A SURVEY OF THE SUBJECT MATTER OF GENERAL SCIENCE IN THE JUNIOR HIGH SCHOOLS IN KANSAS

by

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TABLE OF CONTENTS

INTRODUCTION

A course in general science offers many challenging experiences to the student. General science is designed to prepare students to meet life situations. If this overall objective is to be achieved it is necessary that writers of textbooks, curriculum workers, and teachers of general science be aware of the life situations which will confront the student. This can be done only if writers, curriculum designers, and teachers constantly bear in mind that these life situations are always changing. Situations which confront youth in the forties are different from those of the thirties and those of the fifties will be different still. With this in mind it is necessary that writers, curriculum workers, and teachers be continuously revising and improving the offerings of general science, dropping that portion which no longer has a place in such a course and adding new subject matter as new knowledge, new techniques, and new inventions make their appearance.

HISTORICAL NOTE

In the period 1871-1875, according to Leker (21), about five percent of the schools offered natural science. This early beginning was short lived. In 1884 the United States Office of Education sent out a bulletin encouraging science work. During this time and shortly after, certain educators became interested in special science courses for the grades. Physics texts were

the texts used in this grade work more than any other science text. Out of this, some early authors got the idea of combining several sciences in one text but it can be seen that they always stressed the science of their own special interest. This has led to the criticism that there are no well-balanced textbooks on general science. Present texts, however, have achieved a much more desirable balance in their treatment of the various areas of desirable subject matter.

The general science movement in its present form had its beginning in the schools of the nation around 1915, according to Grunn and Douglass (11, p.114). It was toward the close of the first decade of the present century, however, that courses named "elementary science", "introductory science", and "everyday science" began to appear. The first textbooks as has already been pointed out were adaptations of books in the special sciences. About 1915 general science textbooks in somewhat their present form began to appear. The content of modern textbooks and syllabi reflect the influence of many early authors in the field. Many topics introduced by the early authors have withstood the test of time. The problem of heating the home, ventilation, weather, electricity, and pure water supply, for example, are now as formerly, of great importance.

Science was formerly taught only in the high school but with the coming of the junior high school movement which occurred simultaneously with the general science movement, science became an offering of the junior high school and in many cases,

as today, it was offered in the eighth grade. Many of our school systems are still organized on the 6-2-4 plan in which the secondary school includes grades 9 to 12. On the other hand, many school systems are arranged according to the 6-3-3 plan. A few are organized on the 6-6 plan. This situation has resulted in the retardation of a science program in grades 7 to 9 because it has been necessary to develop two types of science programs for the grades. One finds pupils entering junior high school with no previous science training and some with from 4 to 6 years of instruction. From the organizational aspect this situation presents subject matter difficulties. Noll (26, p. 99) makes the following statement:

> A one-year course in ninth grade science in a four year high school should be different in scope and thoroughness from a two-year, or three-year course for junior high school grades.

He also suggests that the textbook and the approach might reasonably be different. At the present time one may find many junior high schools offering a course in general science in the eighth grade when the plan of organization is the 6-3-3 plan. In other systems where the plan of organization is the 6-2-4 plan general science is not offered as a part of the junior high school curriculum.

THE PROBLEM

The problem of this study was to determine what subject matter was being offered at the time in the Junior High Schools of Kansas, what subject matter was being emphasized, what was being taught that might well be left out, and what, if anything, was being left out that should be included.

METHOD

The field of study was divided into two parts. Part one deals with the problem from the standpoint of the textbook and was divided into two phases thus: (a) A survey was made of four nationally known textbooks, two having been on the Kansas state adopted list at one time or another; (b) a survey was made of the four texts adopted by the state of Kansas for use in the junior high schools beginning with the school year 1947-48. The results of the surveys are given in tabular form in order that comparisons between the texts can be made with ease.

Part two is an overall study of the general science subject matter in the junior high schools of Kansas as revealed by a questionnaire.

For this study three classes of information were sought: (1) Information regarding objectives and outcomes; (2) information as to content and subject matter; and (3) information

from related areas which vitalize and give meaning to the subject matter such as visual aids, supplementary materials, and community resources.

During the spring semester 1946-47, the questionnaire was sent to every junior high school in Kansas as catalogued in the Kansas Educational Directory for 1946-47, compiled by Dr. L. W. Brooks, State Superintendent of Public Instruction.

PART I SOME TEXTBOOK STUDIES

From the very beginning textbooks of general science have been a subject for study and discussion. This is as it should be since it is a well established fact that textbooks must keep up with the developments in science if they are going to be able to meet the needs of the pupils who use them. Textbooks at best are static and must be revised frequently if they are going to serve their purpose well. One of the earliest studies was made by Heineman (14) in which he showed the number of principles presented by each book studied, the number of principles illustrated by each, and the number of principles implied though not definitely presented by each book. Heineman analyzed 16 books in his work, the earliest was published in 1911 and the latest was published in 1925. Simmons (35) conducted a study in which he brought out the teaching helps found in various general science textbooks. He concludes that it seems reasonable to say that aids to teachers add to the value of general science textbooks. This study was reported in 1936 and covered a period extending from 1911 to that time. In his conclusions he lists 16 different factors which he considers to be of special help to teachers. These are: 1. Demonstrations; 2. Exercises; 3. Experiments; 4. Footnotes; 5. Glossaries; 6. Key statements; 7. Key words; 8. Pictures; 9. Projects; 10. Questions; 11. References; 12. Reports; 13. Summaries; 14. Tables; 15. Tests; and 16. Topic Surveys.

Another group of investigators, Pohly (30), Powers (31), and Pressey (32), according to Noll (26, p. 105), has analyzed textbooks and articles on general science and tabulated the frequency of occurrence of scientific terms. These results were then checked by experienced teachers, or against Thorndike's Teacher Word Book. Two of the texts used in the Powers study were general science texts. The vocabulary burden of text A was 1391 words, of text B was 1257 words. The author points out that the vocabularies of the general science texts were smaller than those of texts in biology and chemistry and do not exceed the number of words found in books on other subjects prepared for children of the same grade level. He concludes, however, by saying that it can hardly be denied that the vocabulary burden of all the texts is unnecessarily large. In fact, all these studies agree that there is unnecessarily large use of unimportant, uncommon, and difficult words. These studies would tend to give emphasis to a fact already known, that the subject matter of general science or any subject for that matter, must be couched in terms that are within the vocabulary ability of the pupils.

The foregoing studies are examples of studies done from the standpoint of the mechanical aspects of the general science textbook.

Survey of Earlier Textbooks

For the purpose of this survey, four nationally known texts of the decade of the thirties were chosen. Text A is Wood and Carpenter, "Our Environment, How We Use and Control It".[1] This text was chosen because it has been used as a state adopted text and a very recent revision is now on the state adopted list. Text B is Gruenberg and Unzicker, "Science In Our Lives"[2] and was chosen because it was the state adopted text through the school year 1946-47. Text C is Clement, Collister and Thurston, "Our Surroundings"[3], chosen because it is generally known, is representative of the general offering and covers a wide variety of subject matter. Text D is Meister, "Living With Science"[4], Book Three, and was chosen because the author has made contributions to the development of general science.

The areas of subject matter treated in these texts are: mechanics, heat, sound, electricity and magnetism, light, weather and climate, plants, animals, geology, natural re-

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[1]Wood, G. C. and H. A. Carpenter, "Our Environment, How We Use and Control It", Chicago. Macmillan. 704 p. 1938.

[2]Gruenberg, B. C. and S. P. Unzicker, "Science In Our Lives", New York. World Book Co. 754 p. 1938.

[3]Clement, A. C., M. C. Collister and E. L. Thurston, "Our Surroundings", Syracuse, New York. Iroquois. 675 p. 1938.

[4]Meister, Morris, "Living With Science, Book Three", New York. Charles Schribner's Sons. 791 p. 1940.

sources, health, physiology, heredity, chemistry, astronomy, communications, foods and transportation.

Table 1 is self-explanatory and offers the reader a means of comparing these texts.

Table 1. Characteristics of some earlier textbooks.

Text:	Number of					Words in glossary	Ref. in index	Grade level	Self tests
	pages	drawings	photo.	expts.	units				
A	704	276	87	53	8	0	1097	9	None
B	754	337	73	141	8	0	667	8-9	Subjective questions
C	675	128	131	None outlined in text	Not so arranged	926	1426	9	None
D	791	323	257	82	9	0	1423	7-8-9	42

Survey of Present State Adopted Textbooks

For this survey four texts adopted for use in the Junior High Schools of Kansas beginning with the 1947-48 school year were used.

Text A. "Our Environment, How We Use and Control It, Book III," by George C. Wood and Harry A. Carpenter published by Allyn and Bacon, New York in 1946, is an entirely new revision of an old and proven text. The authors assume that the students come to a course in general science with every conceivable background. With this in mind the first unit, p. 1-75, is devoted to the scientific method of thinking and study. Unit two, p. 76-346, is divided into tool topics. It sets up the working informational tools for the solution of the major topics which follow.

The authors introduce each unit with a reproduction of an oil painting. Below each painting is an appropriate and challenging quotation from some well-known author. Following this is a one page introduction and drawing to instill a friendly emotional reaction from the group. This is followed by an inspirational and guiding prevue of the chapter.

There are 53 experiments, 33 of them labeled as key experiments. Most of the experiments can be done without a large outlay of material and equipment. In the earlier editions the experiments were within the body of the text. In this edition they are boxed out and hence do not inter-

fere with the story being told the pupil.

The illustrations are very good. They consist of (1) line drawings which are large and easily understood, (2) photographs, and (3) reproductions of oil paintings.

Closing the study of the topic is a summary, list of key statements, thought questions, and research problems or projects to work out and write.

Subject matter which might be considered under the following headings is presented: mechanics, heat, sound, electricity and magnetism, light, weather and climate, transportation, plants, animals, geology, conservation, natural resources, agriculture, modern inventions, health and safety, physiology, heredity, chemistry, communications, astronomy, and foods.

The appendix includes a set of 22 pictures called key pictures illustrating scientific ideas and 11 sets of rules covering a wide variety of activities. A good bibliography, pronouncing glossary, and a comprehensive index are also included. This is a practical text containing a wealth of teachable material and one worthy of consideration for use as a text for a course in general science.

Text B. "Science," by Ira C. Davis and Richard W. Sharps published by Henry Holt and Company, New York in 1947, is a book containing 19 units. Each unit is introduced with a section entitled, "The Story of Progress and Discovery". Following this is a set of questions for directing the study of the

unit and a list of words with their meanings which are included to help the pupil understand the unit. This is a well written revision of a previously useful text. There are many large and meaningful line drawings and many good half-tone photographs. Each unit is closed with a discussion of the old and the new. Directions for many useful demonstrations are included in this text which the authors suggest are best done by the teacher. Also there are suggested pupil activities, which in reality are simpler experiments. Subject matter which might be considered under the following headings is presented: mechanics, heat, sound, electricity and magnetism, light, weather and climate, transportation, plants, animals, geology, conservation, natural resources, agriculture, modern inventions, health and safety, physiology, heredity, chemistry, communication, astronomy, and foods. No glossary in the usual sense is provided but the word list at the beginning of each unit replaces the glossary very well. There is a biographical glossary of eminent scientists. A well-chosen index is included. This is an excellent text but most teachers of science think it is somewhat too advanced for use in the eighth grade.

Text C. "Everyday Science," by Otis W. Caldwell and Francis D. Curtis published by Ginn and Company, New York in 1946, is rewritten from the older book, "Science for To-day". It has in the content a very large amount of material not known when the first book was written. The 14 units which make up the body of the book cover adequately the material which should

be included in a course in general science. The article at the beginning of the book entitled "To the Student" on how to study is particularly valuable. Chapter 1 of the text is not made a part of any unit but is a general introduction to the entire field of science. Each unit is introduced by use of a double page photograph particularly suited to the unit to be presented. There are 35 chapters, each introduced with questions answered in the chapter designed to stimulate interest. In this text new words are defined at the bottom of the page. There are 93 experiments suggested with full explanations including explanations of simple apparatus which make it possible for them to be performed by teacher or pupil. A self-test, objective in nature, is provided after each major section in the chapter. A wide variety of exercises and activities is provided at the end of each chapter. Additional lists of problems and a selected list of additional reference books are also provided.

In the back of the book is a list of statements regarding "Scientific Attitudes", "Elements of Scientific Method", and a list of "Scientific Principles". Following this is a section entitled "Science for Leisure Time" which describes a number of scientific pastimes, hobbies, and recreational activities. Suggested activities are a science diary, star studies, a study of industry, making collections, study of the life of a given region, a science scrapbook, the writing of science drama, making a balanced

aquarium, and making a study of our national parks. Subject matter which might be considered under the following headings is presented: mechanics, heat, sound, electricity and magnetism, light, weather and climate, transportation, plants, animals, geology, conservation, natural resources, agriculture, modern inventions, health and safety, physiology, heredity, chemistry, communication, astronomy and foods. A glossary of 20 pages is provided. The last inclusion is a very good index of 16 pages. This text is well-balanced with a wide variety of topics both physical and biological.

Text D. "Science for Everyday Use," by Victor C. Smith and B. B. Vance published by J. B. Lippincott, New York in 1946, is another first-class text on general science. It does not specialize in any one field but gives a balanced program for all. The unusual arrangement of this text is its outstanding characteristic. It is divided into six units: "Matter", "Energy", "Life", "Earth", "Man", and "Inventions". Each unit is divided into three chapters of six main topics each. Each of the six main topics is intended for a single day's problem. Suggestions as to the time to be spent on pupil planning, activities, reports, films, and mastery tests are provided. Motion pictures to be used are suggested in the teacher's handbook which the publisher will furnish together with mastery tests upon request. Each chapter is followed by a study test, suggestions for review of the chapter, a word list for study, a

review matching exercise, a list of related topics, and a selected list of thought questions. Following the main body of the text is a short list of scientific words with the number of the page on which each is used. The index is rather brief covering only 11 pages. This text is one of the most up to date and presents in a very accurate and interesting manner a wide variety of useful subject matter. There is a total of 108 demonstrations outlined within the body of the text and in addition 190 experiments are suggested. Illustrations consist of (1) line drawings, (2) photographs in black and white, and (3) color photographs, all of which are very good. Subject matter which might be considered under the following headings is presented: mechanics, heat, sound, electricity and magnetism, light, weather and climate, transportation, plants, animals, geology, conservation, natural resources, agriculture, modern inventions, health and safety, physiology, chemistry, communication, astronomy and foods.

Following is Table 2 which summarizes statistically the four books on the state adopted list and offers a means of comparing these texts.

Table 2. Characteristics of the present state adopted textbooks.

Text:	Number of pages	drawings	photo.	expts.	units	Words in glossary	Ref. in index	Grade level	Self tests
A	870	239	359	53	7	315	1401	9	Subjective questions
B	538	410	174	144	19	0	536	9	Yes
C	664	239	359	93	14	504	1235	9	Yes
D	731	184	335	108	6	0	658	9	Yes

PART II THE SUBJECT MATTER OF GENERAL SCIENCE IN THE JUNIOR HIGH SCHOOLS OF KANSAS

The writer sent a questionnaire (Appendix) to every Junior High School in Kansas as catalogued in the Kansas Educational Directory for 1946-47 as compiled by Dr. L. W. Brooks, State Superintendent of Public Instruction. Of the 72 schools to which the questionnaire was mailed, 35 reported a course in general science. Five other schools replied but stated that they did not offer a course in general science. This represents a total participation of 55.5 per cent. It is likely that many schools which did not offer general science courses at the time did not reply at all and that the number returning the questionnaire represents a fairly large percentage of those offering such a course.

Since this study is concerned with subject matter, those portions of the questionnaire which do not deal directly with that particular matter will not be treated in this thesis. Those questions which do not deal with subject matter and have no bearing on the problem represent areas of special interest to the writer.

The Junior High School and Its Function

The writer did not intend that this thesis be a treatise on the junior high school as such. However, since the junior high school was organized to perform certain functions and since general science has become such an integral part of the traditional curriculum of the junior high school, it seemed only proper to review these functions and see how general science helps in bringing about their realization.

Much of the work of formulating and setting forth the functions of the junior high school was done in the period between 1915 and 1927.

Numerous statements of the functions of the junior high school have been set forth by various authorities in the field. Among the most significant works, in the period referred to above, are those of Briggs (2), Koos (20), Smith (36), and the Department of Superintendence of the National Education Association (23). Following is the Briggs' list of 1920:

> To continue, in so far as it may seem wise and possible and in a gradually lessening degree, common integrating education.
>
> To ascertain and reasonably to satisfy pupil's important immediate and assured future needs.
>
> To explore by means of materials in themselves worth-while the interests, aptitudes and capacities of pupils.
>
> To reveal to pupils, by materials otherwise justifiable, the possibilities in the major fields of learning.

> To start each pupil on the career which, as a result of the exploratory courses, he, the school, and his parents are convinced is most likely to be of profit to him and the investing state.

Koos has brought together a number of purposes for the junior high school mentioned in various writings before 1920. Those most frequently mentioned were as follows:

> Realising a democratic school system through (a) retention of pupils, (b) economy of time, (c) recognition of individual differences, (d) exploration and guidance, and (e) the beginnings of vocational education.
>
> Recognizing the nature of the child at adolescence.
>
> Providing the conditions for better teaching.
>
> Improving the disciplinary situation and socializing opportunities.
>
> Securing better scholarship.

Smith has evolved one of the most comprehensive and carefully planned statements of function of the junior high school. His statements can be grouped under three main headings. The following is a listing of the major statements of function according to Smith:

> To provide a suitable educational environment for children approximately twelve to sixteen years of age.
>
> To democratize the school system.
>
> To effect economy of time in education.

The 10 most important functions of the junior high school, determined by an analysis by 50 public school officials and 20 college specialists conducted by the Department of Superintendence of the National Education Association in 1927, are as follows:

Meeting individual differences of pupils ---enabling pupils to follow the lines of their interest and ability.

Prevocational training and exploration resulting in wise choices of later school courses and life work.

Counseling or guidance---bringing pupils into contact with the influences that should give direction and purpose to their lives.

Meeting the needs of the early adolescent group.

Bridging the gap between elementary and secondary schools---proper coordination between lower and higher schools.

Development of qualities of good citizenship---preparation of pupils to play a larger part in the life of the community.

Providing opportunity for profitable self-activity---early development of leadership, individuality, and initiative.

Retention of pupils beyond compulsory school age.

Continuation of common education or regular scholastic or academic training.

Rounding out a complete unit of training beyond the elementary grades for those who must leave school early.

Gruhn and Douglass (11) in their recent work have made a statement to the effect that it is desirable from time to time to re-examine the purposes of the junior high school to

> formulate a statement of its functions which is acceptable in the light of present day thinking concerning the nature and purpose of the educational program for this institution.

Gruhn has re-examined the most significant statements of functions of the junior high school and in the light of this

study has set forth a statement of functions which seem worthy of mention at this point. These functions are grouped under six main headings as follows:

Integration
To systematize and intigrate educational outcomes previously acquired.

Exploration
To provide opportunity for the development of a continually widening range of cultural, social, civic and recreational interests.

Guidance
To prepare students for making intelligent decisions regarding immediate and future educational and prevocational opportunities.

Differentiation
To provide differentiated educational facilities suited to the varying backgrounds, needs, interests, capabilities, and personalities of pupils and to provide differentiated educational facilities suited to the varying future occupational needs of pupils.

Socialization
To provide opportunities for the social growth and social participation of pupils.

Articulation
To provide a gradual transition from elementary to secondary education. To prepare the pupil to participate as effectively as possible in all present and future learning experiences.

From the foregoing statement of functions it is possible to determine certain fundamental and underlying principles which pervade this list of Gruhn and Douglass evolved in 1947 and the lists from two decades ago and tie these groups together. Then, as now, the matter of integration was an important consideration. The exploratory function of the junior high school has always been an important function. Retention of pupils was one of the early purposes of the junior high

school and this is an equally important function to-day. Socialization and democratization have been and are now important functions of the junior high school. The guidance function, while it had its place in the past, is at present receiving greater emphasis in the junior high school. To effect economy of time in education was one of the reasons for the establishment of the junior high school and today remains as one of its primary functions.

Mainly through its curriculum is the junior high school, or any school for that matter, able to fulfill its purpose. General science is an important offering in the traditional junior high school and helps to fulfill its function in the following ways:

1. It meets present and future needs of pupils.

2. It reveals to the pupils the possibilities in some of the major fields of learning.

3. It is an exploratory course.

4. It does effect economy of time in education by preparing students for future science courses and providing those who leave school early a wealth of useful information.

5. It serves a guidance function in that the very nature of the course makes for clear independent thinking so necessary if pupils are to learn to make some decisions for themselves.

6. It bridges the gap between elementary and secondary school learning.

Just as it is desirable to formulate a statement of functions which is acceptable in the light of present day thinking, so is it desirable to re-examine, revise and bring up to date the curriculum which brings about the realization of these functions.

Aims and Objectives

In the previous section the special function of the junior high school was discussed. It was pointed out that this institution must fulfill its function through its curriculum. The work of Koos (20) and his statement regarding the functions of the junior high school have been cited. From his summary it can be said that the function of a junior high school is to render service to pupils. If the junior high school or any school for that matter, is to render service to pupils then it must offer what those pupils want and need. What the school has to offer must reach the pupil, to a large extent, through the curriculum. Since it has been established that the aim of the school is to offer to the student those things which he needs to meet life situations and that the needs of the pupils are met through the curriculum, then it immediately becomes apparent that the curriculum must be kept up to date. That it must be constantly studied and improved, and that the aims must be kept clearly in view is equally apparent. Since science is

a definite part of the curriculum of the traditional junior high school it is only reasonable that the aims of general science be considered in this work.

In 1927 Cureton (3) made the statement that, "there is no general agreement concerning the basic aims of junior high school general science." However, by going back some 20 years and studying the aims generally accepted from that time to the present, the writer can see a common thread of objectives running through most of the statements of aims for junior high school general science.

Following are reports of some of the more significant studies made to investigate the aims and objectives of general science.

Leker (21), in 1924, made a study of general science aims in which he set forth aims of four leading textbooks of the day. He reported a study made by Mr. Wallace H. Kiang at the University of Wisconsin in 1924 regarding the aims of general science as listed by 43 authors and writers. Following are Kiang's aims as reported by Leker. The number following the aim represents the number of authors and writers listing that aim.

Better understanding and control of environment	28
Information about nature and science	23
Preparation for later science courses	19
Training in the scientific method	16
Development of power of interpretation and appreciation	14
Development of interest in science	11
Culture	10

Leker states in conclusion:

> No other subject can give the boy or girl who quits school as much usable knowledge as general science in the time that is given to its teaching. On the other hand, should the pupil continue through the high school, he will have the elementary fundamentals of the special sciences and can continue in biology, chemistry, or physics, just where he quit in general science.

Cureton (3) made a study in 1927 the aim of which was to determine the consensus of opinion of general science experts, junior high school authorities, scientists, and junior high school students concerning specific problems as they are related to general science. Among other things the problem of aims was considered. Following is a list of aims which were rated by the above mentioned groups, listed in their order of rank.

> 1. To develop in the child an appreciation of the value and importance of science as it affects his daily life to the end that he may acquire the proper attitude toward those civic-scientific issues which he will later be called upon to lend his voice in solving.
>
> 2. To develop in the child those general attitudes and habits of broadmindedness, fidelity to truth, careful inquiry and evaluation of evidence in connection with problems, of logical analysis of data which will tend to mould his character and temperament in the best manner.
>
> 3. To develop in the child an interest in the value, worth and beauty of science to the end that he may have opened before him a great number of interesting avocations and that he may be stimulated to go farther into one or more of the many fields of scientific endeavor.
>
> 4. To develop in the child those particular habits and attitudes and to present to him those particular facts and principles, most likely to be of definite use to him both as a child and as an adult.

5. To give the child a general preview of the field of science to the end that he may have a better basis for the selection of further science work in the school and perhaps in life.

Bergen (1) reports a study made at the University of Wisconsin during the summer of 1930. The investigation was made to determine a list of specific objectives of general science. The data for the study were secured from a group of 25 graduate students who had a median of five years experience in science teaching. A list of 57 specific objectives for science teaching was secured and these were classified into eight separate catagories. It was found that more emphasis was given to scientific thinking as an objective than to scientific knowledge. Following is a list of the specific objectives receiving the 12 highest ranks.

1. Habit of scientific thinking.

2. Development of scientific attitude.

3½. Knowledge which will give an insight into the nature and organization of the environment making of it and organized whole instead of a lot of disjointed parts.

3½. Powers or ability in the use of the scientific method.

5. Appreciation of the benefits of science.

6. Knowledge of scientific facts, principles, and ideals.

7½. Desire for further knowledge.

7½. Habit of inquiry.

9. Power to apply general principles to new and complicated facts.

10. Knowledge concerning appliances and principles which science has developed which are useful in making for greater comfort and convenience in home and community.

11. Knowledge which will satisfy natural interests in forces of nature with which we are surrounded, and with which we must deal.

12. Appreciation of universal operation of natural law.

Briggs (2) conducted an informal inventory of the needs of science by representative citizens and of its possible values. As a result of this study the author makes the statement that "science deserves a greater place in education than ever before." He also makes it clear that he does not feel that the list of objectives obtained in this study is complete but suggests that the inventory discovers the objectives toward which general science courses should aim. The list of objectives resulting from Briggs' study are listed under six main headings thus:

1. Utility: General science shall teach pupils to know what the utilitarian values of science are, how science is applied to make life safer and easier.

2. Appreciation: Science should make students aware and appreciative of the wonders of nature.

3. Avocation: Science should contribute to the wise and profitable use of leisure time.

4. Social Contacts: Although not an objective directly sought, a knowledge of science makes possible many social contacts.

5. Scientific Attitudes: One of the first objectives of science teaching is the scientific attitude and approach to any problem situation.

6. Preparation: To prepare students for later more specialized study of the sciences.

Croxton (8) made a study in 1925 the purpose of which was to further consider and clarify aims of science teaching. In this work the author makes a statement which is very significant.

> Our problem in science teaching is clear. We must determine what we are trying to accomplish, instead of attempting to find possible uses for the traditional body of subject matter which we are teaching.

Following is a list of the science aims as evolved by Croxton. Their order has no significance. The author suggests that each aim is to be kept clearly before the teacher that definite measures may be taken to achieve it.

1. To open new avenues of interest and satisfaction.

2. To lead to broader concepts and wider outlooks.

3. To lead to utilization of knowledge and experience in coping with the forces of nature and in making use of the fruits of discovery and invention.

4. To develop social attitudes and appreciations.

5. To cultivate scientific attitudes and habits of procedure.

In the Forty-Sixth yearbook, Part 1, of the National Society for the Study of Education (25) is found a very good statement of objectives for science teaching. The statement of objectives as given is not intended to be exhaustive. To quote the yearbook:

> It aims to show types of objectives and to illustrate, rather than to list in complete detail. As a matter of fact, a complete listing of all possible specific objectives should probably not even be considered. The statement of objectives themselves, is intended in a real sense to indicate directions of growth---perhaps never complete, but always being revised by classroom teachers and others, and thus some-

thing never finally and wholly realized.

Following is a list of the objective areas suggested by the yearbook with a few of the illustrative examples for each.

A. Functional information or fact about such matters as:
   1. Our universe.
   2. Living things.
   3. Energy.
B. Functional concepts, such as:
   1. Space is vast.
   2. The earth is very old.
C. Functional understanding of principles, such as:
   1. All living things reproduce their kind.
   2. Energy can be changed from one form to another.
D. Instrumental skills, such as:
   1. Read science content with understanding and satisfaction.
   2. Perform fundamental operations with reasonable accuracy.
E. Problem solving skills, such as:
   1. Sense a problem.
   2. Draw conclusions.
F. Attitudes, such as:
   1. Openmindedness, willingness to consider new facts.
   2. Intellectual honesty.
   3. Suspend judgment.
G. Appreciations, such as:
   1. Appreciation of the contributions of scientists.
   2. Appreciation of basic cause-and-effect relationships.
H. Interests, such as:
   1. Interest in some phase of science as a recreational activity or hobby.
   2. Interest in science as a field for a vocation.

The first question proposed by the writer in the questionnaire sent out to the junior high schools inquired into the aims and objectives of the course in general science. In all, 16 specific aims of a course in general science were suggested. These 16 major aims have been grouped into five cate-

gories. The five catagories with the aims of each catagory are given in Table 3. The number following the specific aim represents the number of science teachers voting for the specific aim.

Table 3. Aims of science teaching.

Aims	Frequency of mention
To promote understanding	
To understand nature's world, plant, animal, and mechanical	8
To understand life and how it can contribute to personal well being	4
To understand the value of science in our modern world	3
To help the pupil understand what he reads and hears	1
To promote development	
To develop creative ability and skill	4
To develop a scientific attitude	10
To develop a wide and varied interest in science	10
To develop right habits, methods, and procedures, and accuracy in reporting knowledge	1
To serve an introductory and exploratory function	
To introduce the student to the basic principles and fundamental theories of science	12
To acquaint him with the special sciences and prepare him for future schooling	14
To promote learning	
To learn to manipulate equipment	4
To make a student aware of and to help him to learn the implications of his environment	7
To learn to make adaptations and adjustments to ones environment	1
To learn of the controls man has over his environment	2
To learn the scientific method of attacking any problem	9
To provide recreation and worthy use of leisure	
To provide a worthy recreational interest for leisure and enjoyment	6

Subject Matter

Before the establishment of the junior high schools, the typical school system offered physiology or natural science in the seventh grade, physiology in the eighth grade and physical geography in the ninth grade according to Gruhn and Douglass (11, p.114). Between 1910 and 1915 courses in general science began to appear which included much material from the fields of chemistry, physics, biology and others. The offering in the field of general science can be considered a traditional field in the modern junior high school. Its position there is defended on every hand.

While it would not be necessary to defend the position of general science in the junior high school it might be necessary to defend some of the subject matter areas of the offering in general science. Indeed, the curriculum in general science grew out of the evolution of the science offerings in the upper elementary and lower high school grades. That evolution is still going on and rightly so. Furthermore it is the job of curriculum workers and textbook writers to see that such evolution be continued. Only through such evolution is it possible to keep the subject up to date, to make it serve adequately those it is designed to serve.

Extensive research and experimentation have been done to determine what is suitable subject matter for general science.

Much will need to be done in the future. Of the research that has been done, much has been based on the analysis of textbooks. Davis (10), Iler (17), Klopp (19), and Webb (37) have analyzed textbooks on general science and all, according to Noll (26, p. 105), concur that these textbooks are substantially alike in the selection of subject matter, but are not in conformity with children's interests.

Harap (13), reported a study in 1924, one of the purposes of which was to determine the science needed by present day American economic life with special reference to food, fuel clothing, and shelter. In his study he made comparisons between actual practice and what was considered efficient practice at that time. Harap's study resulted in a list of scientific terms found in the fields of biology, chemistry, health and hygiene, home economics, and physics. In all, there were 707 scientific terms found in 1328 commodities offered to the consumer.

Curtis (6) made a synthesis and evaluation of three city courses of study, four analyses of textbooks, six studies of scientific interest, three analyses of current literature, Harap's study of consumer science, and one committee report. This work resulted in a list of 1850 topics as the basis for determining what is suitable and the best subject matter for general science.

Cureton (4) brought together the results of various curricular studies in general science, including investigations of newspaper science, children's and adults' questions,

a large number of textbook analyses, books on science teaching, and tests in general science. The purpose, among other things, was to arrive at what should be the content of subject matter of general science. The study resulted in a statement of 512 topics of general science.

Davis (10) made a study to determine the subject matter topics of the eight textbooks most widely used in the schools of Wisconsin. Analyses were made of the latest editions of the eight textbooks appearing during the school year 1929-1930. This study resulted in a statement of 137 topics of general science. It further revealed that of the eight textbooks studied there was close agreement as to the units on Air, Water, Heat, Weather, Light, Magnetism and Electricity, Energy and Machines, Plants, The Human Body, and Foods. There was fair agreement on the units Sound, The Solar System, and Rocks and Soils. There was little or no agreement of the units Animals and Clothing.

In the Thirty-First Yearbook of the National Society for the Study of Education, Part I, A Program for Teaching Science (24), the following statement is made:

> Probably the most effective influence making for greater uniformity in the content and organization of general science was the report of the Commission on the Reorganization of Science in Secondary Schools.

The Report of the Commission on the Reorganization of Science in the Secondary School (23) says in part:

> General science should use any phase of any special science which is pertinent in the citizen's interpretation of a worth-while problem...The par-

> ticular units of study should be those that truly interest the pupils.....No topic should be selected which is meagre in content or lacking in significant problems.....In organizing this material the topic should be the large unit to which many specific pieces of work are related.

Many authors of textbooks heeded the recommendations of the report. Also, following the publication of the report in 1920, there appeared several investigations of the content of general science courses. Webb (37) made an analysis of 18 current textbooks in the field and gained a picture of the branches of science represented and of the major topics of each science. Overn (27) made a study of 13 textbooks appearing prior to 1920 and this study served as an additional check list for topics treated in general science, according to a digest of this study reported by Curtis (5, p. 72-73). Weckel (38) analyzed 14 textbooks and set forth the fundamental topics and their frequency of occurrence in the textbook studied.

Curtis and Hobart (7) made a study, "A Second Synthesis and Evaluation of Subject Matter in General Science," in which a total of 2525 topics was compiled and evaluated to determine their appropriateness for inclusion in general science textbooks and courses of study. This study revises and extends the list of 1850 topics compiled and evaluated by Curtis in 1928. Unfortunately, this second study is unpublished and therefore the former study provides the best available and most comprehensive checklist of topics and principles that have received recognition in textbooks and courses of study.

These studies reveal a close similarity in the subject matter areas included in the various textbooks. There is variation in the names applied and the number of units into which the various subject matter areas are divided. There is some variation in the number of topics treated in the various textbooks analyzed. There is great variation in the number of topics studied and evaluated by the various investigators.

The Curtis and Hobart study, cited above, would constitute the most valuable check list of subject matter topics in general science. As already stated, this is an unpublished study. The latest and most comprehensive study which might be used for such a checklist is the Curtis list already cited. This study does not, however, include any topics appearing since 1928.

An endeavor has been made to devise a supplementary list of modern or recent topics which might be profitably used in a textbook or course of study. Two sources of data were utilized: (1) the eight textbooks reported on in section one were analyzed for recent subject matter topics, (2) the problem was next explained to the pupils in the general science classes at Boswell Junior High School in Topeka, Kansas, where the present writer was teacher of general science. The pupils' interest in the problem was aroused and then they were asked to submit lists of current and modern topics which they would like to find discussed in their own science textbook. Many valuable contributions to the supplementary list were thus obtained. This supplementary list makes no pretense of being complete, it is believed that

it contains some very valuable contributions. The results of these two techniques are given below and are believed to be the most appropriate subject matter areas.

Air

aerodynamics
flight at speed of sound
liquid air
altimeter
wind tunnels
airfoils

Electricity

photoelectric cell
frequency modulation
short wave
electronics
television
sound pictures
wire recorder
telecommunications

Foods

deep freezing
food dehydration
gas refrigerators
homogenized milk
daily food requirements

Transportation

autogyro
helicopter
jet propulsion
pilotless planes
diesel electric
locomotives
diesel engines
superchargers
sail planes
gliders
rocket power
jet propulsion
automatic pilot
gyrocompass
gyrostabilizer
stratosphere flight
midget cars
railroad radio
ground control approach
instrument landing

Industry

air conditioning
prefabricated dwelling
atomic power
plastics
synthetic rubber
rayon
nylon
airplane dusting
cellophane
cellulose
electrotyping
bakelite
plexiglas
high octane gasoline
ambergris
pyralin
thermit

Health

protozoans
penicillin
streptomycin
D. D. T.
blood banks
sulfa drugs
biological warfare
iron lung
virus
atomic disease control

Matter of the universe

radioactivity
uranium
thorium
plutonium
new and rare elements
molecules
atoms
electrons
protons
neutrons
atomic fission

Modern inventions

microfilm
radar
radio beams
atom smasher (cyclotron)
electron microscope
magnetic microscope
atomic bomb
incindiary bomb
flame throwers
flame weeder
black light
walkie talkie
polaroid
V-2 rockets
neon lights
fluorescent lights
artificial precipitation
public address systems
schnorkel breathing equipment

The universe

Mount Palomar
Pluto
artificial meteorites

In the questionnaire sent out to the various junior high schools, three questions regarding subject matter areas were asked. The results of these questions are given in Tables 4 and 5. From a study of these tables, it can be seen that 25 out of the 35 reporting a course in general science feel that the present subject matter is meeting the present needs. However, it must be pointed out that some of those obviously think that some alterations might be made since 31 votes were cast for changes either by addition or deletion of subject matter. Fourteen voted to delete some sections of the present subject matter while 17 voted to make additions of some sections. As might be expected, there is considerable conflict in opinion as to what should be left out and what should be reinforced with additional topics. For example one teacher voted to leave out astronomy while one teacher voted to add topics from that area. Three teachers voted to leave out health while two voted to include more topics from that area. It should be pointed out here that those three voting to leave health out did not do so because they considered it unimportant but because it was being covered in other courses. The one teacher voting to leave out the area on mechanics voted to do so on the basis of a purely local situation in which he stated that his classes were all girls.

The area of modern inventions received more attention than any other as a possible new unit for inclusion in a course of study or general science textbook. In this area were mentioned such things as atomic energy for ships, cars, trains, and sta-

tionary powerplants, radar, television, and electronics.

One teacher suggested a unit on Humanics. This might sound like a unit for social studies but this teacher was emphasizing the importance of the biological and ecological considerations of human existence.

Two teachers voted to leave out areas of the present subject matter but did not indicate what areas they would leave out. Four voted to include additional areas of subject matter but did not make suggestions as to what should be included.

Table 4. Teacher evaluation of subject matter of junior high school general science.

Question	No. voting yes	No. voting no	not voting
3. Do you feel that the present subject matter is fulfilling its purpose?	25	8	2
4A. Do you think that some sections of the present subject matter could be left out?	14	17	4
4B. Do you think that some material should be included that is not at the present time being given consideration?	17	8	10

Table 5. Areas of subject matter of junior high school general science undergoing investigation.

Subject matter areas suggested for inclusion in general science	Number voting	Subject matter areas suggested for deletion from the present offering	Number voting
Unit on humanics	1	Some topics from biology	2
Science of sex	2	Astronomy	1
Current science	2	Communications	1
Additional topics in nature study	4	Heat	1
Additional topics on conservation	2	Unit on human body	3
Modern inventions	6	Health	3
Topics on aviation	3	Heredity	4
Community resources	2	Static Electricity	2
Agriculture	1	Mechanics	1
Additional topics from astronomy	1	Foods	2
Additional topics on health	2	Some topics in electricity	1
Drugs	1		

Supplementary Materials

In most school systems the subject matter offered by the adopted text constitutes the main body of subject matter in the course in general science. This is only a natural situation. However, textbooks are of necessity more or less static. Even with constant revision it is impossible to have the very latest developments in the field of science included in the textbook. For this reason it is reasonable to urge the use of supplementary materials to keep the course in general science modern in every respect in order to relate it to the experiences of the pupils.

Based on information gained from question 8 in the questionnaire, the following categories for classifying the supplementary materials were proposed:

1. Selected general works:
   - books on photography
   - books on weather
   - books on health and first aid
   - books on astronomy

2. Supplementary textbooks:
   - Basic Science Education Series
   - Smith-Trafton Series for 7'th, 8'th, and 9'th grades
   - Gruenberg and Unsicker, Science In Our Lives
   - Wood and Carpenter, Our Environment
   - Dull, Mann, and Johnson, Modern Science
   - Davis and Sharpe, Science

3. Reference works:
   - General Encyclopedias
   - The World Book
   - Book of Knowledge
   - Comptons
   - Junior Brittanica

4. Magazines and Scientific Periodicals:
   - Popular Science
   - Science Digest
   - Science News Letter
   - Current Science and Aviation
   - Popular Mechanics
   - Science Illustrated
   - Nature Magazine

5. Government Pamphlets and Bulletins:
   - Weather Bureau Publications
   - Forest Service Bulletins
   - Department of Agriculture Publications

6. Publications of Commercial Firms:
   - Municipal Public Utilities Studies
   - Westinghouse Little Science Series
   - American Telephone and Telegraph
   - California and Hawaiian Sugar Refining Corporation
   - National Carbon Company
   - Sperry Gyroscope Company
   - General Motors
   - Airlines of the United States
   - Association of American Railroads

Table 6 shows the specific category of supplementary material and the number of schools reporting that catagory. Six schools reported no supplementary materials while many schools reported materials from more than one category.

Table 6. Use of supplementary materials in junior high school general science.

Specific category by number	Number of schools reporting the specific category	Extent of categories reported	Number of schools
1	15	0	6
2	29	1	7
3	9	2	9
4	12	3	6
5	6	4	5
6	7	5	2
		6	0

Visual Aids in General Science

Visual aids may be thought of by some as a type of supplementary material. This point of view was shown by many who answered the questionnaire used for this study. It is true that visual aids make additional subject matter available. Indeed, that fact is the justification of the inclusion of the subject of visual aids in this thesis which is primarily concerned with subject matter. Visual aids make subject matter available that would otherwise be lost. This is true in such a unique way that a separate classification is justified.

Hoban (18, p.9) defines visual aids as

> any picture, model, object, or device which provides concrete visual experience to the learner for the purpose of (1) introducing, building up, or clarifying abstract concepts, (2) developing desirable attitudes, and (3) stimulating further activity on the part of the learner.

Visual aids are very important in the teaching of science. Preston (33) makes many references to the need for visual aids in developing clear mental imagery. He makes the statement that

> no field of knowledge offers greater variety and richness in these helps than does science, and probably no field needs them more.

Perry (28) classifies the various kinds of visual aids under six main headings:

1. The school journey
2. Museum materials
3. Graphic materials
4. Demonstrations and dramatizations
5. Still figures
6. Motion pictures

She refers to the school journey as the most simple of the visual aids and the motion picture as the most complex.

The school journey may be useful in introducing a unit of subject matter or in summary of such a unit. There is usually ample material available regardless of the location of the school.

The museum is a valuable contribution to any school and should be maintained in connection with the science department. Additions can be made to the school museum through the science classes and the science classes or members of the science club can assume some of the responsibility of its maintenance.

Graphical materials such as weather maps, graphical relief maps, the globe, charts and models offered by the biological supply houses make valuable contributions to the general science laboratory or classroom. Many commercial companies provide charts useful in science classes. A chart of the atoms is not out of place in the general science classroom. A chart of the metric system of weights and measures is of great value.

Demonstrations serve as a tool of visual instruction. If planned ahead of time and well done they may greatly enrich and extend the subject matter of general science.

Pictures are of several forms. Still pictures, flat pictures, and stereographs are commonly used. Projected pictures

such as slides and film strips are in common use as visual aids.

Probably the most complex of all visual aids is the sound motion picture. Of the 35 schools participating in this study all reported the use of motion pictures. Perry (26) states that

> young teachers, especially, should be warned that the motion picture in the classroom is not a substitute for supervised study, experiment, discussion, and review.

Many experiments have been undertaken to learn the place of classroom films as a means of instruction. Most of these studies demonstrate that there is a definite place in the classroom for instructional motion pictures.

Wyman (39) conducted a study to determine which of two groups, otherwise handled as nearly the same as possible, got the most out of the two methods of presentation of subject matter, that is, the oral or visual. The author advances experimental evidence that the use of visual aids is of more than theoretical value. The use of such aids makes the subject matter more vital, it gives it more value, and adds a certain clinching power.

There is another side which should be presented here. Kessler (18) made a study to determine the extent to which certain selected instructional films in science contribute to the realization of three of the major aims of science teaching in the secondary schools. These three teaching aims, in terms of which the film contents were analyzed, are:

1. To effect an understanding of scientific principles that will function in the everyday life and activities of the student.

2. To teach the elements of scientific method as skill to be employed in the solution of problems.

3. To develop the scientific attitudes.

In his work Kesslar uses the term "unique function." He defines this term by saying:

> it is an educational experience which the motion picture medium can provide but which cannot be provided by any other type of audio-visual aid.

Following is a list of "unique functions" as suggested by him:

1. Methods or processes not directly demonstrable

2. Action observable only vicariously

3. Observable action observable only through animation

4. Unobservable action through animation

5. Slow motion photography

6. Time-lapse photography

7. Simulation of reality through the incorporation of recorded sound

Twenty-four films, assumed to be the best available, were selected for study. The 1734 scenes which made up the 24 films were analyzed "critically in the light of carefully prepared evaluation criteria." Kesslar feels that the best films in the field do not serve their purpose well; that the best function performed is that of "bringing the world in-

to the classroom." Many of the potentially valuable functions are utilized far too little. Miniature photography is used too little. Too much emphasis is given to the inspirational and the dramatic. According to Kesslar there is no sound evidence that the films do, or even try, to teach scientific principles. The best films do not teach the elements of the scientific method. There is no intention or effort to teach scientific attitudes. He believes that film producers fail to use the specialized function of which this medium is capable.

In the questionnaire which was the basis of this study, questions were asked about two phases of the visual education program, namely: Do you make use of pictures, slides, and films, in developing your course in general science? Do you take your classes on school trips in developing your course in general science? Of the 35 schools participating in this study, all reported the use of pictures, slides, and films in the general science course. Twenty-one of the 35 reported the practice of going on school journeys in the development of the course in general science. Table 7 gives information concerning activities visited.

Table 7. Activities visited on school journeys and number of schools visiting.

Activities visited	Number of schools visiting
Water plant	16
Power plant	14
Fire station	12
Local garage	11
Study of rocks, soils, and erosion	9
Green house	9
Weather bureau	6
Airport	5
Observatory	5
Radio station	5
Railroad shops	4
Telephone office	2
Museum	2
Mine	1
Zoo	1

Community Resources

It is a natural transition from a program of visual aids in general science to one of community studies. This is especially true when one thinks of the school journey. For through the school journey comes so many suggestions for community studies. The community study is more, however, than a school journey. The school journey is usually not longer than two or three class periods combined into one period. The community study may grow out of some activity, observed need, or experience encountered during the school journey and may result in the initiation of a project covering a whole semester or a year, or even more, in some special cases. If the community study can be the direct result of the activities or observations of the pupils, so much the better. Many cases are in the records in which pupils have observed certain conditions which brought about a worth-while community study. Perhaps in most instances it will be necessary for the teacher to guide the pupils in their activities and cause them to see where worth-while studies can be made. Since this is true, it will be necessary for the teacher first to know the community in which he is teaching. To know of its resources for general science subject matter, to know its problems, to know its people and its industries will be required of a teacher who is to direct community studies.

One of the most effective influences making for greater

uniformity in the content and organization of general science was the report of the Commission for the Reorganization of Science in the Secondary Schools (22). This study has also been quoted by the National Society for the Study of Education in its Thirty-First Yearbook, Part 1, A Program for Teaching Science (24). Following is a significant statement from the report of that commission.

> The subject matter of general science should be selected to a large extent from the environment. It will therefore vary greatly in different communities.

The community has long been recognized as a source of valid subject matter by textbook writers and those charged with the improvement of curriculum. The literature is replete with success stories of how both school and community have profited when schools study their communities.

Pierce (29) related a very interesting story of 10 years of development, experience, and success as Wells High School in Chicago, studied and cooperated with the community. During the ten year period the school and community cooperated in the utilization of councils of health, religious activities, gardening, business training, labor conditions, child welfare, and youth recreation.

Pierce suggests as the first step in a community study, a survey to identify the communities educational resources. It is suggested that classes in each major field make surveys of resources relevant to their respective fields. The field trip or school journey is to be widely used. He suggests that par-

ents and interested lay citizens assist teachers and in some cases that they actually replace teachers. Pierce suggests that as the climax of all field trips, a trip be made by pupils unaided by teachers or other adults. These trips are to be reported on later. Some tangible outcomes of community studies are suggested by Pierce:

> Such activities sell the community on the school
> Makes use of parents and lay citizens
> Makes the community a classroom laboratory
> Serves a guidance purpose
> Provides training for community service
> Develops good public relations

Hughes (16) reports a community study in Los Angeles. The prevalence of tuberculosis among Mexicans and Negroes was alarming. The author tells how the schools cooperated in a wisely planned and directed program to allay the fears and superstitions among Negro and Mexican school children regarding tuberculosis. The school cooperated with health authorities and doctors in combatting a dreaded disease. The causes of the disease were explained together with the methods of diagnosis and control.

As a secondary outcome an analysis was made of the vocational possibilities for youth in the field of public health.

Dale (9, p.394) uses the expression "field experiences". He says that sometimes first-hand experiences take on community-wide proportions. This is referred to as a study of the community. Dale relates many instances where school groups

have made profitable use of the community resources in such projects as insect control, reforestation, game preservation, fire prevention, improvement of sewage disposal, and food studies.

Heiss et al. (15, p.153) in discussing the utilization of community resources through the school state that

> a survey of the immediate and neighboring surroundings should be made in order to list all available materials.

They suggest such a survey in order that teachers may familiarize themselves with the location and develop avenues of approach and at the same time become familiar with any special features and purposes which might be served.

Seay (34) finds that through community studies students find new interest in school work. They learn more science. The community learns too, and very often develops a continuing interest in improving itself. He suggests that probably the most valuable studies grow out of the schools desire to relate some educational activity to community needs. He suggests that there are many ways to go about a community study and that elaborate surveys are seldom necessary. The writer agrees with the idea that elaborate surveys are seldom necessary since the main objective is not the survey but to make known the educational resources. Most useful community studies have begun with a survey.

It seemed worth-while to determine what use was being made of the community resources throughout the state of Kansas. With this in mind the question in the questionnaire regarding

a community survey was proposed. Of the 35 schools participating and reporting a course in general science, only five reported having made a community survey to determine educational resources for general science. It is entirely possible for elaborate and time consuming surveys to be made, for facts already known to be catalogued, and for the whole matter to be dropped there. It is reasonably safe to state that most schools do not make as much use of their resources as they should. Probably in those areas where no survey has been made little or nothing has been done in way of utilisation of educational resources.

It was the purpose of this study to point out new topics and new areas of subject matter, and to learn more about the educational resources for general science in the Topeka area. The other teachers of general science agreed to cooperate in a city wide survey and evaluation of resources. Each teacher was interviewed and a list of resources for the immediate area of the school in which he was teaching was made. These lists were compiled into one list and any duplications were eliminated. This composite list was then submitted to the teachers and the supervisor of visual education for evaluation. In evaluating the list of resources the number (2) was placed after those items considered to be of greatest merit, the number (1) after those which were considered worthy but not of greatest merit, the number (-1) after those which might be profitably included if additional material should be desired, and the number (-2) after those items which were considered to be entirely unsuited. Following is a list of the items resulting from the survey showing

the rating given each item.

1.	Topeka Municipal Airport	2	2		2	2	2	2
2.	U. S. Weather Bureau	2	2	2	2	2	2	2
3.	Santa Fe Railroad Shops	1	-1	1	2	-1	1	2
4.	Morrell Packing Company	1	2	1	1	-1	1	-1
5.	Harry M. Liggett Company	1	-2		1		-1	-2
6.	Visit to a bakery	-1	-2	1	1	-2	-1	-2
7.	City Ice Company	2	1	2	1	1	2	1
8.	Good Year Tire Plant	2	1	1	2	2	1	2
9.	Printing Company	1	1		1	1	-1	1
10.	City Water Plant	2	2	2	2	2	2	2
11.	Sewage Disposal Plant	2	2	2	1	1	2	2
12.	Visit a dairy farm	2	-1	1	1	1	1	-2
13.	Tecumseh Power Plant	2	2	2	2	2	2	2
14.	Beatrice Foods Company	1	-1	1	1	-1	1	-1
15.	State Dept. of Health	1	1	-1	1	1	2	2
16.	Visit local garage	-1	-1		-1	1	-1	-1
17.	Visit City Parks	2	-2		-1	1	-1	-2
18.	Visit Fire Department	2	-1		1	2	2	1
19.	City Health Department	1	-1		2	2	2	2
20.	Topeka Foundry and Iron Works	-1	-2		2	1	-1	-2
21.	Johnson Serum Company	-1	-1		-1	1	-1	-2
22.	Visit a rock quary	1	-1		1	1	-1	-2
23.	Radio broadcasting station	1	-1		2	2	2	2
24.	Telegraph office	1	-1		1	2	1	-1
25.	Topeka Pure Water Company	1	-1	2	1	1	1	-2
26.	Call in representative of industry	2	-2		1	2	1	1
27.	Obtain speaker from Kansas Industrial Development Comm.	2	1		1	2	1	1
28.	Beverage bottling Company	1	-2		1	1	1	-2
29.	Flour mill	1	-2		1	-2	1	1
30.	Lake Shawnee	2	-2		-1	-2	1	-1
31.	Field trip to study rocks, erosion, minerals, evidence of glaciers, fossils, etc.	2	2		2	2	1	1
32.	Storm sewers and drainage	2	-2		1	-1	1	-1
33.	Garbage disposal project	2	2		2	-1	2	2
34.	Fire prevention project	1	2		2	2	2	2
35.	Insect and Rodent control	2			2	1	1	2
36.	Washburn Observatory	2	2		2	2	2	2
37.	Telephone Office	-1	2		1	2	1	1

From a study made of the work of several authors who have made investigations into the problem of community resources it is possible to set forth some general objectives and principles regarding community studies.

Objectives

1. To make known to the school the general science resources.

2. To make known to the students the vitel role of general science in the industries, occupations, and general activities of the community.

3. Such studies help the students find new interest in school work.

4. The community learns from such a study and as it learns there is built up a desire for improvement.

5. The school and community come to respect each other more and learn to cooperate more fully.

Principles

1. Community studies should be based on a need.

2. Community studies should be a cooperative project between the school and the community.

3. The school must be willing to relate education to needs.

4. The problem should be one in which the school can give definite help.

5. There is ample materiel in any community for profitable study.

6. Student activity and interest should be stimulated.

7. Pupil interest is an important criterion in determining what is suitable subject matter.

8. Subject matter may vary greatly from one community to another.

SUMMARY AND CONCLUSIONS

Eight textbooks were used for the survey in part 1 of this study. Table 1 summarizes the four earlier texts. Table 2 gives a summary of the four texts from the state adopted list. The two groups may be compared by comparing the data supplied by these tables.

From the findings of this thesis the following conclusions have been reached.

1. There is much variation in the number of pages devoted to a textbook in general science. In the group of earlier texts the number of pages in the largest book was 17 per cent greater than the number in the smallest. In the group of texts from the state adopted list the number of pages in the largest text was 61 per cent greater than the number of pages in the smallest.

2. There is much variation in the number of photographs. In the group of earlier texts one book used as few as 73 photographs while one featured 267 photographs. In the state adopted list there was one text with only 174 photographs while two had 359 each.

3. Wide variation also occurrs in the matter of drawings. In the earlier group there was one text with as few as 188 drawings while one featured 337. In the state adopted group one text featured 401 drawings while the one with the smallest number featured only 184.

4. There is a wide variation in the number of experiments outlined in a general science textbook. In the earlier group of texts, one did not carry an outline of experiments, another outlined 53 and still another outlined 141. In the list of present state adopted texts the one with the least outlined 53 while the one with the most outlined 144.

5. Some texts use glossaries; some do not. Of those using glossaries the number of entries varied within wide limits. One text in the earlier group listed 926 entries. The others in that group had no glossaries. In the present state adopted group two had no glossaries, one had a glossary with 515 entries while another had a glossary with 504 entries.

6. A wide variation exists in the number of entries in the subject index from one text to another. In the earlier group there was one text with only 667 entries in the subject index while all the others listed over 1,000 entries one running to 1,426. In the present state adopted group the variation was from 536 to 1,401 entries in the subject index.

7. In the newer texts, at least, the variation in the number of units into which the subject matter is divided varies considerably. In one of the present state adopted texts the number of units was 6. In another the number was 19. This is not of great importance.

8. In the present state adopted texts there is a wide selection of desirable subject matter and there is a desirable balance maintained between the amount of space allotted to the

various major fields of science represented. In these texts topics from major areas such as: mechanics, heat, sound, electricity and magnetism, light, weather and climate, plants, animals, geology, conservation, natural resources, agriculture, modern inventions, health and safety, physiology, heredity chemistry, transportation, communications, astronomy, and foods are presented.

9. Textbooks in general science, as in all subject fields, are of necessity static. There is at any one time a number of good texts in the field and the authors revise and bring their texts up to date as often as is practical. The practice of multiple adoptions is desirable. This allows a freedom of choice which is a point to be considered since the field is so large and there are so many variations in need and interest from one locality to another in a state the size of Kansas.

10. There are many variations in the statements of specific aims for a course in general science. There is, however, general agreement on the major aims and over a period of 30 or more years it is possible to trace a common thread of objectives through the various statements of specific aims. Continued study into the aims of general science is desirable and it is to be hoped this phase of the problem will receive continued attention from competent students and investigators.

11. General science is one of the traditional curricular subjects in the junior high school. The junior high school can fulfill its purpose only through what it offers. Since this is true the curriculum in general science must be kept up to date.

The offerings must be investigated from time to time and those areas which seem to be of the least value should give way to those which seem to be of greatest value.

12. Most of the teachers participating in this study indicated that they believed the present subject matter to be meeting the needs of the pupils. However 31 out of the 36 who participated voted for either deletion or addition of subject matter. The results of the survey show that there is considerable disagreement as to what should be left out or added. It is recommended that the individual teacher use his best judgment in this matter keeping in mind the interests and needs of the pupils.

13. In view of the fact that science texts do become static, that there is a lag between the subject matter in the text and that which may be of interest to the pupil at a given time, it is recommended that science teachers use a wide variety of supplementary materials such as newspaper science, magasines, and science periodicals. The junior high school exists for one purpose and that is to meet the needs of the pupils. It is the responsibility of the science teacher to keep the course functional, to supplement it wherever necessary and adapt it to the local needs.

14. Visual aids, while considered supplementary materials by some, are of sufficient importance to be accorded a special consideration. Visual aids are of importance from the standpoint of subject matter since through this medium it is possible to vitalize and extend the subject matter in a very material way.

The school journey is probably the simplest and least expensive of the visual aids, the sound motion picture is the most complex.

15. The study of a community is more than a school journey. Valuable community studies may result from material studied or experience gained from a school journey. It is recommended that wider use of community surveys be made. It is important for science teachers to know of the science resources of the community. A community survey is a point of departure. This study shows that schools which have not made surveys have done little in the way of studying the community.

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APPENDIX

1721 Lincoln
Topeka, Kansas
March 4, 1947

Dear Sir:

I am enclosing a questionnaire concerning the subject matter and content of your course in general science. Although there is some uniformity in the general science courses in Kansas, there are properly, many variations. It is the purpose of this study to determine what is being emphasized, what is being taught that might well be left out, and what, if anything, is being left out that should be included. I will make the findings of this study available to any who desire them as soon as they are completed.

I am making this study as a part of the work for my master's degree at Kansas State College and also for the improvement of the quality of my own classroom teaching here in Topeka.

I realize this questionnaire calls for much work and thought. I have prepared it in such a manner as to require a minimum of actual writing. I hope it will not be too much of an imposition upon you and I want to assure you that your co-operation will be appreciated. If you are desirous of having a copy of the results will you please so indicate? I will appreciate your return of this questionnaire at an early date.

Sincerely,

Leonard H. Moulden

General Science Teaching

Please answer completely

1. A. List the ultimate objectives or aims that you as a teacher feel define the purpose or function of a course in general science.

(a)_____

_____

(b)_____

_____

(c)_____

_____

(d)_____

_____

B. It is agreed that in the teaching of any subject to any group we must begin where the student is at the time. Teachers of general science in junior high school must know where their students are and what they have accomplished in their elementary science. In no other way is it possible to bridge the gap between elementary school science and general science in junior high school. Does your school system have a standard adoption of elementary science texts? Yes___No___. If the answer is yes are these texts available to you for your use? Yes___No___.

2. What supplementary material do you have?

(a)_____

(b)_____

(c)_____

(d)_____

3. Do you feel that the present subject matter is fulfilling its purpose? Yes___No____.

4. The content should be in terms of useful subject matter, everything included should be of value. Nothing should be for the purpose of "padding the course" or merely filling up the text or the lesson plan.

A. Do you think that some sections of the present subject matter could be left out? Yes___No___. If your answer is yes, list the topics or sections which you think could well be left out.

(a)_____

(b)_____

(c)_____

(d)_____

B. Do you think that some subject matter should be included that is not at the present time being given consideration? Yes___No___. If your answer is yes, list or name the topics which you feel should be included.

(a)_____

(b)_____

(c)_____

(d)_____

5. A visual education program may be developed along two general lines, (1) Pictures (2) Trips.

A. Do you make use of pictures, slides and films, in developing your course in general science? Yes___No___.

B. Do you take your classes on school trips in developing your course in general science? Yes___No___.

C. How is transportation for your school trips provided? School bus___Private cars___Public transportation___.

D. How are trips planned to insure value to all students?

E. Are groups assigned to make special reports? Yes___No___.

F. Below is a list of places commonly visited on school trips. Please check the places your classes normally visit. Obviously not all suggested places are available for visits by schools in any one area.

(a) Water plant____
(b) Electrical Power Plant____
(c) Railroad Shops____
(d) Airport____
(e) Weather Bureau Station____
(f) Astronomical Observatory____
(g) Zoo____
(h) Green House____
(i) Mine (coal, salt, lead, zinc, etc.)____
(j) Fire Station____
(k) Radio Station____
(l) Local Garage____
(m) Field trips to study any of the following: Rock formations, rivers, evidence of volcanos, work of glaciers, fossils, effects of erosion____
(n) Other

6. Check the plan of organization used in your school system.
A. the 6-3-3 plan____
B. the 6-6 plan____
C. the 6-2-4 plan____

7. In what grade is general science in your system taught?
A. the eighth grade____
B. the ninth grade____

8. How long are your class periods? ____minutes

9. Do you offer a full year course? Yes____No____

10. A. Is student help made use of in demonstrations? Yes____No____
B. In the following list of demonstrations check the ones you usually conduct.

(1) Preparation and properties of oxygen____
(2) Preparation and properties of carbon dioxide____
(3) Preparation and properties of hydrogen____
(4) Properties of water____
(5) Electrolysis of water____
(6) Air pressure, demonstration barometer____
(7) Distilling water____
(8) Preparation of soap____
(9) Construct demonstration fire extinguisher____
(10) Softening water____

(11) Circulation of water by convection____
(12) Breathing apparatus____
(13) Osmosis____
(14) Capillarity____
(15) Destructive distillation of wood and coal
(16) The radiometer____
(17) Requirements for combustion____
(18) Kindling temperatures____
(19) The thermometer, comparison of scales____
(20) Expansion by heat____
(21) Determination of humidity by hygrometer____
(22) Production and transmission of sound____
(23) Light rays and the lens____
(24) Sources of light____
(25) Properties of a magnet____
(26) Making and operating a simple electric cell____
(27) Static electricity____
(28) The electromagnet____
(29) Inducing a current____
(30) Buoyancy____
(31) The principle of the submarine____
(32) Streamlined flow, aerodynamics____
(33) Acid testing of sedimentary rocks____
(34) The amoeba____
(35) The paramecium____
(36) The levers____
(37) The inclined plane____
(38) Preparation of alcohol with yeast____
(39) Presence of bacteria and mold in air and on food____
(40) Use and care of a microscope____
Name any others which you feel are especially good.

11. Following is a list of equipment commonly used in the course in general science. Check the items which you have available for use.

A. Chemistry apparatus
Atomic model____
Balance with weights____
Beakers, assorted sizes____
Blower, hand bellows____
Blowpipe____
Bottles, wide mouth____
Bottles, reagent____
Brushes, test tube and beaker____
Burette____
Burner, alcohol____
Burner, Bunsen____
Burner, wing top____
Candles____
Clamp, burette____
Clamp, test tube____
Clamps, universal____

Condenser, Liebig____
Cork borers, set with sharpener____
Crucible with cover____
Cylinders, graduated____
Deflagration spoon____
Dish, crystalizing____
Dish, evaporating____
Electrolysis apparatus____
Fire extinguisher____
Flasks, assorted, distilling____
Flasks, assorted, Erlenmeyer____
Flasks, assorted, Florence____
Funnels, Glass____
Forceps____
Hydrometer____
Jars, battery____
Mortar and pestle____
Pipette____
Pinchcocks____
Plates, glass____
Ring stands____
Support, test tube____
Test tubes____
Test tubes, ignition____
Thermometer____
Thistle tube____
Triangle, wire____
Trough, Pneumatic____
Watch glasses____
Wire gauze____

B. Biological Equipment

Culture dishes____
Germination box____
Microscope____How many?____
Dissecting set____
Insect cage____
Spreading board, insect____
Specimen mounts, insect____
Life history mounts of Insects____How many?____
Prepared microscope slide sets____How many?____
Aquarium____
Terrarium____
Preserved specimens, animals____
Capillary tube set____

C. Rocks and minerals

Mineral collection____
Sedimentary rocks____
Metamorphic rocks____
Igneous rocks____
Fossil collection____

D. Forces and Machines
- Pulleys____
- Household scale____
- Inclined plane____
- Inclined plane car____
- Centrifugal force hoops____
- Steam engine, cut away model____
- Miniature steam engine____
- Miniature steam turbine____

E. Sound
- Tuning forks____
- Siren____
- Pitch pipe____
- Organ pipes____
- Xylophone, one octave____

F. Weather and Climate
- Mercury barometer____
- Aneroid barometer____
- Altimeter____
- Hygrometer____
- Anemometer____
- Barograph____

G. Magnetism and Electricity
- Lodestone____
- Bar magnets____
- Horseshoe magnets____
- U-magnets____
- Soft iron rods____
- Carbon rods____
- Iron filings____
- Magnetic compass____
- Dip needle____
- Friction rod and flannel or silk____
- Pith balls____
- Static machine____
- Leyden jar____
- Dry cell batteries____
- D C power supply, 6 volts 5-10 amps.____
- Induction coils____
- Magneto generator____
- Transformer____
- St. Louis Motor____
- Rheostat____
- Radio, demonstration outfit____
- Vacuum tubes, demonstration____
- Telephone receiver____
- Telephone transmitter____
- Telegraph key____
- Photoelectric demonstration outfit____
- Galvanometer____
- Voltmeter____
- Ammeter____

Electric bell____
Electric buzzer____
Knife switch____
Push button____

H. Light
Optical disk____
Plane mirror____
Concave mirror____
Convex mirror____
Reading glass____
Prism____
Lenses, assortment____
Refraction tank and protractor____
Miners lamp____

I. Heat
Thermos bottle____
Model hot water heater____
Model hot air furnace____
Compound bar____
Thermostat____
Radiometer____
Ball and ring expansion demonstration set____

J. Miscellaneous
Bell jar and pump____
Slide projector____
Motion picture projector, sound____
Terrestrial globe____
Airplane flight demonstrator____
Model airplane with moveable controls____
Motor driven pressure vacuum pump____
Sink____
Hot and cold water____
Natural gas____

K. In the space provided below list any equipment not covered in the list which you think should be a part of the equipment for every general science laboratory.

12. Which of the state adopted texts will be adopted for use in your course in general science for the year 1947-48?

13. Has an organized study or survey of your community been made to determine its resources for general science teaching? Yes____No____

(1) What was your procedure?

(2) What were the outcomes?

14. Do you feel that we as general science teachers expect too much of our students? Yes____No____ Do you think that the subject matter of the average textbook on general science is on the proper level? Yes____No____ If your answer is no, do you think it is (a) too easy, (b) too difficult?

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