject matter to be covered?
5. Does the course of study adapt itself to the ingenuity of the teacher?
6. Does the teacher have at her disposal sufficient equipment to completely develop units of study in the course?
7. Does the program consider the growth and developmental pattern of boys and girls in its objectives, activities, and subject matter?
8. Are textbooks and other published materials available at the grade level or at a previous grade level for each unit of study?
9. Does the program have the support of those in administrative positions?
10. Does the program prepare the pupil with adequate background for future study in the area of science?

The aspects of elementary science instruction summarized in this report are those most fundamental to the development of an adequate science program. By comparing these aspects the problems involved in elementary science become apparent. The extent to which the objectives and subject matter is adapted to the growth and development patterns

of boys and girls may well determine how well the pupil comprehends what is taught and may thus decide the success of the program at the pupil level. The objectives of a science program indicate what is to be accomplished. The course of study should direct the teacher in the most efficient manner to achieve the objectives. The course of study is supplemented by the textbook, and so in the eyes of the teacher, both are significant. The textbook is of further significance to the pupil since it may be his principle source of information. Hence it is important to both teacher and pupil that the textbook be meaningful.

The summarization and comparison of the fundamental aspects of an elementary science program indicate that the significance of each part must be considered in the development and evaluation of an instructional program in science for the elementary school.

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