1946

A proposed course of study in general science for ninth grade in Louisville schools.

Claude Harold Hughes
University of Louisville

UNIVERSITY OF LOUISVILLE

A PROPOSED COURSE OF STUDY IN GENERAL SCIENCE for NINTH GRADE IN LOUISVILLE SCHOOLS

A Dissertation

Submitted to the Faculty

Of the Graduate School of the University of Louisville

In Partial Fulfillment of the

Requirements for the Degree

Of Master of Arts

Department of Education

by

Claude Harold Hughes

Year

1946

NAME OF STUDENT: Claude Harold Hughes

TITLE OF THESIS: A Proposed Course of Study in General Science for Ninth Grade in Louisville Schools.

APPROVED BY READING COMMITTEE COMPOSED OF THE FOLLOWING MEMBERS:

P. A. Davies

John A. Dotson

NAME OF DIRECTOR: J. J. Oppenheimer

DATE: Aug. 22, 1946

TABLE OF CONTENTS

LIST OF TABLES

P A R T I

CHAPTER I

CHAPTER I

INTRODUCTION

Acknowledgment. The author of this work desires to express appreciation to Dean J. J. Oppenheimer, Dr. Guy Stevenson, and their faculty committee for helpful suggestions in the preparation of this thesis; to Dr. John A. Dotson, Curriculum and Research Director at the Board of Education, for his timely advice and guidance; to Dr. J. K. Long, Assistant Superintendent, for permission to present questionnaires to the teachers in the junior high schools of Louisville, and for other timely aids; to Miss Gertrude Kohnhorst, Principal of Western Junior High School, and the Faculty, for aid and inspiration; to Mrs. Virginia P. Turner, librarian of the Board of Education, and members of the library staff of the University of Louisville, for assistance in locating research material; and to Mrs. Helen Grote, my neighbor, for her accomplishement and patience in typing this thesis; and to Miss Frances Winstandley, teacher of guidance and English in Western Junior High School, for assistance in the preparation of this manuscript.

No less gratitude is due my wife, Marguerite Hughes, for inspiration, encouragement and assistance rendered during this investigation and in the preparation of this thesis.

CLAUDE H. HUGHES

Purpose. The author presents this report of a study to the general science teachers of Louisville in the belief that it will be of benefit in the organization and teaching of this important subject.

The purpose of this study is to suggest a Proposed Course of Study for General Science in the Ninth grade in the Louisville Public Schools, to include objectives, to explain the present status of general science, and to offer a selection of subject matter and contents.

Responsibility for the preparation of thisCourse of Study has led to intensive study, analysis, and evaluation. It contains statistical tables and charts based on a collection of practical data obtained by personal investigation andquestionnaires; by conferences with the Director of Curriculum and Research, and the instructions in ninth grade general science, Louisville Public Schools; and by the evaluations of studies in reference materials.

It is hoped that many of these findings and results will be of value for numerous and practical suggestions for committees appointed to work on a General Science Course of Study for the Louisville Public Schools.

General Statement of Objectives. A course of study in general science for the ninth grade needs no justification since we are living in an age in which science plays so large a part. The rapid advances in pure and applied sciences demand that the future citizen have an understanding of, and an adjustment to, an environment modified by scientific discoveries and inventions.

Valid ninth grade science instruction should stimulate the student to more direct and purposeful activities. It should lead to a higher appreciation of the pleasure and profit to be obtained by the exercise of his own abilities.

General science in the ninth grade should give the pupil control of a large body of facts and principles of significance in the home, school and community. It should build up an intelligent understanding of modern life. Science study of this grade should develop an appreciation of the inner meanings and connections of things; an appreciation of the service of science to the Life and civilization of our time; an appreciation for the slow painstaking efforts and tremendous toil through which scientific progress has been accomplished; and an appreciation of the privileges, duties, and responsibilities that this period of science involves.

General Introduction. In presenting this proposed "Course of Study in Ninth Grade General Science for the Louisville Junior High Schools," it is hoped that the committees assigned the task of preparing a course of study in this grade will regard the following outlines as suggestions only. In no way should this be accepted as a final pronouncement. The outlines are not meant to take the place of any teacher's individual initiative. They are intended to be a stimulus to his thinking and never a substitute for it.

Teachers of science on these Committees will, therefore, use the widest liberty in rearranging, modifying, or adding to

the suggestions made. This proposed course of study should be used as a tool with which to work more effectively. The science teachers of the city junior high schools may have the assurance however that these courses represent the results of a wide excursion into the recent references and literature dealing with the problems of general science course of study construction, and reflect, in a fair measure at least, some of the practices in our better schools comparable in size with Louisville.

Although permission and assistance was granted for the Educational Department of the Louisville Public Schools for the use of questionnaires and research materials, this proposed course of study in ninth grade general science reflects in no manner the policy of the Curriculum Division. Neither does it present the philosophy of the Department of Education of the University of Louisville, for which department this thesis was written. It is the result of studies made by the author and presents only his conclusions.

C H A P T E R II

CHAPTER II

THE OBJECTIVES OF SCIENCE TEACHING

Definition of a Course of Study. Before an effort is made to discuss a course of study, it seems necessary to get an understanding or definition of the term, course of study.

Various definitions of the course of study embody a traditional concept very widely accepted -- that the course of study is a means, developed by a central agency, of setting forth limitations within which the work of the schools shall take place.[1]

Monroe defines the course of study as follows: "Course of Study" is the name given to the specifications and directions relating to a given field of instruction. These specifications and directions include in the addition to the objectives to be obtained, (implied in "ground to be covered"), directions and suggestions relating to what the teacher should do in getting his students to achieve these objectives.[2]

There is a difference of opinion among teachers as to what the course of study means. A research group was engaged for more than five years in determining some evaluative standards.[3] This group has presented a definition of a course of study as follows: courses of study may be defined as that part of the curriculum which is organized for classroom use. They suggest

---

[1] Caswell, Hollis L., and Campbell, D. S., Curriculum Development, 1935, p. 449.

[2] Monroe, Walter S., Making a Course of Study - Bureau of Ed. Res. Circular No. 35 - Univ. of Illinois - Sept. 19, 1935 - Footnote p.4

[3] Gwynn, J. Minor, Curriculum Principles and Social Trends, pp. 224-225, The Macmillen Company, New York, 1943.

content, procedures, aids and materials for the use and guidance of teachers, pupils, and administrators.

Purpose of a Course of Study. The purpose of a course of study is first, to present valid education; then to enlist and direct the fighting interest of parent, teacher and student to achieve this good education for all general science pupils of the ninth grade.

The North Carolina Curriculum Bulletin, 1934, sets up seven standards or criteria for courses of study as follows:

1 - A course of study should state the general objectives or aims to be accomplished.

2 - It should specify what to teach in the way of subject matter.

3 - It should specify when to teach it.

4 - It should suggest how to teach the different phases of work.

5 - It should provide adjustments for individual differences of pupils.

6 - It should provide for measurement of results.

7 - It should provide or suggest teacher helps and references.[1]

The study of ninth grade course of study in general science has two main purposes; namely, to give the pupil an understanding of an important and pervasive aspect of our civilization, and to develop in the pupil the ability to solve such of his

---

[1] Caswell, H. L., and Campbell, D. S., Curriculum Development, 1935, p. 456.

problems as are susceptible to scientific treatment.

In carrying out these purposes and supplying the needs mentioned above, the course of study should aim to provide material which will develop in the pupil specific features of the scientific point of view - some of which will contribute to vocational efficiency, some to social adequacy, some to preservation of health, and some to the worthy use of leisure time.

Definition of a Good Education. The forms of learning now encouraged train the ability to generalize, cultivate useful skills, and develop desirable attitudes toward life.[1] In the words of the Twenty-Sixth Year Book, advantageous learning affects favorably the individual's behavior.

Meaning grows only through reaction. The term 'true learning' therefore is applied to any change in the control of conduct which permanently modifies the individual's behavior.

As Henry C. Morrison has said, "The essence of educating an American citizen is to set him going under his own power and point him right." [2]

Historical Development of Objectives. One of the greatest books of the eighteenth century, the Emile of Jean-Jacques Rousseau, a French Swiss by birth, then living in Paris, appeared in 1762. The book described the education of the boy, Emile,

---

[1] Twenty-Sixth Yearbook, Part II. Of the National Society for the Study of Ed. 1926 - The Foundation of Curriculum Making, P. 124

[2] Morrison, H. C., - The Practice of Teaching in Secondary Schools, 1931, p. 78.

by a new plan, that of rejecting the formal teaching of the schools and permitting him to grow up and to be educated according to nature.

Though Rousseau's enthusiasm took the form of a theory run mad, and the educational plan he proposed was largely impossible, he nevertheless popularized education.[1] He also contributed much to changing the point of view in instruction from sugject matter to the child to be taught, and the nature of instruction to the study of the life and universe amid which man lives here.

Among those most deeply influenced by Rousseau's book was a young German Swiss, by the name of Johann H. Pestalozzi.[2] Inspired by Rousseau's writings, he spent the early part of his life in working out for himself a theory and method of instruction development of the child. He tried to reduce the educational process (until then, the teaching of mere words and facts) to a well-organized routine, based on the natural and orderly development of the instincts, capacities, and powers of the growing child - "development of the faculties" of the child.

Pesstallozzi believed that each human could be raised through the influence of education to the level of an intellectually free and morally independent life, and that every human being was entitled to the right to attain such freedom and independence.[3]

---

[1] Cubberly, E. P., Public Education in the United States, 1919, pp.261-270.

[2] Parker, S. C., History of Modern Elementary Education, 1912, p. 506

[3] Cubberly, E. P., Public Education in the United States, p. 265.

This new school was based on the study of real objects, learning through sense impressions, the individual expression of ideas, child activity, and the development of the child's powers in an orderly way. It led to the development of elementary science study.

Plato set forth a general aim of education in The Republic.[1] He held that education should fashion the life of the individual in an all round manner and "give to the body and to the soul all the beauty and all perfection of which they are capable." Like the aims of Rousseau, Pestalozzi, - all are very general in nature.

Curriculum-making must find guiding principles which will lead it with all thecertainty that is possible in right direction.

Education is primarily for adult life,[2] not for child life. Its fundamental responsibility is to prepare for the fifty years of adulthood, not for the twenty years of childhood and youth. School must be a planning society - of continuous adjustments.[3]

When we know what men and women ought to do along the many lines and levels of human experience then we shall have before us the things for which they should be trained. The first task is to discover the activities which ought to make up the lives of men and women; and along with these, the abilities and personal qualities necessary for proper performance. These

---

[1] Caswell, H. L. and Campbell, D. S., Curriculum Development, pp. 112-114.

[2] Bobbitt, F., How to Make a Curriculum, Chap. II., 1924

[3] Caswell, H. L. and Campbell, D. S., Curriculum Development, pp.28-29

are the educational objectives.

A good suggestion for the accomplishment of the above aims is to follow the instruction of the list of proposed objectives analized on page twenty-eight of this chapter.

The plan to be employed is activity-analysis. The first step is to analyze the broad range of human experience into major fields. The lines can be drawn in any number of ways. The curriculum-making committee will make the divisions that seem best to it for its purpose.

The Need of a Clear Conception of the School's Work. No one can undertake successfully to do anything until the thing to be done - the results to be accomplished - is clearly and definitely in mind. This is true whether the task be a simple one, such as preparing a meal, or a complex one, such as building a state capitol building or drafting a state constitution.

If a clear understanding of the results to be obtained is necessary in doing even the simplest things, how much more important must it be to concdive clearly the ends to be attained through the eleborate process of education. The problems of defining these ends is rendered complex and difficult by reason of the fact that the process of education extends over many years of the child's life. The problem is further complicated by the growth changes and the changes from other causes which take place in the child during the period of his school training. Because several different teachers will help in the child's education before it is completed, it is necessary that each have a clear

understanding of the results public education should obtain, so that every teacher who tries to aid in the child's education may be aiming for the same results.

The whole objective of these teachers, according to the writer's philosophy, should be to effect favorably the conduct and behavior of boys and girls. The purpose is not to train the child to meet certain situations with unvarying responses, but to meet all situations, new as well as old, according to certain standards of value. Life is simultaneous "doing." Means of solving problems are thus emphasized on contrast to solutions to problems.[1]

In a democracy the intelligent participation of all members in the solution of problems is required. This means that individuals must have command of the means of solving problems rather than of ready-made solutions.

The Frequency of Mention of Objectives. The importance of aims or objectives in a course of study lies in the directive influence which they exert upon the selection of content, activities, and experiences. They provide the purpose which makes the course itselfe necessary.[2] In the courses of study in the current collection of fifty-eight courses of study, only thirteen percent contained no statement of objectives. This current collection was an

---

[1] Caswell, H. L., and Campbell, D. S., Curriculum Development, 1935, p. 125.

[2] Bulletin, 1927, No. 31 - "A Survey of Courses of Study and Other Curriculum Materials Pub. Since 1934." U. S. Department of the Int., Office of Education, pp. 17-25.

analysis of 1,262 courses of study, in detail, by the Office of Education, United States Department of the Interior. The percentage of omission is highest among county courses and lowest among city courses. General objectives are included in seventy-six percent of all the courses analyzed.

An examination of fifty-eight courses of study in general science was checked to discover the education objectives of the course.[1] Some of the courses did not include statements of objectives.

TABLE II -- Number of Courses of Study in General Science Stating Objectives.

OBJECTIVES	General Science (58)
Objectives of secondary education, in	14
Objectives of science in general, in	15
Objectives of specific sourses, in	40
Reference to other committees, in	2
Total	71

This table is used to explain the extensive use of objectives in course of study.

The courses were obtained from schools in response to a request from the Office of Education for courses which had been revised since 1925. Some courses were also secured from the Division of Research of the National Education Association. Twenty-six States are represented by one or more courses of study.

[1] Beauchamp, Wilbur, L., Instruction in Science, Bulletin, 1932, No. 17, Monograph No. 22, p. 9 (National Survey of Secondary Education.)

The Evaluation of Objectives. So far as the writer knows there is at the present time no conclusive method of evaluating the objectives as set forth. It is, of course, possible to compare the objectives with the recommendations of various authoritative committees such as those working with the National Education Assocation, the National Society for the Study of Education, and the North Central Association. These committee recommendations represent the consensus as to what the objectives should be. They are significant in that they indicate what objectives are entertained but they are not necessarily the objectives which should be attained in the study of general science. A more recent authoritative formulation of the objectives of science teaching is presented in the Thirty-First Yearbook, Part I, of the National Society for the Study of Education, 1932, in a volume entitled A Program for Teaching Science.[1] The stand taken by this Committee on the Teaching of Science* is shown in the following quotation:

"This committee, then recognizes the aim of science teaching to be contributory to the aim of education; viz, life enrichment. It recognizes the objectives of science teaching to be the functional understanding of the major generalizations of science and the development of associated scientific attitudes."[2]

---

[1] Thirty-First Yearbook, Part I, A Program for Teaching Science, Natl. Society for Study of Ed., 1932, p. 62.

*Committee on the Teadhing of Science (Messrs. Craig, Curtis, Downing, Powers, Pieper, and Watkins), with S. Ralph Powers as Chairman. Thirty-First Yearbook, Part I.

[2] Beauchamp, Wilbur, L. Instruction in Science, National Survey of Secondary Education, Bulletin, 1932, No. 17, Mon. 22, p. 13 Washington, D. C.

This statement is based on the opinion of the members of the committee. As such it probably represents the best composite thinking which we have on this subject. However, one of the problems which must be solved before we can get far in formulating a truly scientific curriculum is that of discovering a method of determining and evaluating the objectives of science teaching.

One way to determine a set of objectives is the suggestions of authors of recognition. The example following from Bobbitt given an idea of one way to select objectives that may be serviceable to a committee:

TABLE III.

Serviceable Classification of Objectives. The following outline is a classification of objectives that has been found serviceable:[1]

1. Language activities; social intercommunication.
2. Health activities (maintenance of physical efficency).
3. Citizenship activities.
4. General social activities contacts and relationships - meeting and mingling with others.
5. Spare-time activities, amusements, recreation - leisure.
6. General mental efficiency.
7. Religious activities - and attitudes.
8. Parental activities, the upbringing of children, the maintenance of a proper home life. Parental responsibilities.
9. Unspecialized or non-vocational practical activities.
10. The labors of one's calling - specialized training.

---

[1] Bobbitt, F., How to make a Curriculum, Chap. II, Houghton Mifflin Company, 1924

The curriculum-maker will be careful to see that his analysis does not omit portions of the broad range of desirable human experience. At all stages of the analysis, attention should be fixed upon the actual activities of mankind.

A curriculum committee should formulate its own statement of its objectives. If it seems desirable, the foregoing lists can be used as starting points. Eliminate what is not approved. Modify what is partially approved. Include what has been omitted.

In the field of English, a course of study was completed last year in the Louisville High Schools, a list of objectives waschosen and many of these can, and should be used for numerous practical suggestions.[1]

In other fields, activity-analyses have been made, many of which can be used for suggestions - as shown in the charts listed in this section of a proposed course of study.

General Aims of English Selected by Louisville Teachers. (Supplement to Study Guide No. 2)[2]

The writer desires to list the following mentioned objectives chosen by the English Committee on Curriculum Revision as a list from which some objectives in ninth grade general science may be suggested.

---

[1] Supplement to Study Guide No. 2, (General Aims of English selected by Louisville Teachers) 1945, Curriculum Division.

[2] Division of Curriculum and Research, Louisville Public Schools, 1945

1. Correct English - effective expression of thought.
2. Ability to meet social and civic needs.
3. Ability to derive pleasure and information (reading).
4. Habits of systematic and effective study.
5. Develop ability to think (logically, independent, creatively).
6. Ability to live more happily and harmoniously (by reading).
7. Formulating a philosophy of life (virility,honesty,cleanliness).
8. Appreciation of beauty (in its many manifestations).
9. Develop literary appreciation and discrimination.
10. Philosophies that influence course of human events.
11. Leisure time.
12. Respect for others and for their views.
13. Desirable qualities of character.
14. Effectiveness in social living (right attitudes, tolerance, respect for others).
15. Critical attitude of their own work.
16. Appreciation of the democratic way of life.

Another selection of objectives for a ninth grade general science course of study was taken from a study by Curtis.[1] This list is offered in Table V for reference, or as a suggestive source, in determining a proposed set of objectives in this thesis.

---

[1] Curtis, Francis D., Second Digest of Investigations in the Teaching of Science, 1931, p. 66. (P. Blackiston's Sons, Philadelphia,) Study No. 79.

TABLE V -- METHOD OF STUDY

An analysis made of objectives relative to general science in forty-two state courses of study and forty-two city courses:[1]

1. Develop powers and habits of observation.
2. Give interesting information.
3. Develop scientific attitude of mind.
4. Accuracy of thought and expression (English).
5. Lead to interpretation of environment.
6. Health.
7. Problem solving.
8. Dispel belief in superstition.
9. Ability to read popular scientific literature.
10. Educational and vocational guidance.
11. Stimulate further and more science study.
12. Develop appreciation of good contributions of science to modern life.
13. Proper attitude towards science.
14. Citizenship.
15. Understand better common natural science, phenomena and application.

Results a Ninth Grade General Science Course Should Produce.

What, then are the results which our educational leaders in curriculum construction believe a ninth grade general science course should produce.

The following article (Table VI) gives the findings of

[1] Curtis, Francis D., Second Digest of Investigations in the Teaching of Science, 1931, p. 66. (P. Blackistonn's Son, Philadelphia.)Study No.79

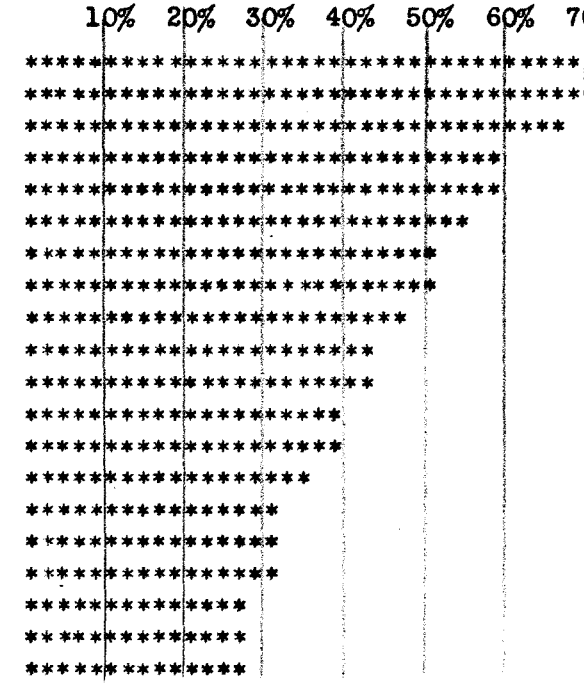
twenty-six sources of authority to determine, as far as possible, which objectives should receive the major emphasis in governing the choice of subject matter in a ninth grade general science course of study.

This list has been determined by a selection of objectives evaluated from analysis from:

1. Consensus of opinion of persons who are ranked as leaders in curriculum construction.
2. Standards set by courses of study in other schools and cities - comparable in size with Louisville.
3. Objectives determined by contents of existing textbooks, and papers written by leaders working in the field of science teaching, and from authoritative books on curriculum construction.

TABLE VI.

Objectives of General Science Teaching -- Based on an Analysis of Objectives listed on twenty-six Sources:*



		Percentage
1.	Citizenship activities (civic)	72%
2.	Knowledge, or understanding of environment	72%
3.	Vocational preparation (self-support)	68%
4.	Health activities (and mental)	60%
5.	Worldmindedness	60%
6.	Ability to solve problems (scientifically)	56%
7.	Ethical character	52%
8.	Leisure occupation	52%
9.	Preparation for life (adult)	48%
10.	Ability to do critical thinking (clear)	44%
11.	Social activities	44%
12.	Scientific interests, attitudes	40%
13.	Appreciation of benefits of science	40%
14.	Command of fundamental processes	36%
15.	Desire for further knowledge	32%
16.	Open-mindedness	32%
17.	Worthy home membership	32%
18.	Scientific thinking, habit of	28%
19.	Cooperation	28%
20.	Knowledge to satisfy natural interest	28%

* Included in this analysis in the above Table VI, were:

1. Leading Educators in the field of educational objectives -- Bobbitt, Bruner, Curtis, Harap, Hunter, Davis, Sharp, etc.
2. Courses of Study in ninth grade general science in cities comparable in size to Louisville, and widely distributed in the United States -- Atlanta, Portland, Indianapolis, Cleveland, Minneapolis and eight others.
3. Authoritative Reference -- Thirty-First Yearbook, Part I, Encyclopedia of Educational Research, Works' Survey Report of Louisville Public Schools, Education for American Youth - Subject Fields in General Education, etc.

Teachers have Ideas of Objectives. Fortunately for science teachers, a relatively small group of textbook and curriculum makers have availed themselves of recent studies in psychology and education with the results that new criteria are being added to these just mentioned. Newer texts and courses of study are built in part on an analysis of the science interests and activities of children at different age levels. Other analyses attempt to get at the life need of the pupils.

Another method is to show what efficiency a given group of objectives has as judged by criticisms of those educated in science.

Any work that is done in the way of evaluating objectives in the teaching of science should naturally be submitted to teachers. They work with children and with the material things which have to do with science teaching. Therefore they are best qualified to speak on this point. Several articles have been written in which the science teacher takes a part in defining.

Table 6 and the objectives were used as a basis for a study carried out with the teachers of ninth grade general science in the Louisville junior high schools, by means of questionnaires submitted. The same twenty objectives were arranged in alphabetical order that were based on the analysis made of the twenty-six authoritative sources.[1]

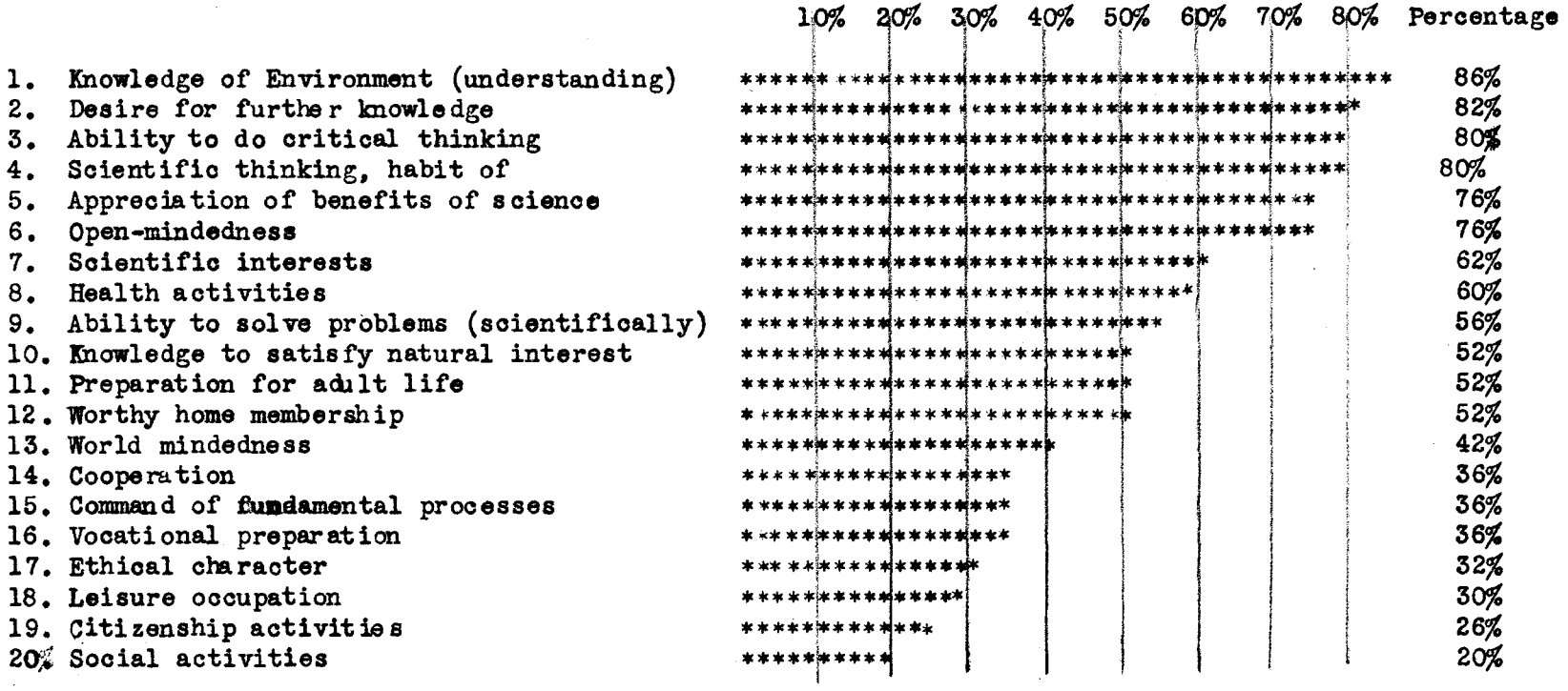
Each teacher was instructed to check any of the twenty objectives which appeared desirable in a general science

---

[1] See Appendix p. 125

TABLE VII

Objectives of Science Teaching -- Based on Analysis of Ninth Grade Science in the Louisville Schools by Thirty Teachers of Ninth Grade Science:



course of study. In addition, they rated the objectives listed according to the degree that science teaching contributed to the skills of life activities mentioned, by checking in one of four columns marked: "very much"; "some"; "very little"; "not any."

This work had as its aim to determine, as far as possible, which objectives should receive the major emphasis in governing the subject matter in a ninth grade general science course of study. It was suggested that the teacher add any additional objectives or any comments at the bottom or on back of the sheet.

The results of this study is shown in Table 7. Two teachers added objectives; only one teacher listed any comments. Only four of the first ten objectives chosen from the list of authoritative references are found in the first ten objectives selected by the ninth grade general science teachers in the Louisville schools. These were "Knowledge of environment (understanding)" - "Ability to do critical thinking" - "Health activities" and "Ability to solve problems scientifically."

The above results offer sufficient proof that leaders in educational thought differ in the terms they use to express the results that education should secure. It is probable however, that desirable results will only be obtained by teachers when they state the objectives as definitely as possible, and conscientiously seek to secure them.

Objectives of Pupils. If we tentatively set the broad aims of education as worthy of attainment, as good scientists we ought to be willing to work with our students and our subject matter in

TABLE VII -- As a Pupil in the Ninth Grade, I am Studying General Science Because it Helps Me to:

	10% 20% 30% 40% 50% 60% 70% 80%	Frequency
1. Select and prepare for vocation	**********	156
2. Become a better citizen	**********	102
3. Prove things, reason better	**********	94
4. Understand environment	**********	91
5. Know living things	**********	90
6. Enjoy good health	**********	85
7. Prepare for the future	**********	77
8. Be World-minded	**********	70
9. Prepare for furthur study	**********	65
10. Be a better home maker and parent	**********	65
11. Prepare for leisure and recreation	**********	62
12. Understand nature	**********	55
13. Address audience, converse	**********	55
14. Make work easier	**********	50
15. Do right, have good character	**********	49
16. Raise standard of living	**********	48
17. Find a hobby	**********	45
18. Understand programs better (assembly)	**********	42
19. Understand science better	**********	41
20. Know more about universe (stars, etc)	**********	38
21. Think Better (clearly)	**********	35
22. Enjoy world peace	**********	32
23. Learn essentials of education	**********	32
24. Appreciation scientific achievements	**********	30
25. Enjoy books and art more	**********	29
26. Enjoy life better	**********	29
27. Know more about myself	**********	28
28. Live up to what is expected of me	**********	23
29. Be up to date (modern)	**********	23
30. Please my parents	**********	21
31. Understand other subjects	**********	20
32. Care of natural resources	**********	20

order to attempt the adjustment of our course of study to meet these aims, thus contributing to the best needs of our pupils. Pupils of high school age are thinking in terms of emotionalized aims or standards. Why should we no help them?

To prove the above statement, Table 8 shows the results of an interesting study carried out in six classes of ninth grade general science, or a total of 198 pupils. These divisions include a wide variety, from retarted to accelerated groups. Each pupil was asked to list his personal aims or objectives in a general science course of completing the statement: "As a pupil in the ninth grade, I am studying general science, because it helps me to --" (see Table 8).

After throwing out all returns of frequency less than twenty out of a total of 198 pupils, and tabulating the most widely chosen objectives, this chart shows that pupils do think in terms of the aims of education. There was a variety of 120 different aims from the 198 papers collected and checked. Among these not standing out in frequency were included; understand human nature; enjoy my vocation; look up reference; graduate with honors; not to be superstitious; improve my mind; and many other valuable aims suggesting consideration.

As before stated, children of high school age are thinking in terms of emotionalized aims or standards. Thomas reports an interesting study carried out in an assembly of high school pupils in South Milwaukee High School.[1] A list of twenty-

---

[1] Thomason, L. G., "Objectives of Sedondary Education According to Opinions of Pupils," School Review, Vol. XXXVII, March 1929.

one objectives was mimeographed and given out to students. They were asked to mark the following list (Table 9) as first, second and third choice. After throwing out the worthless returns and tabulating the objectives chosen, the table 9 shows that children do think in terms of the big aims of education. The only one that does not stand up markedly is that of health.

TABLE IX

HIGH SCHOOL OBJECTIVES	GIRLS (188)	BOYS (156)	BOTH (344)	FIRST CHOICE
1. Reading poetry	1	2	3	o
2. Ethical character	112	97	209	43
3. Please parents	19	17	36	7
4. Play in band	2	11	13	1
5. Worthy home membership	89	104	193	17
6. Enjoy assembly programs	2	3	5	o
7 Increased cost education	7	12	19	o
8. Maintain good health	48	64	112	1
9. Prepare for vocation	148	115	263	77
10. Make world safe for democracy	96	79	175	16
11. Proper use of leisure time	89	64	153	5
12. Win athletic games	8	19	27	1
13. Get High School diploma	46	44	90	5
14. Learn manual training	4	19	23	o
15. Escape hard work	9	12	21	3
16. Learn to address audience	49	48	97	o
17. Understand fundamental processes	113	100	213	21
18.Appreciation art & literature	85	61	146	3
19. Raise standard of living	107	100	207	30
20. Become good citizen	143	159	302	113
21. Be with friends	13	20	33	1

The value of this reference (Table IX) is to offer further proof that children of high school age do understand the objectives, or aims of their educational training. It also points out the importance of such objectives as character building, home membership, vocational preparation, democracy, citizenship, and health.

Objectives Proposed for Ninth Grade General Science in the Louisville Public Schools. Each of these studies may help science teachers develop more clearly their views of the function of science in the education of boys and girls. At the present time there is no conclusive method of evaluating the objectives of science study. The author believes that most situations have two aspects, personal and social; that the needs of the adolescent, or ninth grade pupil, arise from an inter-action between the individual and the social situation; and that the teacher must be concerned with the total situation, which includes both the individual and his environment.

The usefullness of objectives is determined to a large extent by the degree of clarity they represent for the teacher. In some cases objectives are clarified by a statement of their outstanding characteristics. Therefore the author has listed after each character trait which the school consciously aims to develop, the qualities exemplified by an individual possessing the trait. (Indianapolis Course of Study demonstrates this method of clarification.)

The following objectives were selected on the basis of authoritative analysis: the objectives and course of study content as determined by existing texts, course of study, papers written by people and committees in the field of ninth grade general science; choices made by Louisville teachers of ninth grade general science in the junior high schools.

It is in the light of these studies and reports that the

author has selected the objectives, or, learning products, for the proposed course of study in general science for the ninth grade in the Louisville high schools. These objectives are as follows:

1. Appreciation of Scientific Achievements -- to understand and appreciate the importance to oneself and to society of the applications of scientific generalizations and discoveries.

2. Knowledge of Consumer Goods and Products -- to learn the values of products, and the economic consequences of acts; to develop ability to purchase and use products intelligently.

3. Conservation of Natural Resources -- to study the wise use of our natural resources. The learning is greatest when it arises from actual contact with real problems in the environment, such as the Ohio floods in the Louisville area. The average student in ninth grade science needs to understand the simple fact that the conservation idea is based upon the wise use of our natural resources. Fundamentally, conservation education begins with the schools; they can make sure that the citizens of the future are conservation-minded.

4. Development of a Scientific Attitude of Mind -- to foster such specific ideals, habits, and concepts as those of accuracy, persistence, open-mindedness, honesty, cause and effect, which are essential to the study of science.

5. Development of Wholesome Intellectual Interests -- to encourage desirable use of leisure time and which may serve as a basis for educational and vocational guidance.

6. Enjoyment of Sound Health -- to attain and maintain physical fitness. Provide opportunity for acquaintance with elementary laws of nature necessary for the health of the individual and the community.

7. Growth in the Ability to do Critical Thinking -- to learn to think by thinking. All youth needs to grow in their ability to think rationally, to express their thoughts clearly, and to read and listen with understanding.

8. Knowledge (understanding) of Environment -- to satisfy the natural interest in the things and forces of nature with which pupils and man are surrounded and with which they must deal.

9. Preparation for Further Study -- to create a desire for a further knowledge, advanced training -- to develop skills sufficiently proficient to meet competition.

10. Selection and Preparation of a Vocation -- to provide opportunities for student to explore the fields of science- all American youth will be expected to engage in useful work and will need to sustain themselves and others;all therefore require occupational guidance and training.

11. Understanding of the Generalizations of Science needed by a Citizen of a Modern Democracy -- to provide facts, or knowledge, nedessary for solution of everyday personal, social, and civic problems. All youth need to understand the rights and duties of a citizen of a democratic society, and to be diligent and competent in the performance of their obligations as members of the community and citizens of the state and nation.

12. Worthy Home Membership -- to furnish an understanding of the significance of the family for the individual and society and the conditions conducive to successful family life. All American youth (or nearly all) are members of family groups now and will become members of other family groups in the future; all require an understanding of family relationships.

Summary of this Chapter. The author has endeavored to show that a course in ninth grade general science should be practical - it should be organized to meet the needs of the student.

The objectives of a school are the guide posts that indicate the direction in which the program is pointed. In order to give such direction clearly and forcibly, objectives need careful analysis and specific definition.

Clearly defined goals give direction for the school's work with students. The development of the individual must take into account both his present needs arising from problems of adaption to his environment, and the nature and direction of the development of the social environment.

In a democracy, policies and ideals are subject to examination, criticism, and re-definition at all times. The same policy holds true for the fundamental purposes of a school staff. Objectives, once stated, must be subjected to critical examination and re-definition. The process is continuous. Teachers must be serious students of adolescents, of democracy, and of their community. The problems of each school are specific to that school. No school staff can meet its responsibilities by an

uncritical adoption of another school's program.

A study of the major purposes of education, as stated in the preceding paragraphs, leads to the conclusion that probably the three most important aims of education toward which all others should contribute are:

(1) The happiness and all-around wholesome development of the individual.

(2) The improvement of the physical and social environment.

(3) The maximum welfare of society through the cooperative efforts of individuals and groups.

PART II

CHAPTER III

CHAPTER III

STATUS OF THE PRESENT NINTH GRADE COURSE OF STUDY IN GENERAL SCIENCE IN THE LOUISVILLE PUBLIC SCHOOLS.

In an attempt to analyze the status of the present course of study in ninth grade general science the investigator has included the following basis: (1) a review of the Works' survey including criticisms and recommendations; (2) a review of the Works' survey on general science by the ninth grade teachers of general science; (3) teachers' attitudes toward the present course of study in ninth grade science; and (4) opinion of the present course of study after serving as a committee member on the last revision.

The author believes it is necessary to discuss the essentials of a good school in order to set a standard for determining the status of the present Course of Study in Ninth Grade General Science in the Louisville Pupilc Schools.

Essentials of a Good School. Before any sort of business or enterprise may begin work, those things essential or important in producing the results desired must be determined and provided. A railway system must have a roadbed, rolling stock, customers to be served, and a corps of expert workmen and officers before it can produce the results for which it exists. A bank must have a suitable building properly equipped, a public needing its services, capital, and expert directing officers, if it is to succeed. So, also must a factory, a farm, or a dairy

be provided with the essentials peculiar to the work of each before success is possible.

A school is no exception to the rule just stated. Indeed, it is an excellent illustration of the fact that in any enterprise those things must first be determined which are essential to securing the results for which it is to be responsible, as set forth in the preceding part of this thesis.

It will be well, therefore, to note briefly the various essentials which are employed by the school in its effort to realize the objectives of education.

The essentials in a school have been variously stated by different writers on education, but for our purposes they may consist of seven, as follows:

1. The school plant and its permanent fixutres.
2. The courses of study and syllabi, which direct what shall be taught and indicate the emphasis desired.
3. The textbooks, references, and other supplementary books.
4. The instructional supplies and equipment.
5. The establishment and maintenance of harmonious, mutual relationships.
6. The school's standards of conduct and educational attainment.
7. The instructional staff.

It is only necessary to discuss the second essential,

the course of study, in this chapter. It would be difficult to over-emphasize the vital importance of this essential of the school, as it probably determines to a very great extent how the time and energy of both pupils and teachers shall be spent.

Knowing what a course of study is in terms of the service it should render will enable the teacher to judge it critically for the purpose of seeing how it should be supplemented and certain phases of its requirements surpassed, and at the same time it will cause him to be concerned that his own efforts shall always contribute to its improvement. This brief notation will aid us in keeping a well-balanced view of the entire round of the school's educative efforts.

Present Status of Objectives in the Ninth Grade Course of Study in General Science. The present Course of Study for General Science, Grade Nine, of the Louisville Public Schools offers no set of objectives. The Survey made by Dr. George A. Works makes the following statement:

> "The Junior High School Course of Study in General Science have very largely committed reference to functional aims. The immediate goals and the suggested content indicate a preoccupation with the subject matter of science. In general, classes observed indicated the latter condition although a number of teachers are giving continuous attention to the applications of science to life problems.[1]
>
> "Effectiveness of instruction could certainly be increased by further attention to the immediate

---

[1]Works, George A., Survey Report of the Louisville Public Schools, 1943, p. 371.

> environment. The course of study appears to be unduly centered on preparatory work for more science instruction. Neither the stated purposes, or the learning activities, suggest that the science curriculum is to serve the unique needs of the Louisville community. The objectives are so generally applicable to almost any part of the United States that they give the appearance of having borrowed bodily from the literature of science education. The emphasis appears to be on the teaching of a great mass of conclusions, findings, and generalizations. It is very doubtful if pupils can profit significantly from this type of instruction. A broader experience with first-hand situations and problems, more real experience with the scientific method, and increased time for an assimilation of the process as well as the results of scientific investigation would seem to insure more satisfactory outcomes. Pupils should have more opportunity to study nature and evidences of applied science. The excessive textbook orientation of the instruction is unfortunate."

I have offered improvements in the above situation in my proposed outlines by: (1) including a selection of objectives to which I have devoted a chapter; (2) giving attention to immediate environment (through pupil activities) and; (3) offering a broader experience with first-hand situations and problems.

The educational world has always had objectives. Writers of textbooks have pointed out that Plato, Bacon, Pestolozzi, Rousseau, Froebel, Spencer, and all leaders in education had definite aims which they have emphasized. Recent workers such as Bobbitt, Charters, Snedden, Monroe, Harap, Douglas, and others have emphasized the idea of objectives that are a seeking after ways and means of improving the conditions of society, made especially inferior because of the war. An

application of science to living, and the readjustment of society to the demands of modern life.

Much depends upon objectives to describe the end or condition the individual is striving to achieve. Objectives of education serve to direct the activities of the teacher, and through the activities of the teacher, influence the aims and activities of the pupil. The effective teacher selects the activities, the subject matter, and the important points for emphasis in terms of the objectives of his course.

Science Offerings in the Louisville High Schools. A statement in regards to the present science offering in the Louisville High Schools may be taken from the Works' Survey:

> "During each year the junior high school pupils have a course in general science. There are two meetings a week in grade seven, three in grade eight, and four or five in grade nine. The science requirements for graduation from senior high school can be met by one year of botany, chemistry, or zoology and physiology combined, taken in grades ten through twelve. These courses are offered by most schools, as are physics, a third semester of chemistry, and a year of aeronautics. Biology is given by duPont Manual."[1]

Within the past year, the subjects botany and zoology have been discontinued and a biology course has been offered in grades ten through twelve.

In line with the philosophy of general science

---

[1] Works, George A., Survey Report of the Louisville Public Schools, 1943, p. 370.

teaching, the work in grade nine is more specialized than that in grades seven and eight.

Present Course of Study in General Science. An outline of the present Course of Study in Ninth Grade General Science will be made that the reader might have a better understanding of the subject matter and organization. This may best be summarized by again referring to the Work's survey report:

> "Mimeographed courses of study were developed in the early thirties. In 1938 and 1939 revisions of the junior high school courses were prepared. As assembled for teacher use, these include concepts and understandings which are to be taught. Suggestions for teachers, in the for of references, assignments, experiments, and appropriate learning experiences accompany pupil worksheets. These are included for each problem or aspect of a unit. Definite time allotments are made and worksheets provided for a substantial number of days. Thus in the ninth grade unit on matter, energy and work, fourteen worksheets are included for the eighteen days which are recommended.
>
> "Grade seven includes units on plants, air, fire, water, rocks and soil, and animals. Grade eight has units on the heavens, weather, uses of water, and gardening. The first semester of the ninth grade is physical science and the second semester biological science."[1]

Since general science in the ninth grade is the only required science in the Louisville Public High Schools (at the time of revision, 1939) the Committee on Course of Study Revision has always felt that the course should include many biological topics. In revising the course, Units on Animals, Plants, Soils, and Gardening were placed in the seventh

---

[1] Works, George A., Survey Report of the Louisville Public Schools, 1943, p. 370.

and eighth grade work. Then, by careful planning, the committee was able to make the work of nine "B" physical science and to leave for completion in nine "A" the fundamental biological principles. Thus the pupil before leaving junior high school has become acquanited with kinds of processes in living things, including himself.

As listed in the present course of study of Ninth Grade General Science, the contents for nine "B" includes:[1]

Introductory Sheet . . . . . 1 period

Unit 1 -- Matter, Energy and Work . 18 periods

Unit II -- Air . . . . . 12 periods

Unit III -- Heat . . . . . 16 periods

Unit IV -- Light . . . . . 11 periods

Unit V -- Magnetism and Electricity 15 periods

Contents for grade nine "A" includes:

Unit I -- Living Things . . . . . 10 periods

Unit II -- How do Living Things Carry on Life Functions . . . . 32 periods

Unit III -- What are the Laws of Heredity and How can living Things be Improved . . . . . 8 periods

Unit IV -- How are Living Things Dependent on each other . . . . 12 periods

Unit V -- How are Living Things Sorted . . . . . 8 periods

---

[1] Course of Study in General Science, Louisville Public Schools, Grade Nine, April 1939, "Introduction".

In each unit above, the number of periods allotted include time for tests and evaluation of learning.

> "To put the Course of Study in a practical form, at the beginning of each unit were placed the understandings to be developed in that unit.[1] Following the understandings, the pupil worksheets will be found, each accompanied by a page of suggestions for the teacher. These worksheets and page of suggestions were tried out in the school in classwork and correct before being placed in the final printing, so the Committee on Revision of the Ninth Grade General Science Course of Study knew that all suggestions were practical devices for teaching the desired principles. These principles are stated in each Unit Outline under the heading of General Concepts. However, the suggestions need not be followed implicitly. If a teacher has another device which he considers better than the ones suggested, he should by all means use his own. Space is left on 'The Suggestion Sheet' for teacher's notes."

Point of View of Teachers Toward the Present Course of Study in Ninth Grade General Science. To give an explanation of the teachers' attitude toward the present Course of Study in Ninth Grade General Science, and the way in which they use it the author desires to quote again from the Work's Survey which makes the following report:[2]

> "Some teachers depart more than others from the general plan proposed in the course of study bulletins. The extent to which use is made of particular reference books or texts, often conditions the nature of the work in a particular class. Several teachers expressed a need for a re-examination of the junior high

---

[1] Ibid., "Introduction"

[2] Works, George A., Survey Report of the Louisville Public Schools, 1943, p. 370

> school program to introduce new materials, improve the continuity and possibly eliminate other topics."

Downing, in his contribution in the Thirty-First Yearbook, points out that the selection of curricular material should come from that biological subject matter that deals with problems of one's practical and potential needs.[1] He further shows in a report that there are relatively few generalizations that can be taught in a semester and that teachers would do well to concentrate on such generalizations as can be best given.[2] As a teacher of long standing the writer would subscribe in general to the results of the Downing investigation with reference to the time needed to obtain an understanding of principles.

The Committee on the Teaching of Science, of the Thirty-First Yearbook wishes again to emphasize its recommendation in Chapter I, of the Thirty-First Yearbook that the work of the seventh, eighth, and ninth grades be organized as an integrated sequence.[3] Recognition of the special subjects, such as biology, physics, and chemistry, does not offer a proper criterion for the selection of content for the intermediate school. The challenging phenomena of experience arise from observation of living things (of which the pupil is one) in a

---

[1] Downing, E. R., The Course of Study in Biology, Committee Report, National Society for the Study of Education. Thirty-First Yearbook, Part I, A Program for Teaching Science, 1932.

[2] Downing, E. R., Chairman, "The Teaching of Biology", North Central Association Quarterly, March, 1931.

[3] Thirty-First Yearbook, National Society for Study of Education, Part II, A Program for Teaching Science, 1932, pp 7,9,128.

physical environment. The work in Science that is offered below the level that marks the beginning of specialized (tenth grade) should be organized about those principles and generalizations of science, knowledge of which contributes directly to understanding of the adaptations of living things to their physical environment.

Conversations with the ninth grade science teachers in Louisville indicated that they felt a lack of opportunity for the usual extra-curricular outgrowths which accompany class work in science. There were not enough photography, astronomy, chemistry, aviation, ratio or natural history clubs. These are not entirely absent, but certainly the abilities among staff members indicate that excellent leadership resources are now unused.

In line with the preceding list of attitudes toward in ninth grade course of study in general science, I wish to list a few of the recommendations and criticisms of the Works' survey. It tends to help present an insight into the present status from a different angle -- viewpoint of an educational authority on characteristics of a good course of study.

Recommendations and Criticisms by the Works' Survey[1] of the Course of Study in Ninth Grade General Science.

Recommendations: The attempt to adapt materials to pupils of poor ability is commendable.

Criticisms: The scope of the program is so broad that only cursory attention is given to many aspects. The excessive

---

[1] Works, George A., Survey Report of the Louisville Public Schools, 1943, pp. 371 to 376.

textbook orientation of the instruction is unfortunate. The units for the Junior High Schools are not effectively related to one another.

The program of science as outlined reveals very little evidence of preparation for community living or for the exploration of the vocational activities that are well represented in Louisville.

There were not enough photography, astronomy, chemistry, aviation, radio or natural history clubs.

CLASSROOM METHOD

Recommendations:

The reality of the pupils' environment is being brought into a number of classrooms for study.

TEACHING EQUIPMENT

Criticisms:

The use of make-shift arrangements and other inadequate laboratory facilities in now necessary.

Recommendations:

1. The instructional program can be considerably improved through a thorough revision of the science curriculum. This should involve the development, through co-operative teacher effort, of the new science courses of study or guides for grades seven, eight and nine, biology, the physical sciences (for the college entrance group) and senior science (for the non-college student). These courses should be sequential in nature and should presuppose that all students will take a four-year science

sequence, and a substantial number, a five-year science sequence in the six years of the secondary school.

2. The committee of teachers and supervisors assigned to revising the course of study in science should include representatives from the fields of English and social studies, in order to insure adequate provision for relationships between the natural sciences and these subject fields. Conversely, natural science teachers should be placed on committees assigned to revise the program in social studies and English.

3. Since teaching apparatus and equipment are somewhat meager, special attention should be placed upon this problem for the next five years. Much of the equipment can be built in the shops. However, the school budget should provide a specific sum to be spent each year on science teaching equipment.

4. More definite leadership is needed to capitalize upon the intelligence and experience of the many fine and well-trained teachers now serving in the secondary schools of Louisville. The science teachers seem to have "no friend in court" to speak for their interests. Leadership is needed for all the projects mentioned in the recommendations.

5. The program of science instruction in Louisville needs a more progressive and dynamic extra-curricular program. There are not enough science clubs of every kind and

description, nor do the pupils engage sufficiently in project activities growing out of their work in classes.

6. For the war period, pre-induction training courses might well receive greater attention. The possibility of aiding students through such courses should receive careful consideration.

7. A better understanding and relationship should be fostered between teachers and supervisors. This can be done by enlisting the best thought of the science teaching staff and by encouraging experimentation.

Following the reference of the recommendations and criticisms by the Works' survey of the Ninth Grade General Science Course of Study, the writer includes below a summary of a proposed review of this report by general science teachers of the junior high schools who held committee meeting to consider the above issues. This was done through the Research Department with a view to providing the best possible educational program for Louisville.

Review of the Works'[1] Survey and Suggestions Approved by Teachers of General Science. Maximum results can be obtained from the Works' Survey only through careful study, candid analysis, and cooperative enterprise of the entire personnel, with a view to providing the best possible educational program for Louisville.

---

[1] Division of Curriculum and Research, Louisville Public Schools, Jan. 1944.

It was recommended that teachers meet in groups of various departments according to subject fields in the secondary schools to consider the issues presented by discussions in the Louisville Public School Survey.[1] Duties of chairmen appointed were: to arrange and hold meetings, to direct discussions of issues which were termed points for debate or controversies, to arrange the selection of a recording secretary whose duty was to record the proceedings of the meeting.

It was desired that information be made available on every major recommendation as to: number of teachers agreeing on every major recommendation and a consensus of reasons for so regarding the recommendation. These expressions of opinion were used in compiling a digest for use in subsequent steps of the study. Group expressions were not indentified as to names of persons or schools.

Suggestions approved and compiled by the science teachers of the junior high schools by the above method are listed in the following summary of their points of view toward the present Course of Study in General Science:

1. The course of study in general science should be revised. This work should be done under the supervision of someone trained in curriculum construction.

2. The course of study should be revised according to the needs of the children and changing conditions. More

---

[1] Works, George A., Survey Report of the Louisville Public Schools, 1943.

work on the units on machines, commmnication, chemistry, and radio should be included in the course of study.

3. The scope of the junior high school science is intended to be broad in order to give pupils some ideas of the specialized branches he will meet later in his school work or if school is not continued, to give a general understanding of scientific facts.

4. There should be a closer cooperation between the science and health departments, especially in the ninth grade, to tie up with the health units in the ninth grade. As it is now, there is no cooperation.

5. In the ninth grade science, knowledge is developed slowly, but the growth is continuous. This building up of scientific knowledge should lay a strong foundation for future science study.

6. The course in Nine "B" physics includes too many units to be taught in one term. It might be advisable to offer the physics course to college preparatory pupils and to offer a more varied course to other groups.

7. A narrower scope of offerings with elimination of the time element. (Ninth grades require seventeen weeks to complete the course. Little time is left for exploration and mastery tests which are so essential in curriculum planning.

8. For the war period, pre-induction training courses might well receive greater attention.

9. Present course of study has excellent material; the way it is used depends upon the teaching personnel.

10. Provide better correlation to various units of study.

11. Make science a major part of the curriculum. More interest could be maintained, as the pupils have an idea that the work is not considered as essential part of the curriculum.

12. We believe that science should emphasize cultural as well as vocational aspects.

13. The criticism that the sharp division of the ninth grade work into physical and biological science is questionalbe (by Works' Survey)[1] is answered by the fact that the only science which the Curriculum Committee was allowed to require was General Science and since the Committee felt that biological knowledge was needed by all pupils, a term of it was placed in 9 "A".

14. We object to the criticism: "the program is so broad only cursory attention is given (Works' Survey) to many aspects," because the philosophy of a general science course is to take up many things in a general way.

15. In the limited time allowed for high school science a wider acquaintance with scientific principles will be gained by a study of factual material than by detailed laboratory manipulations.

16. It is recommended that two years of science be required for graduation from high school, as was suggested by the Works' Survey Committee.

---

[1] Works, George A., Survey Report of the Louisville Public Schools, 1943

17. The ninth grade science work carries over well into senior high school.

Following this explanation is a report relating the opinions of the ninth grade general science teachers from a junior high school in the Louisville Puplic School system. The report contains a summary written by the secretary of their science committee on a review of the Works' survey report on the ninth grade general science status in the Louisville Public Schools. It seems to be a typical example of the attitudes of the ninth grade general science teachers as a group. I thought this of sufficient value to include in this part of the study (teachers' attitudes.)

Review of Report on the Works' Survey in General Science by the Teachers of One Junior High School:

> "The increasing penetration of science into all aspects of human affairs and relationships characterizes this age and sets it apart as a very different world for the people living in it from all other times. We are informed through the medium of governmental bulletins and the abundant advertising and propaganda in newspapers and periodicals of all kinds that a new age is about to be opened for the masses of people. Wisely and newly directed science holds forth possibilities. In modern society, science is not an abstract field concerned only with materials and forces, but has become a prime social mover.
>
> "The science curriculum should be so selected and developed that it becomes a functioning part of the pupils' environment rather than abstract information to be used for interpreting the environment. A curriculum study was begun in science in 1932. Every faculty of the secondary schools was represented in a unified course of study developed. Before this program

was undertaken the science courses in the various schools had little in common. Further progressive developments and revisions were contemplated in 1938-39 but this work was discontinued by administrative action. However, nothing in the course of study as it exists need hinder teachers in developing their courses, and neither will a revised course be a cure-all.

"The fact that the Works' survey report emphasizes matter of textbook memorization, may well be in many cases due to the fact that many teachers must meet their classes in rooms that are crowded and inadequate, rooms with no gas, water or electric outlets. Neither does the school budget provide a specific sum to be spent by each school.

"The criticism has been made that the emphasis appears to be on the teaching of a great mass of conclusions, findings and generalizations and little experience with first hand situations and real experience with the scientific method. This may be true, but is easily understood as many of the teachers in the department are not science majors, furthermore the classroom is not arranged or equipped for teacher demonstration, or pupil participation. We feel that the greatest need is to have a unified program from the material standpoint.

"Equipment is meager, inadequate, the requisitioning uncertain and the lapse of time in obtaining material is unsatisfactory.

"Science teachers carry a full teaching load. There seems to have never been any provision thought of for the time necessary to prepare experimental teaching demonstrations or for carrying out laboratory exercises. The number of pupils and size of the classes is an important consideration in determining the experimental and laboratory exercises that a science teacher can effectively supervise.

"The survey recommends a revision of the junior high school courses in science. With this we most heartily agree, but before the work is started it would be wise to adopt a text book that will meet the needs of the pupils.

> "The criticisms of the department are so general as to be of little value. Quote, 'The scope of the program is so broad that only cursory attention is given to many aspects.' This may be true in grades seven and eight where only two and three periods a week may result in adequate pupil understanding, but as the time limit is a state regulation, very little can be done unless a four day program for ten weeks each semester can be arranged in seventh and eighth grades. In the ninth grade however, the program is not so broad that a pupil of average intelligence would fail to receive an understanding of life and the environment.
>
> "If the science taught is to serve only the needs of the Louisville community and is not generally applicable to any part of the United States, then the time and money is being wasted.
>
> "There may be excessive textbook orientation and too much emphasis on conclusion and findings, but this we know, that the majority of the pupils are interested in the work, make practical applications, and through this are helping to improve their community, the Works' Survey to the contrary not withstanding."

Scope of the Program as Reported by the Works' Survey.[1] On pages 370 to 372 o the Works' Survey is found a scope of the present Course of Study in general science (including ninth grade). Below is stated a summary of this scope to bring out an additional point of view of the present status of the Ninth Grade Course of Study in General Science:

> "The scope of the program in the general science course of study is so broad that only cursory attention is given to many aspects. The result is inadequate pupil understanding and possibly a waste of time. The attempt to cover too much material, in an effort to contact the major common aspects of the science

---

[1] Works, George A., Survey Report of the Louisville Public Schools, 1943, p. 370-372

> fields, should undoubtedly be replaced by a policy of selecting for study those areas which are of greatest assistance in contributing to an understanding of life and the environment. Some units now taught could be eliminated and others combined."

This criticism has been expressed by several science teachers, in a previous statement. Organizing some units around certain major problems or areas of living might help to place various topics in their proper perspective and increase the contribution of science instruction to improve living.

> "The units for the junior high school are not effectively related to one another. Little provision is made for carrying learning experiences to higher levels of understanding as the child increases in maturity. This is an admittedly difficult problem, but well worthy of further consideration.
>
> "Several topics are conspicuously absent. Food, communication and transportation would appear to be sufficiently important to receive considerable direction. Others, such as soil conservation, are worthy of consideration in their scientific aspects, at least.
>
> "The attempt to adapt materials to pupils of poor reading ability is commendable. However, this is achieved primarily by a reduction in the quantity of subject matter. There is little evidence of a modification in the goals sought or the kinds of learning experiences provided. Possibly some concepts are too difficult for slower pupils. Probably their instruction might be enriched and improved by the introduction of more demonstrations and a larger number of first hand experiences. A mere reduction in the amount of reading to be done does not seem to meet the problem."

The rather large percentage of boys and girls, 44.8% or nearly one-half enrollment, who leave before graduating makes more important the science course in grade nine. This statement may be verified by a reference to a report from the Research

TABLE X

NUMBER OF STUDENTS ENROLLED IN DEPARTMENTS AND COURSES IN EACH SENIOR HIGH SCHOOL AND PERCENT SUCH ENROLLMENT IS OF TOTAL MEMBERSHIP OF THE SCHOOL, LOUISVILLE FIRST SEMESTER -- 1944-45

-A-

School and Enrollment	ATHENS - 916		ATHERTON - 756		GIRLS - 853		MALE - 1283		MANUAL - 997		SHAWNEE - 689		CENTRAL - 947	
DEPARTMENT AND COURSE	Number	per cent	Number	per cent	Number	Per cent	Number	Per cent	Number	per cent	Number	per cent	Number	per cent
Science (total)	403	44	363	48	367	43	731	57	608	61	441	64	663	70
Chemistry	-	-	146	19	91	10	218	17	173	17	111	16	86	9
Physics	26	3	-	-	-	-	127	10	309	31	-	-	83	9
Botany	-	-	135	18	156	17	156	12	-	-	116	17	275	28
Zoology	-	-	59	8	85	10	128	10	-	-	75	11	47	5
Physiology	-	-	23	3	35	4	35	3	-	-	34	5	45	5
Textile Science	127	14	-	-	-	-	-	-	-	-	-	-	32	3
Biology	-	-	-	-	-	-	-	-	79	8	-	-	-	-
Practical Chemistry . . .	-	-	-	-	-	-	-	-	-	-	-	-	18	2
Health Reading	-	-	-	-	-	-	-	-	-	-	15	2	-	-
Aeronautics	-	-	-	-	-	-	21	2	18	2	14	2	17	2
Physiography	-	-	-	-	-	-	29	2	-	-	-	-	-	-
Radio	31	3	-	-	-	-	17	1	29	2	-	-	-	-
Chemistry Reading	-	-	-	-	-	-	-	-	-	-	61	9	-	-
Lab. Tech.	-	-	-	-	-	-	-	-	-	-	15	2	-	-
Household Physics	-	-	-	-	-	-	-	-	-	-	-	-	15	2
Related Science	202	22	-	-	-	-	-	-	-	-	-	-	-	-
Textile Chem.	-	-	-	-	-	-	-	-	-	-	-	-	25	3
Hygiene	17	2	-	-	-	-	-	-	-	-	-	-	-	-
Health	-	-	-	-	20	2	-	-	-	-	-	-	20	2

EACH JUNIOR HIGH SCHOOL OF LOUISVILLE, AND PERCENT SUCH ENROLLMENT IS OF TOTAL MEMBERSHIP OF THE SCHOOL

-B-

School and Enrollment	BARRET -657		EASTERN -983		HIGHLAND -620		LOUISVILLE -1665		PARKLAND -917		SHAWNEE -754		SOUTHERN -1156		WESTERN -1004		JACKSON -637		MADISON - 1360	
DEPARTMENT AND COURSE	Number	per cent	Number	per cent	Number	per cent	Number	Per cent	Number	Per cent	Number	per cent	Number	per cent	Number	Per cent	Number	Per cant	Number	Per cent
General Science . .	552	84	983	100	601	97	1665	100	871	95	626	83	1156	100	994	99	637	100	1204	96

*of 6441 enrolled in Senior High Schools, 3576 carried science or about 55.2 percent;
9753 enrolled in Junior High Schools, 9289 carried science or about 95.4 percent;
As a result -- we see that nearly half of the pupils drop science after ninth grade, (44.8%)

Department [1] -- shown in Table X as follows: Number of Students Enrolled in Departments and Courses in Each Junior High School and Each Senior High School and the Percent Such Enrollment is of the Total Membership of the School, Louisville, first semester, 1944-45. Of 6441 students enrolled in the Senior High School, only 3576 pupils (about 55.2%) were enrolled in science courses. This leaves about 44.8% or (2865) pupils without the advanced knowledge in science.

For these students instruction in ninth grade general science should take on the characteristics of a terminal course, rather than one which prepares them for the senior high school science work. The program of science as outlined reveals very little evidence of preparation for community living or for the exploration of the vocational activities that are well represented in Louisville.

Chapter II of this thesis offers suggestions to improve this situation through the proposed list of objectives. Also, Chapter IV offers improved devices and new units which were intended to take on the more characteristics of a terminal course, or preparation for community living -- through the proposed outline of Topics on Communication, Transportation, Conservation, and Consumer's Knowledge.

As previously stated, the present course of study in general science includes, assembled for teachers' use, "Concepts" and "Understanding," which are to be taught. "Suggestions for Teachers," in the form of references assignments, experiments,

---

[1] Division of Curriculum and Research, Louisville Public Schools, 1944-45

and appropriate learning experience accompany pupil worksheets. These are included for each problem or aspect of a unit.[1] From the reports the writer has received in personal and group interviews and discussions with many ninth grade general science teachers in Louisville schools, it is evident that they are almost unanimous in praise of these "Suggestion" sheets. The teachers find them "very helpful -- saving of time -- more can be accomplished -- an inspiration -- and especially valuable to beginning teachers in general science, or new teachers coming in to the Louisville school system -- also helpful to substitute teachers, as it provides continuity and helpful instruction."

A Study of the Junior High School Program of Studies in Louisville Public Schools as Compared with Other Cities,[2] Comparable in Size: (Time Allotment)

Cities Reporting:

Allentown	Erie	Montclair
Altoona	Fall River	Nashville
Brocton	Kansas City	New Bedford
Cleveland	Los Angeles	New Haven
Detroit	Lynn	New York
Elizabeth	Milwaukee	Oakland

---

[1] See Appendix for Sample Sheets, p 128-129.

[2] Division Curriculum and Research of Louisville Public Schools - Based on Report of Elizabeth, New Jersey Public Schools study from The Bulletin of the National Association of Secondary-School Principles, April, 1945.

Pasadena	Reading	Trenton
Passaic	Rochester	Troy
Peoria	Schenectady	Washington
Philadelphia	Scranton	White Plains
Providence	Somerville	Wilmington
Racine	Springfield	

Length of each period in minutes (inclusive of passing time) (number of replies ... 30)

"Only one school reported a 60 minute five-period day while seven schools reported a six-period day of 50 minutes, and two schools of 60 minutes. The seven-period day had the greatest variations in period lengths -- two schools had 40 minute periods; seven schools, 45 minute periods; eight schools, 50 minute periods; and two schools, 55 minute periods. Only four schools reported an eight-period day, these being 40 minutes in length."

"It was found that the 50 minute period was more popular than any other, appearing in slightly less than one half of the schools and nearly equally divided into a seven or a six-period day. A full homeroom period is included when reported. Short homeroom periods are omitted."

The above mentioned study is used as reference to show that the present system of fifty minute periods now used in ninth grade general science in the Louisville junior high schools conforms with the more popular plan adopted by a large percent of representative cities mentioned in the study or slightly less than one half of the schools.

TABLE XI

GRADE 9 - THIRTY-EIGHT SCHOOLS REPORTING TIME ALLOTMENT

(From Preceding Study)* Program for one-half year.

Subject	Periods per week Louisville	No. of Cities having same program as Louisville	Number of Cities Which Differ from Louisville Periods per Week 1	2	3	4	5	6	7
REQUIRED:									
English	5	28	-	-	-	3	-	2	1
Gen. Sci.	5	12	-	3	-	-	12	-	-
Gen. Math. or Alg.	5	20	-	-	-	4	-	-	-
Soc. St.	5	15	-	1	1	6	1*	-	-
Phy. Ed.	2	0	-	-	-	-	-	-	-
Health & Phys. Ed.	0	-	2	17	9	2	8	-	-
Ind. Arts	5	0	-	4	-	1	1*	-	-
Home Ec.	5	0	-	4	-	1	1*	-	-
Music	0	-	9	1*-3	-	-	1*	-	-
Art	o	-	5	1*-3	-	-	1*	-	-
ELECTIVES:									
Soc. St.	0	-	-	1	-	2	8	-	-
Math.	0	-	-	-	-	2	16	-	-
Science	0	-	-	1	-	3	12	-	-
Ind. Arts	0	0	-	1	1	6	-	5	6
Home Ec.	0	0	-	1	1	6	-	5	6
Music	5	10	6	4	-	-	4*	-	-
Art	5	10	3	6	2	4	4*	-	-
Jr. Bus.Tr.	5	19	-	-	-	2	-	-	-
Typing	5	5	-	-	-	3	1*	-	-
Gen. Lang.	0	-	-	-	-	1	1*-9	-	-
Latin	5	18	-	-	-	2	-	-	-
French	5	11	-	-	-	2	-	-	-
German	0	-	-	-	-	-	3	-	-
Spanish	0	-	-	-	-	1	4	-	-
Italian	0	-	-	-	-	1	3	-	-

Adopted Text for Ninth Grade General Science. The success of a ninth grade General Science course will depend largely upon the reference material available. The present text book in use is modern but not well adapted to the course of study.

The new grade nine science book,[1] Modern Science in Man's Progress, has some material which has been covered in grade eight, Our Environment, How We Adapt Ourselves to It. This Modern Science series has a different arrangement of materials from the present junior high school Courses of Study which can cause confusion until adjustments have been made through a new Course of Study or revision of the Ninth Grade General Science Course of Study. Modern Science in Man's Progress, Book 3, for ninth grade science is a modern text in general science. It is modern in material, teaching method employed, organization, and in teaching devices.

The teachers of the Ninth Grade General Science have been following the Course of Study and attempt to draw their material from this new textbook, aided by suitable reference material. In the use of this new textbook, the teachers find it necessary to rearrange the sequence of units in order to satisfy the course of study requirements. Supplementary texts and references are necessary aids since the adopted text does not cover every topic in the present course of study.

One of the most persistent demands of present-day education is more integration and less specialization in the presentation of subject matter, especially that having to do with

---

[1] Division of Curriculum and Research, Louisville Public Schools, September 1945

fundamentals. In the Thirty-First Yearbook,[1] Part I, (recommendations of the Committee on the Teaching of Science,) page 194,

> "..... a program of science study organized not on the basis of any special science or sciences, but rather upon the basis of large topics, problems or Units relating to the significant problems that arise out of present-day experiences."

is advocated.

Summary of this Chapter. In an attempt to analyze the status of the present Course of Study in Ninth Grade General Science in the Louisville Public Schools, the writer has first stated the essentials of a good school. This introductory topic may serve as a standard of evaluation.

The writer has made extensive use of the Survey Report of the Louisville Public Schools made by Dr. George A. Works at the request of the City of Louisville and the Board of Education. The value of such a report, coming from a staff of experts in their field and greatly facilitated by the whole-hearted cooperation of members of the staff of the public school system, cannot be overlooked in the preparation of this chapter.

As a result of studies made of the Works Survey; a review of the present course of study; conversations with ninth grade general science teachers; and drawing on the experience of the writer, the status of the present course of study in ninth grade general science may be stated as follows:

---

[1] Thirty-First Yearbook, Part I, National Society for theStudy of Education, Part I, A Program for Teaching Science, 1932

1. The instructional program can be considerably improved through a thorough revision of the science course of study.

2. There is a need for a re-examination of the junior high school program to introduce new materials, improve the continuity and possibly eliminate certain topics.

3. Several topics are conspicuously absent, such as: food, communication, transportation, conservation of natural resources, home improvement.

4. Much improvement is necessary in attempt to adapt materials to pupils of poor reading ability.

5. There is a lack of opportunity for the usual extra-curricular outgrowths which accompany class work in science.

6. Effectiveness of instruction could certainly be increased by further attention to the immediate environment.

7. The program of science as outlined reveals very little evidence of preparation for community living or for the exploration of the vocational activities that are well represented in Louisville.

8. The rather large percentage of boys and girls (44.8%) (or nearly half) who leave school before graduating makes more important the science course in the ninth grade. For these students instruction should take on the characteristics of a terminal course, rather than one which prepares them for more science.

9. The present system of 50 minute periods now used in ninth grade general science in the Louisville junior high schools conforms with the more popular plan adopted by a large percent of representative cities comparable in size with Louisville.

10. The present adopted textbook in general science for the ninth grade, Modern Science in Man's Progress, is a modern text, but not well adapted to the present course of study.

CHAPTER IV

CHAPTER IV

A PROPOSED OUTLINE OF GENERAL SCIENCE SUBJECT MATTER FOR NINTH GRADE, LOUISVILLE PUBLIC SCHOOLS.

Trends in Teaching General Science in Junior High Schools. What emphasis should be placed on subject matter in a ninth grade general science course of study may be determined by a result of trends in the field of subject matter. This is due to the fact that traditional practices of dealing with subject matter are thoroughly entrenched and that vested interests have a considerable stake involved. The curriculum worker who is to deal successfully with the problem centering around subject matter must have a clear understanding of certain basic concepts which explain the nature, function, source and use of the subject matter.

A trend may mean a tendency.[1] A trend may be desirable or undesirable. You may agree with some trends and disagree with others. Any movement or program in which there is a genuine desire for change is a trend. Any trend to be worthy of discussion should have continued for some length of time. It should have received general recognition as a movement. It should be growing.

There seems to be an erroneous idea, or trend of thought, that any teacher can teach general science.[2] This idea has been an important factor for a lack of success in the general science department of many schools. The writer has seen this problem

---

[1] Gersbacher, W. M., "Are General Science Courses Meeting the Needs of the High School Student," - School Science and Mathematics, January 1942, pp. 47-54.

[2] Davis, Ira C., "Trends in Science Teaching," - School Science and Mathematics, May 1942, pp. 450-454.

demonstration in schools and in classrooms, and feels justified in making the above statement by the results of actual experience. The success of a course in meeting objectives is largely dependent upon the teacher. In general it is assumed in courses of study that the teacher has a background of experience which will supplement the course outlined.

The trend, of course, is to provide more adequately for the interpretation of the forces, materials, and phenomena than has been done in the past.[1] The general science courses are focused upon interpretation of the environment and the topics and problems make a direct attack upon the problems of everyday life.

A shift in emphasis from the subject matter to the child has been in progress for the past fifty years.[2] This shift has kept pace with the percentage of graduates of secondary schools who enter college. In 1930 the general slogan seems to be that every boy and girl was entitled to a general high school education. All subjects must contribute to that education. In the Thirty-First Yearbook of the National Society for the Study of Education, principles and generalizations of science were set up as goals for the pupil. A knowledge of these broad generalizations and principles are needed if boys and girls were to understand the world in which they lived. Emphasis was placed on scientific methods and attitudes and thinking instead of the subject matter.

---

[1] Beauchamp, Wilbur, Instruction in Science, From Bulletin, 1932, No. 17, p. 39. National Survey of Secondary Education, Monograph No. 22.

[2] Davis, Ira C., "Trends in Science Teaching" - School Science and Mathematics, May, 1942, pp. 451-452

There is also a change in the kind of science being taught to some extent in the junior high school. The tendency is toward teaching science as one complete area and not as specialized areas. It is considered unwise to attempt to crystallize the offerings in ninth grade general science. Recognition of the special subject, such as biology, physics, and chemistry does not offer a proper criterion for the selection of content in this course of study.[1]

There is a changing point of view in evaluation or testing. Many new types of tests are being used. The shift is from pure information items to questions which attempt to obtain outcomes, applications, understandings, appreciations, attitudes and methods. The movement has not continued long but it has possibilities which science teachers should not ignore.

To quote the Twenty-Sixth Yearbook of the National Society for the Study of Education, Part II, page 17:

> "In times past, and too largely in present school practice, the curriculum has been conceived primarily as formal subject matter (fact, processes, principles) set out to be learned without adequate relation to life. The pupil has too frequently been required to repeat words, express ideas which he does not understand, and to accept, adopt and use materials which have been furnished him ready-made and completely organized by the teacher."

(taken from Beauchamp - Bul. 1932, No. 17, - P. 16)

To quote from Bulletin 1932, No. 17 of National Survey of Secondary Education, Monograph No. 22, p. 19:

> "A present trend in the organization of subject matter is the unit method, since few, if any,

---

[1]Report of the Harvard Committee on General Education in a Free Society, Chapter IV.

> of the courses appearing before 1926 were divided into what were referred to as units. Prof. H. C. Morrison is given credit for this widespread trend, in his book 'The Practice of Teaching in Secondary Schools,' which appeared in this year."

Philosophy of Junior High Science. The rapid growth of the junior high school science has been brought about partially because of lack of adjustment between science in the grades and in the senior high school, and partly because the junior high school is frankly organized to meet the needs of children who are just finding themselves and who are expecting to continue their work in the senior high school. The junior high school is distinctly a time for adjustment and exploration as will be seen by reference to the numerous courses of study which follow. Science in these grades, therefore, should do its part toward carrying out this idea. As Cox[1] points out, "A child of the junior high school age lives in a world of things, forces, phenomena, and people. He does not live in a plant and animal world in the seventh year, and in a health world in eighth year, and a physical science world his ninth year."

Pieper[2] indicates the same general viewpoint for organization of science in the seventh, eighth, and ninth grades and gives a series of principles for the selection of subject matter that places the emphasis on subject matter as a means to

---

[1] Cox, P. W.L., The Junior High School Curriculum, Scribner, 1929 (From Science Teaching by George W. Hunter, 1943, p. 126)

[2] Pieper, C. J., "Science in the Seventh, Eighth and Ninth Grades," National Society for the Study of Education, Thirty-First Yearbook, Part I, A Program for Teaching Science, 1932, p. 193-195

an end rather than material to be memorized. The Committee on the Teaching of Science believes that subject matter should deal with activities and problems interesting to the child and which form part of his experiences. Emphasis should be placed on practical adjustments to environment by means of activities that are, as far as possible, based on direct and concrete experiences. Organization of subject matter should consist of a number of relatively large units organized into problems so that children will be habituated in this important phase of the science method.

If we consider all that has been said with reference to sequence, content, and methods used in the presentation of science in the junior high school it would seem that the underlying philosophy of the course should be based on the relationship of the environment to the child, first as an individual, and later as a growing citizen in the environment of the school community. Into such a course the materials of science should be integrated with the curricula materials of geography, history, civics, and especially health education.

Children grow much in capacity between the seventh and ninth grade levels. The instruction of the ninth grade level will be, therefore, not only at a higher terrace of difficulty but should be given from quite a different social viewpoint. The ninth grade pupil has become a school citizen with the responsibilities of citizenship as a part of his mental outlook. As the outlook of the child broadens in the ninth grade a cycle of science activities will develop at a still higher terrace of difficulty. At this age level the child might transfer his science

interests in the wider field of the nation and the world. If there is any one lack greater than others in our present day citizens, it is their lamentable ignorance of all matters in which science affects their lives and their pocketbooks. Matters of vital importance come up for legislation, matters concerning public health administration, the application of science in public works. the use or abuse of waterpower privileges, or the exploitation of the natural resources of the nation for individual gain and what does Mr. Average Citizen do? He often votes as he is told to vote.

In the ninth year the applications of science is the desired outcome. The philosophy of presentation should result in the ultimate generalization that man of all the animals is the only one who can control and artifically change his environment. As such he has dominion over the earth.

Modern Conception of Learning. The Twenty-Sixth Yearbook points out that in the past the curriculum was conceived primarily as formal subject-matter to be learned; learning was though of as the ability to repeat facts, phrases, and formulae with little regard for the pupil's understanding of their real meaning.[1] Recently we have recognized that there are many different forms of memorizing and learning, some advantageous, others worthless in the development of the child.

The forms of learning now encouraged train the ability to generalize, cultivate useful skills, and develop desirable attitudes toward life. In the words of the Twenty-Sixth Yearbook,

---

[1]National Society for the Study of Education, Twenty-Sixth Yearbook, Public School Publ. Co., Bloomington, Ill., 1927

"Advantageous learning affects favorably the individual's behavior. Meaning grows only through reaction. The term 'true learning' therefore, is applied to any change in the control of conduct which permanently modified the individual's behavior. Advantageous learning is never guaranteed by mere formulation of subject-matter. The teachers must strive to bring the pupil to the point where the best arrangements of subject-matter are made his own for actual conduct through the process of true learning." As Henry C. Morrison has said, "The essence of educating an American citizen is to set him going under his own power and point him right."[1]

To carry the newer conception of education into the field of science teaching, we might set up the following guiding principle: The study of science in the junior high school should so modify the life of the boy and girl through the nature of the content and the method of study that they will better understand, more fully enjoy, more thoroughly appreciate, and more thoughtfully adjust themselves to the environment in which they live, and as far as possible, control it.

Selection of Subject Matter. The task of selecting subject matter for use in the instructional program is a difficult one. Thus is raised the problem that has plagued men interested in education for many generations: What knowledge is of most worth? Out of all the valuable things that could be learned, what shall I choose? And, ever more pertinent, what shall be chosen for the immature person under the guidance of the school? This is the

[1] Morrison, H. C., - The Practice of Teaching in Secondary Schools. University of Chicago Press, 1931

problem upon which those responsible for curriculum making have expended more effect and thought, perhaps, than any other.

There are four principal bases upon which the selection of potential subject matter may be made:[1] 1. significance to an organized field of knowledge; 2. significance to an understanding of contemporary life; 3. adult use; and 4. child interest and use. The first two of these bases rest largely on tradition and judgment. The last two may be determined by scientific procedures.

Pieper and Beauchamp suggest the following four major criteria.[2] These may well be divided by the teacher into a series of subordinate questions which will serve as guides in the selection and organization of subject-matter. The four major criteria (with a few suggestive subordinate questions) may be stated as follows:

(1) Does the subject-matter appeal to the interest of boys and girls as worth while and real in their daily lives: that is, are the phenomena studied common to the experience of every child? Do the applications permit such pupil activities as operation, construction, dissection?

(2) Is it possible to organize the subject-matter in such form that the method of study gives proper training in desirable attitudes, habits, skills, and ideals? Can the material be organized so that it presents practical problems to be solved? So that it brings out the relationship of science facts and thereby leads to an understanding of the environment rather than to a mere

---

[1] Caswell, H. L. and Campbell, D. S., Curriculum Development, American Book Co., 1935, p. 255.

[2] Pieper, C. J. and Beauchamp, W. L., - Report on Objectives and Methods in General Science, - From the Teacher's Guidebook for Everyday Problems in Science, Revised - 1940. Scott, Foresman & Co.

memorization of facts?

(3) Is the subject-matter such that the knowledge gained has a positive value in the life of the pupil? Does it relate to personal and community health? Does it deal with home applications of science? With important community problems?

(4) Are the subject-matter and the method employed of the proper degree of difficulty? Do the problems and study material test the best reflective thinking powers of the pupils and yet prove to be thoroughly understandable? Are they organized to allow for individual differences within the classes? Are the material and method real science rather than toy science busy work, experiments for own sake, without including philosophical and theoretical topics which belong only in later courses?

These questions should constantly be in teacher's mind while formulating a course, and should be the guides in teaching. The interests, needs and abilities of those studying science are the three watchwords of every science teacher. It should be remembered, however, that interest alone is not a valid criterion. Mature minds must, to a degree, build a course which will attain the objectives previously stated, making use of the interests of boys and girls to motivate and to approach those major facts, principles, or generalized concepts which form the framework of a substantial course in the science of our environment.

In organizing the material for a ninth grade course of study in general science, the topic should be the large unit to which many specific pieces of work are related. A wide variety of headings appear in plans for units of work or units

of experience and in reports of units actually taught.[1] Many of these headings are alike in reality although worded differently. Most written units present the aims or desired outcomes; suggestions for startings, developing, and closing the unit; and bibliographies for pupils and teachers; in some cases the significance of the unit, objects of interest to the pupils, and evaluation of results are also used as headings.

Basis for Selecting Subject-Matter. There is at the present time, so far as the writer knows, no conclusive method of evaluating units in general science from either textbooks or courses of study.[2] However, criteria are presented which have been proposed by various authorities and curriculum committees. Morrison's definition suggests two criteria for a "learning unit"; 1. The unit is comprehensive. 2. The unit is significant.[3]

One type of study, frequently used to evaluate units in general science, is concerned with analysis of the materials treated in textbooks and courses of study. The basis of selecting contents cannot be determined with accuracy in the case of such studies.

Inasmuch as the writer of different texts or the committees that prepare different courses of study may use entirely

---

[1] Encyclopedia of Educational Research, Walter S. Monroe, University of Illinois, Macmillan Co., 1941, pp. 376-377.

[2] Caswell, H. L., and Campbell, D. S., Curriculum Development, American Book Co., 1935, pp. 427-439.

[3] Morrison, D. C., The Practice of Teaching in the Secondary School, pp. 25-26, 1931.

different bases of selecting the materials they include, analysis of texts and courses of study merely indicate the materials that are most generally considered worthy of inclusion without regard to basis of selection.

The writer has made an analysis of twenty-five general science textbooks, the most modern available, to determine the frequency of units listed. This list of texts include: Dull-Mann-Johnson, Modern Science in Man's Progress, 1942, Henry Holt and Co.; Beauchamp-Mayfield-West, Science Problems, Scott-Foresman & Co., 1939; Carroll, Understanding the Universe, 1943, John C. Winston & Co.; Smith-Trafton, Using Science, 1942, J. P. Lippincott Co. The results of this analysis is shown in Table 12. While only a relatively small number of textbooks on ninth grade general science have been considered here which are based on the unit system, there are actually a large number which did not deserve to be included because the date of their revision was not modern. The twenty-five textbooks selected in Table 12 had relatively much merit and a wide selection of reference material. The date of publication ranged from 1936 to 1944, the latest publications received by the Louisville Division of Curriculum and Research.

TABLE XII -- FREQUENCY OF UNITS IN TWENTY-FIVE MODERN LEADING NINTH GRADE GENERAL SCIENCE TEXTBOOKS.

Units	Frequency	Percent	Rank
Light	25	100	1
Magnetism and Electricity	25	100	2
Machines	24	96	3
Living Things	23	92	4
Heat and Fire	21	84	5
Air	20	80	6
Sound	20	80	7
Transportation and Communication	20	80	8
Water	20	80	9
Energy and Matter	19	76	10
Human Body	19	76	11
Solar System, Universe	19	76	12
Climate and Weather	18	72	13
Heath and Disease	18	72	14
Earth and Its Substance	15	60	15
Matter	13	52	16
Work	12	48	17
Conservation of Natural Sources	11	44	18
Chemical and Physical Changes	4	16	19
Home Improvement	2	16	20

This Table 12 shows the rank of the units in ninth grade general science with the highest frequency found used in twenty-five modern textbooks. This analysis of texts merely indicates the units that are most generally considered worthy of inclusion.

Interests of Children in Subject Matter. Robertson includes children's interests as one of his three bases for selection of subject matter in his study of content in general science.[1] He defines a basis for selecting content in terms of scientific principles, subject matter topics, and children's interests. A collection of scientific principles was made and submitted to a jury of three science teachers. The resulting list was refined and submitted to a group of subject matter specialists. A list of 243 principles resulted. A list of subject matter topics was prepared in much the same way. Children's interests were checked by reference to questions asked. These principles, topics and interests may be employed as a basis for checking the potential value of content. Thus, significance to the subject field and children's interests are used as a basis of selection of subject matter in this case. The practical curriculum worker will find it wise to employ children's interests as one of his bases for selecting potential subject matter.[2]

Since the subject matter of general science should be selected to a large extent from the environment, it will vary greatly in different communities. The courses of study, therefore, in order to contribute to the pupils' interests and needs, will contain selections of subject matter adapted to that area.

Science is universal and constant in the life of our

---

[1] Robertson, Martin, A Basis for the Selection of Course Content in Elementary Science, University of Michigan.

[2] Caswell, H. L. and Campbell, D. S., Curriculum Development, American Book Co., 1935, p. 274

citizens, and hence to be useful to all pupils, general science must accept the seience of common things as its legitimate field. The science of common use and that of the classroom should be the same.

The particular units of study should be those that truly interest the pupils. Interest not only secures productive attention but is an evidence of attention. To be substantial educational, interest must rest upon a sense of value, an evident worthwhileness in the topics considered.

To carry out the above statements, the writer presents Table 13 to show the results of a study which proves that children do display interests in objectives, carried out in six classes of ninth grade general science or a total of two hundred pupils in a junior high school. These divisions include a wide variety from average to accelerated groups. Each pupil was instructed to check his desires from a list of twenty-five units which appeared desirable in a general science course of study taken from the text analysis above. He rated the units listed, according to the degree that science teaching contributed to his interest by checking its importance in one of the four columns marked: "very much;""some;" "very little;" "not any." They were encouraged to add any additional units they choose on the sheet. Only two pupils made additional choices, one each, as follows: How the world uses scientific knowledge today; science for human control.

TABLE XIII -- Pupil Interests in Ninth Grade General Science Topics.

AS A PUPIL IN THE NINTH GRADE, I AM INTERESTED IN THE FOLLOWING TOPICS IN GENERAL SCIENCE:

TOPIC	Number	Percent	Rank
The Human Body	198	99	1
Living Things	190	95	2
Air	185	93	3
Light	184	92	4
Food	180	90	5
Chemistry of Common Things	170	85	6
Water, Use to Man	166	83	7
Our Environment	162	81	8
Earth and Minerals	148	74	9
Magnetism and Electricity	142	71	10
Machines	140	70	11
Matter, Energy and Work	136	68	12
Fire and Heat	120	60	13
Health and Disease	120	60	14
Weather and Climate	112	56	15
Sound	103	52	16
Micro-organisms, their work	99	50	17
Home life, betterment	90	45	18
Communication	72	36	19
Clothes, Importance & Knowledge	70	35	20
Transportations	63	32	21
Universe (Solar System)	50	25	22
Community Sanitation	48	24	23
Conservation (Natural Resources)	30	15	24
Economy in Use and Buying	24	12	25

Analysis of Unit Frequency in Course of Study. Another type of study frequently used to evaluate units in general science for the ninth grade is concerned with the analysis of the material treated in courses of study. Again, the writer explains the basis of selecting content cannot be determined with accuracy in the case of such studies. They merely indicate the materials that are most generally considered worthy of inclusinn by trained authors or committees.

The writer has made an analysis of ten general science courses of study to determine the frequency of units listed. The results of this analysis is shown on Table 14. The list of Courses of Study selected for this study include those from: Indianapolis, 1935; Jersey City, 1933; Berkeley, Calif., 1943; Atlanta, Ga., 1938; Minneapolis, 1941; and others. These mentioned were chosen because they represented widely distributed sections of our nation; they were representative cities comparable in size with Louisville. Dates were accepted, as these Courses of Study were all that were available at the Curriculum Division office at the time the study was made.[1] As before mentioned in this thesis, there appears to be a smaller number of significant research studies on general curriculum initiated within the three year period 1942-1944 than in any similiar period for a decade, probably due to research for war purposes.

---

[1] Review of Educational Research, Vol. XV, June 1945, "Curriculum" - Chap. II, pp. 207 - 210, by H. H. Heyl and Wm. E. Young.

TABLE XIV -- FREQUENCY OF UNITS LISTED IN 10 COURSES OF STUDY IN NINTH GRADE GENERAL SCIENCE:

UNITS	Frequency	Percent	Rank
Magnetism and Electricity	9	90	1
Fire and Heat	8	80	2
Light Energy	8	80	3
Machines, Use to Man	8	80	4
Air - How Man uses it	6	60	5
Health and Disease	6	60	6
Work and Energy	6	60	7
Communication	5	50	8
Living Things	5	50	9
Water - Uses to Man	5	50	10
Weather and Climate	5	50	11
Clothes	4	40	12
Sound	4	40	13
Transportation	4	40	14
Conservation	3	30	15
Food	3	30	16
Earth and Minerals	3	30	17
Human Body (Food, etc.)	3	30	18
Matter (Energy and Work)	3	30	19
Universe	3	30	20
Our Environment	2	20	21
Home Life, Betterment	1	10	22
Community Sanitation	1	10	23
Micro-organisms, (Their Work)	1	10	24
Chemistry (of Common Things)	1	10	25

The significance of the analysis shown in Tables 12, 13 and 14, in the selection of subject matter is the frequency of units used, and studies made which combined two or more of the bases for selecting subject matter. This combination includes subject matter topics, and children's interests. My conclusion is that no single basis of selecting potential subject matter is adequate in practical programs of curriculum development. Rather, attention well may be given to each basis. Assurance of the value of the proposed material will be increased as it is seen to be (1) significant to the organized field of knowledge, (2) significant to contemporary life, (3) commonly used by adults, and (4) of general interest to children.

Items of low frequency may really have a far sounder basis for being included in a course than those with a high frequency.[1] Even so, the higher frequency indicates the materials that are most generally considered worthy of inclusion without regard to basis of selection.

An example of unit selection from a Course of Study and in the opinion of Hunter, one of the soundest educationally, is that of the State of Minnesota.[2] This outline recommends carefully graded and integrated work, establishing the philosophy that, to be workable, health education and agriculture should be integrated with general science. The pamphlet contains much suggestive material, especially in the introduction, standards of achievement, suggestions for equipment, and bibliography. The outline of the ninth grade

---

[1] Caswell, H. L., and Campbell D. S., Curriculum Development, Page 273 American Book Co.

[2] Hunter, Geo. W., Science Teaching at Junior and Senior High School Levels, American Book Co., 1934, pp. 135-136

follows:

I. Environment . . . . . two weeks

II. Air and Its Work . . . . . five weeks

III. Water and Its Work . . . . . two weeks

IV. Heat and Its Work . . . . . two weeks

V. Light, Its Use and Control . . . . . three weeks

VI. Study of Industry . . . . . four weeks

VII. Use and Control of Energy in Transportation . . two weeks

VIII. Use of Food by the Human Body . . . . . six weeks

IX. Nervous System and Environment . . . . . three weeks

X. Safeguarding and Improving the Life of Individual and Community . . . . . five weeks

Suggestions for Evaluating the Topic.

A. Have your pupils developed proper attitudes or appreciation toward:

1. Completing projects and bringing to class original work?
2. The inventors and the contributions they make?
3. The gradual improvement made and met by people?

B. Have your pupils improved in:

1. The ability to use books? to locate material?
2. The ability to read to obtain accurate information and evaluate this information?
3. Use of the table of contents to locate information?
4. Ability to participate in class discussion and sticking to the problem?
5. Ability to cooperate with the class? Make and carry out plans for study?
6. Ability to speak and spell correctly? Write in an interesting manner? Express ideas through drawing, constructing?

7. The ability for assuming responsibility?

C. Do your pupils know:

1. The background of this topic?

2. The importance of the discoveries in this field?

3. How to talk scientifically with adults on this topic?

4. How to correlate this topic knowledge with other activities?

5. How to evaluate, judge, choose, when the opportunity developes?

D. Interest in Objectives:

1. Measured in Acitivies of the student

(a) What is written in scientific fashion among the students?

(b) What is talked in scientific fashion among the students?

2. Daily care of the Bulletin Board.

3. Display of interesting projects.

4. Active use of newspaper and current magazines.

Guides to Teachers.

1. The activities listed in the teaching outline are suggestive and they will vary with differing conditions.

2. No attempt is made to organize material beyond the limits imposed by the necessity of meeting life experience.

3. No definite time limit is placed on any individual or group activity other than the limit for the topic in the outline.

4. An effort is made to maintain the individuality by the teacher by providing a wide range of opportunity.

5. Material is organized in a manner that will permit the use of any method of instruction.

6. The central theme throughout this plan is learning to live

and all activities are selected with this purpose in mind.

7. A science teacher's obligation is to teach boys and girls how to live and how to use science as a means toward this end.
8. The child's own interests, needs, and purposes are the points around which his educative experiences should be grouped.
9. The most reliable information about learners is that obtained by observing them in their various activities.
10. Common interests make group teaching possible; different interests make individual teaching necessary.
11. Only when the ways of behavior of the learner are permanently modified does real learning take place.
12. The teacher must be alert for better methods and materials.

Sequence of Topics in the Junior High School. To summarize these text books and courses of study, it is evident that no definite procedure has yet been worked out by which curriculum makers can reach definite conclusions as to the exact sequence of material to be used in the junior high school. It is obvious that interpretation of the child's environment is the chief theme and for that reason, doubtless, courses of study should rightly vary according to the type of environment and the social needs of the community.

The sequence of topics does not conform to that of some texts. Where the chapter order is of different arrangement, however, or where the textual content is not grouped in the same

way, the chapters can be studied very satisfactorily out of their order. It is expected that no class will be limited to the opportunities provided by any one text. Other reference material should be accessible and included in the work expected.

Each topic lends itself well to the development of worksheets.[1] A sample worksheet is found in appendix (B) in abridged form. From this the teacher can plan as she needs for the various topics. If possible, each pupil should have a mimeographed copy and be encouraged to make full use of it. From year to year the teacher can improve on the form of the topic in the light of her experience with it. This method has been experienced by the writer and found to be most satisfactory, a vital process.

General Science Laboratory. In the thriteen topics listed are a total of eighty experiements and studies. As many as possible should be worked out in the presence of every pupil, either demonstrated by the teacher or with the assistance of members of the class, or else done, whenever possible, by the pupil himself. But regardless of who does the work, each pupil must write down his own account of the experiment. The reports should be so worded, and with such figures and drawings as are suited, to indicate that the pupil understands the nature of the problem and the outcomes.

Not fewer than sixty of the experiments and studies should be done or witnessed by every pupil and the report satisfactorily entered into his notebook. More than sixty, if time

---

[1] See Appendix "B", pp. 128-129

and conditions permit, will help to make the teaching more effective. These should represent all the topics and be justifiably spread over the entire year's work. Experiments should be such as require the use of equipment and give the pupil a knowledge of laboratory procedure.

General Science is one of the very best courses for exploratory purposes. In its study many pupils discover interests and aptitudes not hitherto apparent. The alert teacher will provide opportunities for the development of these interests, will encourage the students in these studies, and give them the wise educational and vocational guidance that these situations make possible.

Suggestions Regarding the Construction of a Teaching Outline in This Proposed Course. The writer is selecting the "subject-matter" method of organizing the topics in a ninth grade course of study. He is organizing tentative outlines for teachers which will include the following phases: basic facts; experiments and problems; pupil activities and reports; continuous evaluation by the teachers; and a reference list for pupils. The chief objection to the "subject-matter" organization of topics seems to be that the things-to-be-learned receive primary attention rather than the learner.[1] Therefore, the science teacher, even realizing the importance of pupil interest toward success, should keep on constant guard

---

[1] Gwynn, J. M., Curriculum Principles and Social Trends, Macmillan Co., 1943, p. 179

against this difficulty.

In the National Survey of Secondary Education, Francis D. Curtis reports the following methods in use for the teaching of subject-matter.[1] (1) the project method; (2) the problem method; (3) differentiated assignments; (4) long-unit assignments; (5) the contract plan; (6) the laboratory plan; (7) individualized instruction; (8) some modification of the Morrison plan; (9) the Dalton plan or some modification; and (10) the Winnetka technique or some modification. He stated that all of these methods "are one and the same thing, differentiated only in name." This statement is the grounds for the writer's selection of the type teaching outline chosen; the"subject-matter type" with certain modifications.

Other bases for selecting the subject-matter type in the following outline are as follows: (1) my knowledge gained through twenty years of teaching experience in this field of general science; (2) the fact that the teachers in ninth grade general science in the Louisville Public Schools seem to be subject-matter minded.

Because of the latter fact, too sudden a shift in organization in Louisville might be unwise, but it could be done gradually. In organizing the materials in the outlines in each topic, the writer had the materials in these four objectives in mind: (1) significance to an organized field of knowledge; (2) significance to an understanding of contemporary life; (3) adult use; and (4) child interest and use. The topic is the unit of most high school courses as now organized.[2]

---

[1] "The Unit Assignment", Clearing House, IX (May 1935) 543-46

[2] Billett, R. O., Fundamentals of Secondary School Teaching, Houghton Mifflin Company, 1940, p. 505.

Topic Selection and Basis for Selecting. The writer has selected the following thirteen topics as a basis for organization of tentative outlines for teachers in the ninth grade general science course of study in the Louisville junior high schools:

Topic (1) Matter, Energy and Work.

This Topic ranked No. 10 in frequency in the textbook questionnaire; No. 19 in frequency in courses of study table; and No. 12 in the child interest questionnaire. I placed it first because this Topic includes the foundation of all science. It is recommended in the Thirty-First Yearbook, Part I, page 28, quote: "learning to control energy in other ways has affected our manner of living."

Topic (2) Air and Its Work - Uses to Man.

This Topic ranked No. 6 in textbook frequency; No. 5 in courses of study analysis; and No. 3 in child interest questionnaire. I placed it second because of its necessity to life and the fact that it is one of the most common forms of matter. Its high frequency should be considered in its worth.

Topic (3) Light Energy, Its Service to Man.

This Topic ranked No. 1 in textbook frequency; No. 3 in course of study analysis; and No. 3 in child interest questionnaire. Again, high frequency had its influence on determining its worth. I placed it in this order because of its environment benefit to mankind and it is another common form of energy as in Topic 1.

Topic (4) Fire and Heat as Servants to Man.

This Topic ranked No. 5 in textbook frequency; No. 2 in courses of study analysis and No. 13 in child interest

questionnaire. I placed it in the above order because it is another common form of energy and it has played an important part in the progress of civilization.

Topic (5) Magnetism and Electricity.

This Topic ranked No. 2 in textbook frequency; No. 1 in course of study analysis, and No. 10 in child interest questionnaire. Again frequency designated its worth. I placed it in this order because it is another common form of energy and plays such a large part in the pupils' lives each day. We are living in an electric age: Thirty-First Yearbook, Part I, p. 29, "This is an electric age."

Topic (6) Communication.

This Topic ranked No. 8 in textbook frequency; No. 8 in courses of study analysis, and No. 19 in child interest questionnaire. The low frequency in the latter points out a dire need or understanding on the part of the pupil of the importance of this Topic. I placed it in this order because its success today depends upon the understanding of the preceding topic (Magnetism and Electricity). It was selected as a part of this subject matter upon the recommendation of the Works' Survey report, "Communication would appear to be sufficiently important to receive considerable attention." Thirty-First Yearbook, Part I, also recommends it as an important topic in general science subject-matter.

Topic (7) Transportation. -- How the World Rides.

This Topic ranked No. 8 in textbook frequency; No. 14 in courses of study analysis; and No. 21 in the child's interest. It was selected as a part of this subject on the same

basis as Topic 6 above. In addition, highways have always played a large part in world history (Romans, the Aztecs in Mexico, Incas in Peru.)

SECOND SEMESTER

Topic (8) Life on Earth.

This Topic ranked No. 4 in textbook frequency; No. 9 in courses of study analysis, and No. 2 in child interest. The high frequency designates the worth of this topic. The writer feels it very important that pupils know more about life around them, a part of their environment.

Topic (9) The Human Body -- Parts, Functions and Food.

This Topic ranked No. 11 in the textbook frequency; No. 18 in courses of study analysis, and No. 1 in child interests. The latter number denotes the desire and need of pupils for knowledge of their bodies. The low frequency of parts 1 and 2 is largely due to the inclusion of this Topic under other headings. The writer realizes our bodies are the most intricate machines in existence. They consist of millions of parts, each having its particular work to do. Our bodies require the right food.

Topic (10) Health and Disease.

This Topic ranked No. 14 in textbook frequency; No. 6 in courses of study analysis, and No. 14 in child interests. This is one of the few topics that does not stand up markedly in the proceding analysis. This case bears reference to an interesting experiment carried out by L. G. Thomson[1] in an assembly of high

---

[1] Thomson, L. G., "Objectives of Secondary Education According to Opinions of Pupils," School Review, Vol. 37, March 1929

school pupils in South Milwaukee High School. A list of twenty-one objectives was mimeographed and given out to students from which they were to list a first, second and third choice. Health was the first choice in only one case out of some 344 pupils. I have no explanation for this result. I selected this Topic, however, because our health is a matter of concern not only to ourselves and our home folks but to our community and to the nation. It is an important topic in "Planning for American Youth"[1] and "Education of all American Youth"[2] (see bibliography), books written by two recent authorities containing modern subject matter.

Topic (11) Betterment of Home Life.

The Topic ranked No. 20 in textbook frequency; No. 22 in courses of study analysis, and No. 18 in child interests. This is another topic that does not stand up markedly in the preceding analysis. Even so, items of low frequency may really have a far sounder basis for being included in a course than those with a high frequency. For example, the writer feels the importance of this topic after studying the suggestions offered in the modern reports referred to in Topic 10. The 64-page pamphlet Planning for American Youth, colorfully illustrated, required two years in preparation by outstanding educators and should be an exceptional authority.

---

[1] National Association of Secondary-School Principals, Washington, D. C., Planning for American Youth, 1944, p. 43.

[2] Educational Policies Commission, Education for All American Youth, 1944, N. E. A., Washington, D. C., pp. 114-119.

Topic (12) Conservation of Natural Resources.

This Topic ranked No. 18 in textbook frequency; No. 15 in courses of study analysis, and No. 24 in child interests. The reasons for selecting this topic are very similiar to Topic (11) above. The Works' Survey also stated that other topics, such as soil conservation, are worthy of consideration in their scientific aspects, at least.

Topic (13) Problems of the Consumer.

This Topic was not listed in any of the textbooks, nor courses of study. It ranked No. 25, or last in child interests. This Topic, however, was selected on a similiar basis of Topic (11) above mentioned. The value of this Topic was further strengthened in my mind from a study of "Using Standards and Labels."[1] A chief purpose of this study is to prepare a series of teaching-learning topics for use in secondary schools. The topics are intended to help young people to become more intelligent, more effective, and more conscientious consumers in the economic system in which they live. Consumer education is having a rapid development in secondary schools.[2] This trend is the result of no mere fad. It has its roots deep in fundamental changes in our economic life and in the problems of our society.

---

1 Using Standards and Labels, A Problem of the Modern American Consumer - (Consumer Ed. Series, Unite No. 6) Washington, D. C., 1945

2 The Place of Science in the Education of the Consumer, The Consumer Education Study, 1201 Sixteenth Street, N. W., Washington, D. C., 1945.

FIRST SEMESTER

Teaching Outline

Topic 1. MATTER, ENERGY AND WORK

Basic Purpose: To acquire an understanding of how energy moves the matter in the world and in so doing accomplishes work.

Facts and Problems:

1. The world is made up of matter. What is matter? Characteristics? What are elements? Compounds? Solution? Mixture? Give examples of each. What are molecules? Kinds of matter? Three forms of matter and characteristics of each.

2. Energy is that which moves matter. Ability to do work. Kinds of energy. Energy can be changed.

3. Work is moving of matter. Handicaps--Weight a measure of gravity. What is gravity? What is friction? Advantages and disadvantages. What is inertia? Advantages and disadvantages.

4. Machines make work easier. A Machine is a device which given an advantage over work. Examples: lever, pulley.

Experiments:

1. Compare the weight of a quart of milk with a quart of water. (to illustrate the experimental method)
2. Distinquish between general and special properties of matter.
3. Show properties of water.
4. Demonstrate Radimeter--effect of heat energy upon the vanes.
5. Show the preparation and properties of oxygen.

6. Demonstrate the properties of carbon-- physical and chemical.

7. Demonstrate the properties of hydrogen--physical and chemical.

8. Show the electrolysis of water--compound and its elements.

9. Demonstrate gravity--friction--inertia.

10. Demonstrate the lever--its three classes--the law of machines.

Pupil Activities and Reports:

1. Look at film "Lumbering in the Pacific Northwest," or other similar films from the Board of Education, Division of Curriculum and Research.

2. Construct a graph showing in percents the weights of common elements you know.

3. Make a labeled sketch of a blast furnace.

4. Collect materials and use them to demonstrate five physical and five chemical changes before the class.

5. Make out a chart listing ten materials--stating their use and special property.

6. Bring to class posters, clippings, types of bearings, simple machines.

7. Report on:

   The Building of Pyramids
   Galileo and the Leaning Tower of Pisa
   Archimedes and his Mechanical Devices
   Gravity on Other Solar Bodies
   Demonstrations of Inertia in Everyday Life
   Contribution of Robert Fulton, Eli Whitney, Cyrus McCormick, Elias Howe, Henry Ford and others.

References:

Adams, J. K., Harper's Machinery Book for Boys.

Caldwell and Curtis, Introduction to Science, Chap.12,13.

Darrow, F. L., The Boys' Own Book of Great Inventions.

Gibson, C. R., Machines and How They Work.

Lake, Harley, Welton, Exploring the World of Science, Chap. 15, 16.

Magazines: Popular Mechanics, Popular Science, Science and Invention.

Meister, Morris, Energy and Power.

Pieper and Beauchamp, Everyday Problems in Science, Chap.12

Regenstein and Teeters, Science at Work.

Pamphlets: In library (sets): Machinery at Implement Stores.

Teaching Outline

Topic 2. AIR AND ITS WORK -- USES TO MAN

Basis Purpose: Develop an appreciation of the importance of air in all living matter, and how air does a large amount of work in the world.

Facts and Problems:

1. Air is matter and exerts pressure.
2. Air pressure does work, aids man.
3. Air offers resistance to moving bodies.
4. Air vibrations produce sound.
5. Air is necessary for life.

Experiments and Studies:

1. Prove air is matter -- it occupies space and has weight (use football bladder and air pump)
2. Make a barometer (mercurial if possible.)
3. Make a siphon: demonstrate its use.
4. Demonstrate a parachute. Discuss streamlining and advantages as in submarines, airplanes, automobiles, trains, ships.
5. Demonstrate production of sound. (Tuning forks -- bell in vacuo.)

Pupil Activities and Reports:

1. Make a list of compressed air devices used in industry.
2. Make a weather map, showing markings and explain.
3. Cut pinwheels from paper, arrange in wind.

4. Bring to class for demonstration: soda straws, ink wells, atomizers, chicken waterers, vacumn cup, basketball shoes, insect spray guns.

5. Diagram diving bells and caissons, label, and explain.

6. Visit railway station and locate, if possible, the air pump on the locomotive, and air connections on cars.

7. Make a list of sayings bases on wind direction.

8. Report on Galileo and Torricelli, studies of air pressure.

9. Sketch and label a lift pump. Tell how it works.

10. Make a poster of streamlined objects.

References:

Archibald, Douglas, The Story of the Earth's Atmosphere, D. Appleton - Century Co.

Compton's Pictured Encyclopedia. Compressed Air, Vacumn Respiration.

Darrow, F. L., Thinkers and Doers, p. 213-223.

Gibson, C. R., Chemical Amusements and Experiments.

Houston, E. J., The Wonder Book of the Atmosphere, F. A. Stokes Company.

Lake, Harley, and Welton, Exploring the World of Science.

Meister, Morris, Water and Air.

Regenstein and Teeters, Science at Work, Rand, McNally & Co.

Watkins and Bedell, General Science for Today.

Wood and Carpenter, Our Environment - Book III.

Teaching Outline

Topic 3. LIGHT ENERGY, ITS SERVICE TO MAN

Basic Purpose: Enable the pupil to understand the nature of light, its use by man, importance to all life.

Facts and Problems:

1. Light is a form of energy by which we see things.

2. What causes shadows?

3. Light waves can be refelected.

4. Light waves can be separated into many colors.

5. Light waves can be bent (refracted.)

6. Use of lens, importance to man.

7. Knowledge of artificial light.

8. Understanding of the structure of the camera, and its importance to man.

Experiments:

1. Show how light travels in a straight line.

2. Demonstrate how a prism breaks up sunlight into the colors of the spectrum. Explain the rainbow.

3. Demonstrate the angle of reflection equal to the angle of incidence. Explain "funny mirrors."

4. Demonstrate the pin hole camera, compare with the eye, function, parts.

5. Show how light rays can be bent.

Pupil Activities and Reports:

1. Construct a periscope and demonstrate its use before the class: "use cheese box and mirrors."

2. Make a pin hole camera and demonstrate it before class.

3. Draw and label a diagram of the human eye.

4. Explain how a mirror is constructed.

5. Report on "infra-red" and "ultra-violet rays."

6. Report on Isaac Newton and light. Nature of light.

7. Describe lighting systems in modern buildings, auditoriums, churches, schools.

8. Make posters; different types of lights used; eye glasses; colors of paints advertised; etc.

9. Bring empty cameras from home to examine and demonstrate in class.

10. Conduct a class project; lighting exhibit; showing growth and development of man's need of illumination.

References:

Caldwell, O. W., and Curtis, F. D., Science for Today, pp. 457-490.

Compton's Pictured Encyclopedia:
Vol. L. pp. 125-131, What Scientists Know of Marvels of Light; Vol. C. Color, p. 307; Vol. L. Lens, pp. 96-98; Vol. S. Rainbow, pp. 241-244; Vol. L. Lamps and Lighting, pp. 57-59; Vol. C. Camera, pp. 39; Vol. E. Eye, pp. 344-352

Dull, C. E., Modern Physics.

Eastman Kodak Co., Rochester, N. Y., How to Make Good Pictures.

Lake, Harley, Welton, Exploring the World of Science, Chaps. 21-22.

Meister & Morris, Energy and Power, Chapter 1 to VI, Charles Scribner's Sons.

The DuPont Magazine, Oct. 1945, Color in the Plant, pp. 10-17, E. I. duPont DeNemours and Co., Inc., Wilmington, Del.

The World Book Encyclopedia -- Various Topics

The Book of Popular Science.

Teaching Outline.

Topic 4. FIRE AND HEAT AS SERVANTS TO MAN

Basic Purpose: The origin, control and use of fire, the effect it has upon the progress of civilization, and the extent to which we depend upon it for our everyday needs.

Facts and Problems:

1. Report on the early history of fire.
2. Report on the part fire and heat has played in man's progress.
3. Prove that heat is a form of energy, coming from the sun.
4. Show how heat affects matter.
5. Demonstrate how heat can be transferred from one kind of matter to another (heating devices).

6. Learn the characteristics of types of fire extinquishers.

7. Become acquainted with common fuels -- importance and sources.

8. Acquire some understanding of the importance of heat measurement by Centigrade, Fahrenheit, and other types of thermometers.

9. Learn how our Homes are heated.

Experiments:

1. Show the necessity of oxygen, heat, and a combustible substance to start combustion.

2. Demonstrate the fire extinquisher.

3. Show how heat affects solids, liquids, and gases.

4. Compare the Fahrenheit and Centigrade thermometers.

5. Show how charcoal is made from wood.

6. Show how coal is charged into coke.

7. Demonstrate conduct of heat (conductometer) (thermostat).

8. Demonstrate convection currents.

9. Show how heat affects solids, liquids and gases.

10. Demonstrate a hot water heating system.

11. Demonstrate types of insulation and methods.

Pupil Activities and Reports:

1. Collect specimens of fuel used in your community.

2. Inspect the school heating plant.

3. Make a chart showing uses of heat in everyday life -- sources -- processes.

4. Have a Boy Scout, or pupil domonstrate fire making.

5. Burn paper by focusing sun rays with magnifying lens or reading glass.

6. Make a list of common fire precautions.

7. Investigate the kind of roof materials listed in stores.

8. Give a report of some fire (Chicago fire).

9. Visit a fire station; report to your class.

10. Make a chart on list of "Precautions against Fire in My Home."

11. Draw and label a fire extinquisher. Explain its use.

12. Sketch a suitable poster for "Fire Prevention Week."

13. Debate: Resolved: that fire makes a longer contribution to civilization through its use in industries than it does through its use in homes.

14. Report on:

    Evaluation of Heating Device in the Home
    Fireless cooker
    Vacuum or Thermos Bottles
    How to Get Metal from Ores
    The Coal Age or the Oil Age
    What Causes Explosion
    The Story of Prometheus (may obtain from English Department)
    Smelting of Ores.

References:

Caldwell and Curtis, Introduction to Science, p. 149-212.

Comptom's Pictured Encyclopedia -- School libraries.

Darrow, Floyd, Boy's Own Book of Great Inventions.

Greenwood, E., Prometheus (Harper's 1929)

Meister, Morris, Heat and Health - Charles Scribner's Sons.

Maud and Miska Petersham, The Story Book of Oil, The John C. Winston Co.

Parker, B. M. and Holley, C., Heat, Row, Peterson & Co, 1942

Parker, B. M. and Holley, C., Thermometers, Heat and Cold.

Pieper and Beauchamp, Everyday Problems in Science.

The World Book Encyclopedia.

The High School Physics Text (or a modern text).

Teaching outline.

Topic 5. MAGNETISM AND ELECTRICITY

Basic Purpose: The importance of electricity in our daily lives and the understanding of its generation, nature and use.

Facts and Problems:

1. Magnetism as a kind of energy; the way magnets act.
2. Electromagnet and its uses.
3. Electricity -- conductor and insulator.
4. Electricity; how it can be generated.
5. Three methods of generating electricity.
6. What constitutes and electric current (voltaic).
7. The essential parts of an electric cell.
8. The construction of a dry cell.
9. Elementary principles of electroplating.
10. The use of the common elecrrical units (volts, ohm, ampere, watt, kilowatt hour.)
11. Transformation of electrical energy.
12. The cause of lightning.

Experiments:

1. Demonstrate magnetic action; also the compass.
2. Construct and operate electromagnets.
3. Show how the electric door-bell works.
4. Construct an electric circuit and demonstrate; conductors, fuses, switches, source of energy, lights.
5. Construct an electric heating device.
6. Test different forms of matter for conductor and insulator.
7. Generate electricity by rubbing.
8. Construct and demonstrate a voltaic cell.
9. Study the structure of a dry cell.

10. Demonstrate the dynamo and galvanometer.

11. Demonstrate the St. Louis Motor (or a simple motor).

Pupil Activities and Reports:

1. Construct a compass--using cork and magnetic needle.

2. Make a list of uses of electric cells and batteries.

3. Construct a simple electric motor.

4. List household appliances using electric motors.

5. Visit the hydroelectric plant and make a report.

6. Check your electric meter over a period of weeks.

7. Report on mem who have made important discoveries in electricity.

8. Make diagrams of a few rooms in your house to show lamps and electrical outlets.

References:

Baxter, L. H., Electro-Craft in Theory.

Caldwell and Curtis, Introduction to Science.

Compton's Pictured Encyclopedia.

Crawford, J. E., Practical Electricity, 1942.

General Electric Co., Adventures in Electricity, by General Comics, Inc., Schenectady, New York.

Parker, B. M., The Book of Electricity.

Peterson, C. F., Fundamentals of Electricity.

Popular Mechanics.

Millikan and Gale, Elements of Physics.

Morgan, Alfred, A First Electrical Book for Boys, Charles Schribner's Sons.

Reh, Frank, Magnetism and Electricity.

Skilling, W. T., Tours Through the World of Science.

The World Book Encyclopedia.

Teaching Outline

Topic 6. COMMUNICATION

Basic Purpose: Cultivate in the pupils an appreciation of the part played by communication in our modern life and to help them understand how devices for this communication operate.

Facts and Problems:

1. Develop in the pupil an appreciation of the fact that much, if not all, of our modern mode of living depends upon the existence of dependable and speedy methods of communication.

2. Bring before the pupil the conception that communication has not been always as it is now, has passed through different stages due to efforts of many people.

3. Understand the workings of our postal system.

4. Understand how the telegraph set works.

5. Understand how the telephone works.

6. Understand how the radio works.

Experiments:

1. Demonstrate how sound is produced (use tuning forks).

2. Demonstrate the telegraph set in class.

3. Demonstrate the telephone in action in laboratory.

4. Show how the electric bell and buzzer work.

5. Examine a phonograph if possible, study it carefully.

6. Examine a crystal radio set (may construct one).

Pupil Activities and Reports:

1. Install an Electric bell in the home or school room.

2. Make a tin-can (and wire) telephone: talk over it.

3. Demonstrate, or have a Boy Scout explain the wig-wag system.

4. Report on a trip to a newspaper office (how news is

collected, locality served, kinds of news, watch it printed).

5. Reports: Picture writing of early days; Use of flags at sea; Evolution of the book; Alexander G. Bell; Morse, the inventor of the telegraph; The Trans-Atlantic cable; the Pony Express.

6. Report on how Indians used smoke signals.

7. Relate the poem "Ride of Paul Revere."

8. Assign reports on the personnel and writings of the postal system; use of stamps (varieties).

9. Visit your nearest radio station -- observe and report.

10. Report on a trip to telephone exchange.

11. Report on a trip to a telegraph station.

12. Report on the history of printing -- teletype.

References:

Beard, D. C., American Boys' Book of Signs, Signals and Symbols, Lippincott.

Bragg, Sir William H., The World of Science.

Compton's Pictured Encyclopedia.

Meister, Morris, Magnetism and Electricity.

Mills, John, The Magic of Communication.

Pictures from the Bell Telephone Lab., 463 West St., N.Y.

Pamphlets from the local Bell Telephone Company.

Smith, Victor C., Grafton, G. H., Teeters, W. R., Using Science, 1942

Van Buskirk, Smith, and Nourse, The Science of Everyday Life.

World Book Encyclopedia.

Teaching Outline

Topic 7. TRANSPORTATION -- HOW THE WORLD RIDES

Basis Purpose: Learn about our modern means of transportation and understand and appreciate the steps necessary in its development.

Facts and Problems:

1. Get some idea of primitive transportation and the stages of improvement leading to the present.
2. Learn what resistance transportation must overcome.
3. Study how safe highways are constructed -- good roads.
4. Discuss the development of the automobile, its importance.
5. Discuss steam transportation, its importance.
6. Discuss water transportation (why bodies float) -- methods of water transportation and importance.
7. Study the importance of the submarine, how it operates.
8. Review the methods and importance of air transportation.
9. Discuss speed and safety in transportation.

Experiments:

1. Illustrate advantage of types of wheels for certain kinds of roads (large and wide for sandy).
2. Show the effect of different grades.
3. Demonstrate how water buoys bodies up (buoyancy).
4. Demonstrate the Cartesian diver (showing how submarines may rise and sink in the water).
5. Demonstrate what gases are lighter than air.

Pupil Activities and Reports:

1. Investigate and report on the roads near your city (may do this with streets).
2. Report on traffic regulations in your city.
3. Make an air craft scrapbook.

4. Report on: Robert Fulton; Henry Ford; Wright Brothers.

5. Look up directions and make a toy airplane.

6. Make a trip to Bowman Field and report your experiences (or any Municipal Airport).

7. Bring and demonstrate a model or toy airplane.

8. Make posters on: streamlined machines -- types of automobiles or steam engines.

9. Report on historic flights.

10. Report on causes of automobile accidents.

11. Make a poster of clippings from news columns of traffic accidents.

12. Plan trips to various parts of the world.

References:

Baxter, T. and Young, B. M., Ships and Navigation.

Bishop, F., The Story of the Submarine, Century Co.

Compton's Pictures Encyclopedia, F. E. Compton Co., Airplane, p. 63; Automobile, p. 274; Canals, p. 625; Locomotive pp. 2043-2663; Railroads, p. 2962; Roads, p. 3023; Ships, p. 3207; Street Railways, p. 3370; Subways, p. 3550.

Harmey, L. B., The Skycraft Book, Heath.

Harpers Aircraft Book.

Highway Construction, Bul. 38, U.S.Bureau of Education, Washington, D. C.

Hamilton, J. R., and Thurston, L. L., Safe Driving.

Hunter, George W., and Whitman, W. G., Problems in General Science.

Smith and Grafton, Using Science.

Webster, H. H., Travel by Air, Land and Sea.

Some Interesting Pictures:

Development of Transportation, Erpi (16 sound).

Automobile, Eastman (16 sound).

Air Liner, Bell and Howell (16 sound).

New Roads to Roam, Ford Motor Co., (16 sound).

Railroad Safety, Eastman (16 sound).

Ring of Rails, General Electric Co., (16 sound).

Farther,Faster anf Safer, Pennzoil (16 sound).

Ocean Liners, Eastman (16 sound).

SECOND SEMESTER

Teaching Outline.

Topic 8. LIFE ON EARTH

Basic Purpose: Provide the pupil with a conception of what it means to be alive, and the various forms of life on earth; give him an understanding of the development of life, knowledge of heredity and importance to mankind.

Facts and Problems:

1. Plants and animals are very much alike in many respects.
2. There are big differences between living things.
3. Certain factors are needed to keep living things alive.
4. All living things have a definite structure.
5. All living things must perform certain functions in order to continue to live.
6. Heredity and its importance.

Experiments:

1. Demonstrate the "Hay infusion" and protozoa.
2. Show that living things are made up of cells.
3. Study different tissues on microscopic slides.
4. Plant various seeds and record results over a period of weeks.
5. Devise simple demonstration to show "transpiration" and "osmosis" (See Hunter and Whitman work book, p. 301).

6. Study the parts of a flower.

7. Use Charts demonstrating the meaning of heredity.

Pupil Activities and Reports:

1. Collect frog eggs and observe how they develop.

2. Prepare an aquarium, observe daily (also terrarium).

3. Make a labeled collection of seeds.

4. Have pupils make charts listing under large group headings the principal plants and animals found in their community.

5. Report on living things observed during a hike in one of our parks.

6. Report on the following: Darwin, Mendel, DeVries, Burbank, Leeuwenhoek, Pasteur and others.

7. Have pupils prepare a germinating box, observe.

8. Write a paragraph on importance of the statement "the plants feed the world."

References:

Baker and Mills, Dynamic Biology, Rand McNally Co.

Curtis and Caldwell, Biology for Today.

Compton's Pictured Encyclopedia.

Comstock, Anna B., Handbook of Nature Study.

Dougan, L. M., Stores of Outdoor Science.

Hodge, C. F., Nature Study and Life, Ginn & Company

Hunter and Whiteman, Problems in General Science.

Hunter, G. W., A Civic Biology, American Book Company.

Kinsey, A. C., New Introduction to Biology.

Moon and Man, Biology for Beginners.

Pieper, Beauchamp, Frank Everyday Problems in Biology.

Watkins and Bedell, General Science for Today.

Wilson, A., Insects and their control, Andrew Wilson, 1931

Wood & Carpenter, Our Environment, How we use and control it.

Teaching Outline.

Topic 9. THE HUMAN BODY -- PARTS, FUNCTIONS, AND FOOD

Basic Purpose: Understand better the life functions of the human body, obtain a knowledge of its parts of the importance of food.

Facts and Problems:

1. Food as fuel for the human engine, needs.
2. The nature of some of our common foods.
3. Food differs in their uses as fuel.
4. Selection and preparation of foods.
5. The human body is adapted to use foods as fuel.
6. Digested food carried by a circulator system to the body cells.
7. Wastes are excreted through the large intestine, lungs, kidneys, and skin.
8. The work of controlling the body -- the nervous system.
9. the frame work of the body.
10. The eye, function, parts and care.
11. The ear, functions, parts and care.
12. Our body is the greatest piece of machinery in the world, we should treat it right.

Experiments:

1. Make tests for the different kinds of nutrients.
2. Conduct an experiment with white rats or guinea pigs for diet and growth relative to food.
3. Show action of saliva on food.
4. Study a drop of blood under the microscope.
5. Study circulation in web of a frog's foot, if possible.
6. Demonstrate how we breath (bell Jar, toy balloons).

7. Demonstrate excretion -- breath on a mirror, in lime water, and place hand in a glass jar for a few minutes.

8. Demonstrate osmosis.

Pupil Activities and Reports:

1. Make out a day's menu for yourself.

2. Make a chart or graph showing percentage composition by weight of some common foods.

3. Sketch and label various organs of the body: (eye, ear, brain and spinal cord, digestive tract, circulatory tract, excretory organs, nerve cell).

4. Make a list of "cures" for indigestion or constipation, advertised over radio and in news and magazines. (May do this for other "suggested" remedies and reliefs).

References:

Baker and Mills, Dynamic Biology, Rand McNally & Co.

Bayles and Burnett, Biology for Better Living, Silver, Burdette.

Compton's Pictured Encyclopedia.

Conn and Budington, Advanced Physiology and Hygiene, Silver, Burdette.

Cockefair and Cokefair, Health and Achievement.

Greer, Foods and Home Making, Allyn & Bacon.

Hutchinson, Building Strong Bodies, Goughton, Mifflin Co.

Lake, Harley, Welton, Exploring the World of Science, Silver, Burdette.

Newmayer and Broome, The Human Body and Its Care.

Walters, F. M., Physiology and Hygiene, D. C. Heath & Co.

Wood and Carpenter, Our Environment, Book 3

Visual Aids: *Digestion of Foods, Erpi Sound film (16 mm)

*The Heart and Circulation, Erpi Sound film (16 mm)

*Food and Nutrition, Erpi Sound film (16 mm)

(*) Are available at the Board of Education

Teaching Outline

Topic 10. HEALTH AND DISEASE

Basic Purpose: Impress upon pupils the importance of tested scientific procedure in relation to health.

Facts and Problems:

1. Explore unscientific practices that have resulted from superstitious beliefs and reliance upon medical fakers.
2. Learn about the contributions of leading scientists to the conservation of health.
3. Develop a favorable attitude toward scientific procedure in the maintenance of public health.
4. Show a willingness to rely on the advice of properly trained health authorities.
5. Develop an individual sense of responsibility for keeping physically fit.

Experiments:

1. Examine prepared slides of bacteria under microscope.
2. Grow yeast and mold in laboratory.
3. Demonstrate growth of bacteria in petri dishes. May get culture and medium from State Board of Health.
4. Reports on trips to the city dumps and incinerators.

Pupil Activities and Reports:

1. Study the life of each: Leeuwenhoek, Pasteur, Lister, Jenner, Koch, Major Reed, and Lazear.
2. Fill out a chart listing twenty diseases, cause, means of distribution, and prevention.
3. Report on trips to Board of Health, Clinic).
4. Report on "Means of Protection against Bacteria."
5. Report on pamphlets from your city Health Department.
6. List ten rules for good health. Check your cooperation.
7. List ten causes for ill health.

References:

Baker and Mills, Dynamic Biology, Unit 3 and 4.

Bayles and Burnett, Biology for Better Living, Silver, Burdette.

Blount, The Science of Everyday Health.

Cockefair and Cokefair, Health and Achievement, Ginn & Company.

Compton's Pictured Encyclopedia.

Health Information Pamphlets, N. Y., Metropolitian Life Insurance Co.

Lake, Harley, Walton, Exploring the World of Science, pp. 606-682

Williams, The New Healthful Living, The MacMillan Co.

Wood and Carpenter, Book III, How We use and Control It. Topics 21 to 23.

Ziegler and Jacquette, Our Community.

Teaching Outline.

Topic 11. BETTERMENT OF HOME LIFE

Basic Purpose: Encourage a desire for better home life -- an understanding of the necessities, advantages, and methods of better homes.

Facts and Problems:

1. Plans for building a house.
2. Things that make an ideal home.
3. Building materials used in our houses.
4. Better arrangements -- efficiency saves steps, time, and labor.
5. Cleanliness in the home.
6. Safety in the home.
7. Labor saving devices in the home and convenience.

8. Better knowledge in structure of furniture, (posture, comfort).

9. Heating, ventilation, lighting, and plumbing in modern homes.

10. Attractive outside appearance of the home.

11. Financing plans for a home (Louisville companies).

Experiements:

1. Demonstrate building materials in laboratory.

2. Collect and examine building plans, from magazines.

3. Make some concrete.

4. Collect and demonstrate types of insulation.

5. Determine what roofing materials are fireproof.

6. Compare hardwoods and softwoods.

7. Learn how a water heater works.

8. Demonstrate the effects of insulation.

Pupil Activities and Reports:

1. Collect and state advantages of house plans.

2. Make a poster of heating devices for the home.

3. Draw the floor plans of a house in which you think you would like to live.

4. Draw a detailed floor plan for an efficient kitchen.

5. Make a list of the things you think could be done to make your present home more livable.

6. Discuss safety, in your home -- are there any fire hazards?

7. List the materials used in your school house.

8. Landscape, on paper, a home site.

9. Observe and record the construction of a building.

10. List heating systems for homes and state their merits.

11. List important items to consider in choosing a home as plumbing, drainage, and transportation.

12. Discuss reports from finance companies, home loan, etc.

References:

Carpenter, F. H., How the World is Housed, American Book Co.

Churchill and Wickenden, The House Owners Book, Funk & Wagnalls Co.

Dull, Mann, Johnson, Modern Science in Man's Progress.

How to Judge a House, U. S. Department of Commerce.

Hunter and Whitman, Problems in General Science.

Magazines: American Home, Better Homes and Gardens, House and Garden.

Phelan, O. B., The Care and Repair of the House.

Smith & Trafton, Using Science.

The Home-Owners Handbook, Scientific American Publishing Co.

Van Buskirk, Smith, Nowrse, The Science of Every Day Life.

Teaching Outline.

Topic 12. CONSERVATION OF NATURAL RESOURCES

Basic Purpose: Inculcate an appreciation of the importance of the conservation of our biologic wealth, as wildlife, forests, etc. Gain knowledge of conserving and improving human and natural resources.

Facts and Problems:

1. How we may conserve and improve our natural resources, such as: trees, forest, wildflowers, birds, wild animals, soil, water, air.

2. How we may conserve and may improve human life.

3. How science can help us keeping from wasting nature's wealth, (coal, oil, minerals).

4. Importance of crop rotation and its value to soil.

5. How we can be st enjoy our wild animals.

6. Explanation of the term extinct animal and causes.

7. How we make the best use of our forests.

8. Learn what is meant by balance of nature.

9. How steps in flood control are taken.

10. Why conditions in nature are continually changing.

Pupil Activities and Reports,

1. List animals that have become extinct.

2. List plants and animals that have been introduced into our country by man.

3. Work out with the help of your classmates, a conservation project to use in stopping soil erosion on your school ground. List the causes.

4. Make a list of the ways to save coal, oil, mineral.

5. Make a booklet about coal, including kinds of coal, uses, methods of mining. Use pictures from magazines.

6. Make a map of the United States showing the locations of the principal coal fields, (oil, minerals, forests).

7. Make a list of reasons why wild life is disappearing so rapidly in most places.

8. Get a copy of the game laws in your state and study them carefully -- discuss with class members.

9. Make out a chart showing what becomes of the wood in a tree.

References:

Beauchamp, Mayfield, West, Science Problems.

Bruere, M. B., Taming our Forests, U. S. Department of Agriculture.

Butler, O. M., American Conservation in Pictures and Story, American Forestry Assn.

Chase, S., Rich Land, Poor Land, McGraw, 1936

Hotchkiss, W. O., The Story of a Billion Years, Williams, 1932.

Howard, L. O., The Insect Menace, Appleton-Century

Pamphlet Series, by Maud and Miska Petersham, The Story Book of Oil, Story books on Iron and Steel, Coal, etc.

Powers, Neuner, and Bruner, Man's Control of His Environment.

Pamphlets from Government Bureaus; Mining, Forestry.

Sharpe, C. F. S., What is Soil Erosion? Government Printing Office, 1938.

Teaching Outline

Topic 13. PROBLEMS OF THE CONSUMER

Basic Purpose: All youth need to know to purchase and use goods and services intelligently, understanding both the values received by the consumer and the economic consequences of their acts.

Facts and Problems:

1. How accurate is your buying?
2. How do you make up your mind when buying?
3. How may you base your buying on sure, accurate knowledge, not guesswork?
4. How may you understand value of standardization in industry and commerce?
5. How may you learn to use labels in shopping?
6. How may you find services of testing and rating agencies?
7. What is the importance of looking toward tomorrows labeling?

Pupil Activities and Reports:

1. Find out the important things to know about your products. eg. Foods; tenderness; motor oils; viscosity.
2. Collect "raw materials" to discuss in laboratory; collect labels, tags, stamps, pamphlets.
3. Write to proper organizations and authorities for the background information you need. Also use the

information you can find in textbooks, pamphlets, and other references.

4. Analyze in detail what the labels tell you -- compare various kinds of labels -- select your best.

5. Develop a vocabulary of the standard terms used on labels of your product. Make a working dictionary for yourself.

6. Find out what lies behind labels; laws, standards, responsibilities.

7. Prepare a report to give the class the benefit of your learning.

8. Write a report on the Pure Food and Drug Act, passed by Congress in 1906.

9. Write a report on "Adulteration of Foods" listing kinds of food and manner of adulterating. Results.

References:

American Dental Association, 222 E. Superior St., Chicago.

American Medical Association, 535 N. Dearborn St., Chicago.

Household Finance Corporation, 919 N. Michigan Ave., Chicago, Household Equipment, Household Refrigerators, Electric Vacuum Cleaners, Consumer's Research Bulletins; Consumer's Union Reports.

Information labeling; The National Consumer-Retailer Council's Booklet, 8 W. 40th. St., New York City, 25¢

The Illuminating Engineering Society.

The National Bureau of Standard, Washington, D. C.

The Place of Science in the Education of the Consumer, The Consumer Education Study, 1201 Sixteenth Street, N. W., Washington, D. C., 1945.

Using Standards and Labels; A Problem of the Modern American Consumer, Consumer Ed. Series, Unit No. 6, 1201 Sixteenth Street, N. W., Washington, 6, D. C.

SUMMARY OF CONCLUSIONS.

The purpose of this study has been to offer a tentative course of study in ninth grade general science for the Louisville Public Schools and to suggest ways for its improvement. In order to accomplish this purpose a background was first presented which consisted of a brief history and development of objectives used in courses of study, methods used in selection of objectives, and a proposed list of objectives selected by the writer.

This proposed list was selected by employing analytical procedures in dealing with objectives. Analysis and evaluation of objectives listed in textbooks, courses of study, and educational authorities. As a complement to this background, a questionnaire study was made of the choice of objectives by ninth grade general science teachers in the Louisville Junior High Schools.

Conclusions Drawn From the Historical Developments of Objective:

From the historical sketch the following conclusions were gleaned regarding objectives for a tentative ninth grade course of study in general science. The writer recognizes the aim of science teaching to be contributory to the aim of educations; viz, life enrichment. He recognizes the objectives of science teaching to be the functional understanding of the major generalizations of science and the development of associated scientific attitudes. Education is primarily for adult life, not for child life.

Conclusions Drawn from the Questionnaires:

From the questionnaire studies it is obvious that the use of objectives should be included in a ninth grade science course

of study. It is evident that textbook authors, expert opinion and course of study organizers include many objectives of high frequency. It is also obvious that teachers have a knowledge of objectives and pupils of junior high school age are thinking in terms of emotionalized aims or standards.

The objectives of a course of study are the guide posts that indicate the direction in which the program is pointed. In order to give such direction clearly and forcibly, the writer has selected a clearly stated set of objectives to be offered in this proposed course of study in ninth grade science.

The Present Course of Study - Status:

From a review of the Works' Survey we find the following report: the ninth grade course of study in general science has very largely omitted reference to functional aims; in line with the philosophy of general science teaching, the subject matter in grade nine is more specialized; the units are not effectively related to one another; effectiveness of instructinn could certainly be increased by further attention to the immediate environment; several important topics are conspicuously absent.

Conversations with the general science teachers indicate that they felt a need for a thorough revision of the science curriculum. The program of science instruction in Louisville needs a more progressive and dynamic extra-curricular program.

Contents:

Certain definite tendencies were also noted in proposing content materials for the course of study in ninth grade

general science. Both expert opinion and contemporary practice point to the trend of including a shift in emphasis from subject matter to the child in the past fifty years. Emphasis is placed on scientific methods and attitudes of thinking. Also there is a change in the kind of science to be taught in the junior high school — an increased tendency to base this science on the experiences and activities of children rather than printed page. Then the present trend in organization of subject matter on the unit or topic plan.

Unit Organization:

There is a wide diversity of opinion and a multiplicity of practices regarding what should rightfully be considered a unit of instruction. However, the course of study in ninth grade general science in the Louisville Public Schools conceives of the unit in its broadest sense of a mere logical division of subject matter. Real life-functioning units which start with the needs and interests of the pupil are almost non-existent. Only complete and revolutionary reorganization of the curriculum can manifest the best traits of the tendency toward real unit instruction.

Attitudes and Ideals:

A final trend more readily evident in theory than in practice advocates the assumption by the school of the responsibility for something more than the teaching of facts and declares that the school should also attempt to construct in the pupils emotionalized attitudes and ideals. While almost all educators would subscribe to this idea, it was found by the Works' survey that much of the emphasis in the Louisville Public Schools ninth grade general

is upon facts and little attention has been given to the forming of attitudes and ideals which will contribute to the social well being. The teacher-pupil relation is greatly overworked. Real initiative on the part of the pupil and wholesome cooperation among pupils are not provided.

This summary contains only the more general recommendations and criticisms. The more detailed comments appear in the various chapters which constitute this study.

Individual Differences:

Writers have long emphasized the necessity for providing for the individual. However, the writer has not made an effort to meet this provision because of the magnitude of its scope. He realizes it is sufficient in importance and size to become a subject for a separate study or thesis, and should be treated in that respect.

Suggestions for Further Study:

It was the assumption of this thesis that the criteria for proposing a tentative ninth grade course of study in general science in the Louisville Public Schools should be drawn from three sources; opinions of experts; accounts of practices in schools elsewhere, comparable in size with Louisville; and child interest. Since these are not the only sources from which criteria can be obtained, it would be very much worth while if a similar study could be made with criteria obtained from such sources as the scientific needs and interests of children on the ninth grade junior high school age. This could well be a study for a teacher committee on the revision of a ninth grade general science course of study.

BIBLIOGRAPHY

BIBLIOGRAPHY

BOOKS AND SURVEY REPORTS

American Council on Education, What the High Schools Ought to Teach, Washington, D. C., 1940.

Billett, R. O., Fundamentals of Secondary-School Teaching, Houghton Mifflin Co., Boston, 1940.

Bobbitt, F., How to Make a Curriculum, Houghton Mifflin Co., 1924.

Bobbitt, F., The Curriculum of Modern Education, McGraw-Hill Co., 1941

Bossing, N. L., Progressive Methods of Teaching in Secondary Schools, Houghton Mifflin Co., 1935.

Burton, William H., The Guidance of Learning Activities, D. Appleton-Century Co., 1944.

Caswell, H. L., and Campbell, D. S., Curriculum Development, American Book Company, Boston, 1935.

Curtis, F. D., Third Digest of Investigations in the Teaching of Science, P. Blackiston's Son & Co., 1939.

Dewey, John, Experience and Education, Macmillan Co., New York, 1938

Downing, Elliot R., An Introduction to the Teaching of Science, University of Chicago Press, 1934.

Draper, W. M., Principles and Techniques of Curriculum Making, D. Appleton-Century Co., New York, 1936, Chaps.4,5,6

Educational Policies Commission, Education for All American Youth, 1944, N.E.A. Washington, D. C.

Giles, H. H., McCuthen, S. P., Zechiel, A. N., Exploring The Curriculum, Harper and Bros, N.Y., 1942.

Gwynn, J. Minor, Curriculum Principles and Social Trends, Macmillan Co., 1943.

Harap, H., The Technique of Curriculum Making, Macmillan Co., 1943.

Harap, Henry (Ed.), The Changing Curriculum, D. Appleton-Century Co., 1937.

Hunter, Geo. W., Science Teaching at the Junior and Senior High School Levels, American Book Co., N.Y., 1934.

Judd, Charles H., Education and Social Progress, Harcourt, Brace and Co., N. Y., 1934.

Kilpatrick, W. H., Education and the Social Crisis, Liveright Pub. Corp., N.Y., 1932

Leary, Bernice E., A Survey of Course of Study and Other Curriculum Materials Published Since 1934, U. S. Dept. Interior, Office of Ed., 1937, Bulletin, No. 31, Washington, D. C.

Lee, J. M. and Lee Dorris M. (Potter), The Child and His Curriculum, D. Appleton-Century Co., 1940

Monroe, Walter S. (Editor), Encyclopedia of Educational Research, Macmillan Co., 1941.

Morrison, Henry C., The Practice of Teaching in the Secondary-School, Univ. of Chicago Press, Chicago, 1931.

National Society for the Study of Education, Thirty-First Yearbook, Part I, "A Program for Teaching Science," Public School Publishing Co., 1932, Bloomington, Ill.

National Society for the Study of Education, Twenty-Sixth Yearbook Part II, "The Foundation of Curriculum-making," 1926, Public School Publishing Co., Bloomington, Ill.

Norton, J. K., and Norton, Margaret, Foundations of Curriculum Building, Ginn & Co., 1936

Progressive Education Association, Commission of Secondary School Curriculum, Committee on the Function of Science in General Education, Science in General Education, Appleton-Century, 1938

Reeder, Ward G., How to Write a Thesis, (Ohio State University,1930) by Public School Pub. Co., Bloomington, Ill.

Risk, Thomas M., Principles and Practices of Teaching in Secondary-Schools, American Book Co., 1941

Spears, Harold, The Emerging High-School Curriculum and Its Direction, American Book Co., N.Y. 1940

Well, L. B., (et al.)High School Curriculum Reorganization, The North Central Association, Ann Arbor, Michigan, 1933.

Works, George A., Survey Report of the Louisville Public Schools, Louisville, Ky., 1943

BULLETINS AND PERIODICALS

National Association of Secondary School Principals, Washington, D. C., Planning for American Youth, 1944

National Survey of Secondary Education, Monograph, Bulletin No. 22, Supt. of Documents, Washington, D. C,, Beauchamp, W. L., Instruction in Science, 1933

Review of Educational Research, N.E.A., Washington, D.C.

Curtis, Francis D., "Teaching of Science in Grades VII, VIII, IX," October 1945.

Heyl, H. H. and Young, Wm. E., "Curriculum," June, 1945

School Science and Mathematics, Milwaukee, Wis.

Davis, Ira C., "Trends in Science Teaching," May, 1942

Gersbacher, W. M., "Are General Science Courses Meeting the Needs of the High School Student?" Jan. 1942

Hunter, W. W., and Parker, Alice L., "The Subject Matter of General Science," Dec. 1942

Jones, F. T., "Trends of Emphasis in Science Subjects In Tennessee Accredited Secondary-Schools," Oct. 1941

Pettit, D. D., "The Content of Junior High School Science," October, 1940.

Powers, S. R., "Preparation of Science Teachers to Contribute to General Education," April 1942

Supplementary Education Monograph, No. 31, University of Chicago Press, Bobbitt, Franklin, "Curriculum Investigations," Chaps. I to XI, 1939

The School Review, University of Chicago Press, Chicago, Ill.

Matson, V. F., and Pierce, P. R., "Science in the Core Curriculum," Feb. 1946.

The Teachers College Record, Columbia University, N.Y.
Caswell, H. L., "Scientific Aids to Instruction," Mar, 1946

Eby, Kermit, "Labor's Program for Teachers in the Postwar World," Oct. 1945.

Kross, Anna M., "Youth and the Postwar Period," Oct, 1945

U. S. Department of Interior, Office of Education, Bulletin No. 31, Supt. of Documents, 1937. Washington, D. C., "A Survey of Courses of Study and Other Curriculum Materials Published Since 1934."

COURSES OF STUDY

Arkansas, State, Tentative Course of Study for the Arkansas Schools, Second Section, Bulletin No. 5, Little Rock, State Department of Education, 1936

Atlanta, Georgia, City Schools, (Junior High School) 9th Grade Science, 1938

Berkeley Public Schools, California, Outline for Science, Junior and Senior High Schools, 1942

Cincinnati, Ohio, Public Schools, Grades 9 and 10 Science, 1943

Cleveland, Ohio, High School Bul. No. 12, Course of Study in General Science, 1930

Indiana High School, General Science, Bul. No. 100-E Dept. of Public Instruction, Indianapolis, 1933

Indianpolis, Indiana, Course of Study in General Science, 1935

Jersey City, New Jersey, Public Schools, Syllabus in General Science, Sept. 1933

Louisville, Kentucky, Course of Study in Ninth Grade General Science, April, 1939

Minneapolis, Minnesota, Public Schools, Handbook on The Teaching of Science, Grades 7-8-9-, Board of Ed., Sept. 1941.

Oklahoma State High Schools, Course of Study in Science, Department of Education, Bul. No. 129, 1931

San Diego, California, City Schools, Course of Study for Junior High Schools, Board of Education, 1943

San Francisco, California, Senior High School, Grades 9, 10, 11, 12, 1942

State of Washington, Olympia, Science and Mathematics, State Department of Ed., 1930

APPENDIX

APPENDIX A

Sample Copy of Teachers' Questionnaire on Objectives

INVESTIGATIONS IN THE TEACHING OF GENERAL SCIENCE IN THE NINTH GRADE

Purpose: To determine, as far as possible, which objectives listed on next page, should receive the major emphasis in governing the choice of subject matter in a ninth grade general science course of study.

This list has been determined by a selection evaluated by analysis from:

Evaluated list of objectives:

1 - Consensus of opinion of persons who are ranked as leaders in curriculum construction.

2 - Standards set by courses of study in other schools and cities - comparable in size with Louisville, e.g. (Atlanta, Indianapolis, etc.).

3 - Objectives determined by contents of existing texts - papers written by leaders working in the field of science teaching - and from authoritative books on curriculum construction.

To teachers of ninth grade general science in the Louisville High Schools.

Please check any of the following twenty objectives, which appear desirable in a General Science Course of Study.

Make a check ( ) in one of the four columns, as you would rate the objectives as explained above.

Please add any additional objectives you choose, at the bottom of the sheet, or on back of the sheet; also add any comments.

It is not necessary to sign your name

OBJECTIVES OF SCIENCE TEACHING

BASED ON ANALYSIS OF TWENTY-SIX AUTHORITATIVE SOURCES

Science teaching should contribute to these skills or life activities to the degree checked:	Very Much	Some	Very Little	Not Any
1. Ability to do critical thinking				
2. Ability to solve problems, scientifically				
3. Appreciation of benefits of science				
4. Cooperation				
5. Command of fundamental processes				
6. Citizenship activities				
7. Desire for further knowledge				
8. Ethical character				
9. Health activities				
10. Knowledge to satisfy natural interest				
11. Knowledge of environment (understanding)				
12. Leisure occupation				
13. Open-mindedness				
14. Preparation for adult life				
15. Scientific interests				
16. Scientific thinking, habit of				
17. Social attitudes				
18. Vocational preparation (self-support)				
19. World mindedness				
20. Worthy home membership				

List below any additional objectives

1.				
2.				
3.				
4.				

Not necessary to sign your name

MATTER, ENERGY, WORK

(Time Allotment - 18 Periods)

GENERAL CONCEPT. Energy moves the matter in the world and in so doing accomplishes work.

CONTRIBUTORY CONCEPT I. The world is made up of matter.

Understandings

1. Matter is anything that occupies space.

2. Matter can be weighed.

3. Each kind of matter is different from every other kind of matter.

4. Matter can be divided into two groups, elements and compounds. Elements are simple. They cannot be broken up into other kinds of matter. Compounds can be broken up into elements.

5. All matter is made up of molecules.

6. Any kind of matter may take three forms: solid, liquid, and gas. In a solid the molecules are close together and moving slowly, in a liquid they are farther apart and moving faster, in a gas they are very far apart and moving very rapidly.

CONTRIBUTORY CONCEPT II. Energy is that which moves matter.

Understandings

1. Energy is ability to do work. It pushes or pulls matter.

2. There are several kinds of energy: heat, light, electricity, chemical action, motion.

3. One kind of energy can be changed into another kind.

CONTRIBUTORY CONCEPT III. Work is the movement of matter.

Understandings

1. Work is done when matter is moved.

2. Handicaps to work are weight, friction and inertia.

3. Weight is our measure of gravity.

4. Friction is the resistance to rolling or sliding one piece of matter over another.

5. Inertia is the tendency of matter in motion to remain in motion and of matter at rest to remain at rest.

GENERAL SCIENCE - Grade 9

SUGGESTIONS FOR THE TEACHER

SHEET 1 WHAT ARE TWO GENERAL PROPERTIES OF MATTER?

Ref: "What Matter is Like"--p. 96.
Wood-Carpenter, Book III, Sec. 27 in 1937 edition.
Lake-Harley-Welton-- Exploring the World of Science --pp. 248-253.

Part 1 Assign for home preparation for this sheet the study of "What Matter is Like"--p. 96. The term "property" should be thoroughly discussed so that the pupils get a clear understanding of the scientific meaning of the word.

Part 2 Do Experiment 25, p. 106, and have the pupils write it up on the work sheet. Explain exactly what is wanted under each heading.

Part 3 Have the pupil write the answers to the following questions on the back of the work sheet.

1. Why did the water rise in the cylinder?
2. Is water matter? Give a reason for your answer.
3. Could the stone and the water occupy the same space at the same time? Why?
4. Did the stone have weight?
5. What is matter.

Part 4 If time permits discuss with the class the impossibility of putting two pieces of matter in the same place at the same time. Illustrate with two books in the same place, filling a bottle with water when it is already full of air, driving a nail through a board or a needle through cloth. Show that the air must come out to let the water in, that the nail and needle simply push the fibers apart. Bring out the fact that two kinds of matter cannot occupy the same space at the same time.

WHAT PRINCIPLE HAS BEEN DEVELOPED IN THIS SHEET?

1. Matter is anything that occupies space or can be weighed.

9 GRADE - GENERAL SCIENCE

Name_____ WORK SHEET 1

WHAT ARE TWO GENERAL PROPERTIES OF MATTER?

MATERIALS:

In the space above draw the cylinder with the water in it, draw the stone, and draw the cylinder again with both the water and the stone in it.

DIRECTIONS: Tell in three sentences what you did.

RESULTS: Record your results.

CONCLUSION: Answer the questions.

GENERAL SCIENCE - Grade 9

SUGGESTIONS FOR THE TEACHER

SHEET 2 ARE ANY TWO KINDS OF MATTER ALIKE?

Ref: "What Matter is Like"--pp. 96-97.

Part 1 A number of articles should be presented to the class for observation. By using wood, a rubber band, paper, copper wire, cloth, tinfoil, glass, etc., you can show that kinds of matter are different. Describe each of these articles. The rubber band has a distinguishing characteristic, the elasticity. The wood is hard and will burn. The paper will tear and will burn. The wire will bend, but will not burn, etc.

Part 2 To demonstrate matter is different, even though it looks alike, you may use water, acid, and ammonium hydroxide. Pour a small quantity of each in a test tube. Test each solution with both red and blue litmus. Pure water will have no effect on litmus. The acid turns litmus red. The ammonium hydroxide turns litmus blue.

WHAT PRINCIPLE HAS BEEN DEVELOPED IN THIS SHEET?

1. Each kind of matter is different from every other kind of matter.

Name_____ WORK SHEET 2

ARE ANY TWO KINDS OF MATTER ALIKE?

Questions	Answers	
1. List ten kinds of matter in this room.	1.	6.
	2.	7.
	3.	8.
	4.	9.
	5.	10.
2. Name four kinds of matter that will not burn.	1.	3.
	2.	4.
3. Name four kinds of matter that will burn.	1.	3.
	2.	4.
4. If all of these will burn, how can you tell them apart?		
5. Name two kinds of matter that are elastic.		
6. List six words that describe some property of matter.	1.	4.
	2.	5.
	3.	6.
7. Name three liquids that look like water.		
8. How did you know these were not water?		

WHAT PRINCIPLE HAS BEEN DEVELOPED IN THIS SHEET?

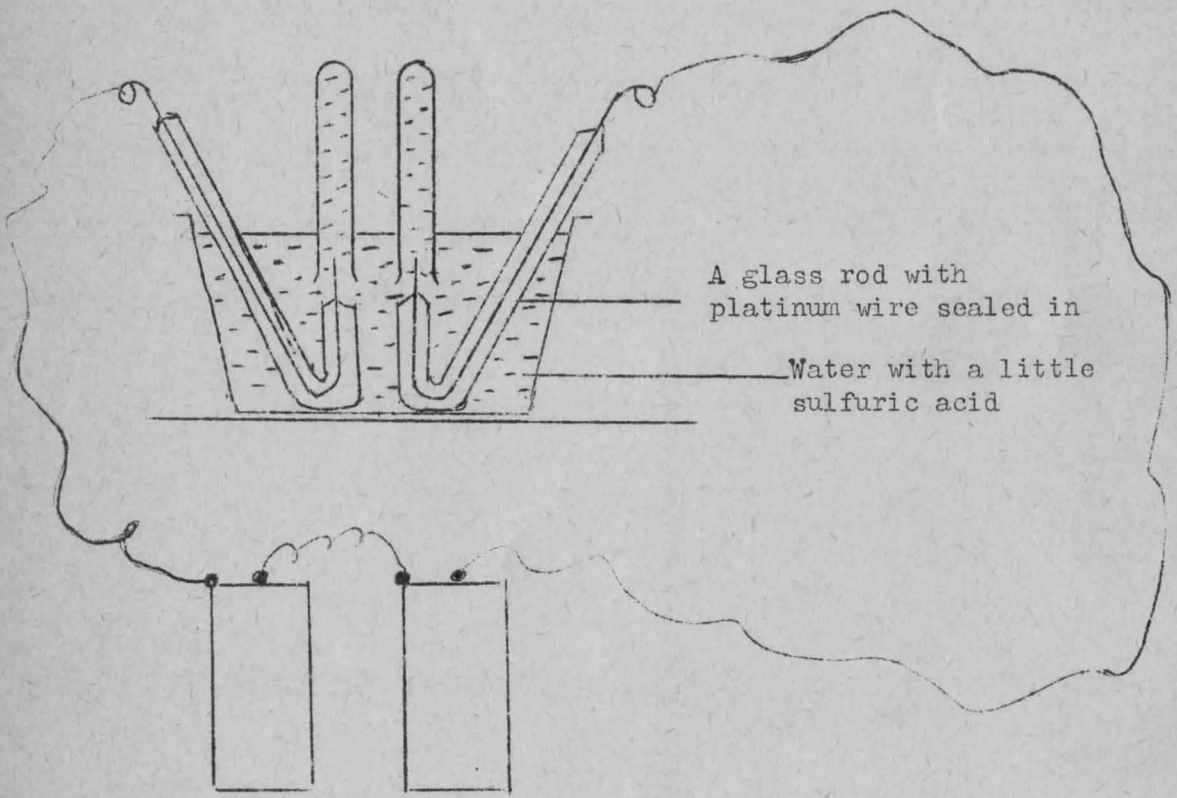
GENERAL SCIENCE - Grade 9

SUGGESTIONS FOR THE TEACHER

SHEET 3 TWO CLASSES OF MATTER

Ref: "Elements, Compounds, Mixtures"--pp. 98, 99, 100.

Part 1 The above reference should be assigned for home work at the previous period. Then discuss the topic thoroughly. Show samples of elements and compounds. Heat some wood in a test tube. Show the carbon and water. Heat some elements in test tubes, such as carbon, iron, copper. Burn a piece of magnesium and examine the white magnesium oxide obtained. Bring out the fact that a compound does not look like its constituent elements. Do the electrolysis of water to show how the compound, water, can be decomposed into oxygen and hydrogen. Below is a simple apparatus for the experiment. See that the pupils understand that there are these two classes of matter; but that mixtures can be made. Call attention to the exact proportions in a compound.



WHAT PRINCIPLE HAS BEEN DEVELOPED IN THIS SHEET?

1. There are two classes of matter, elements, which cannot be broken up into other kinds of matter, and compounds, which can be broken up into elements.

9 GRADE - GENERAL SCIENCE

Name_____ WORK SHEET 3

TWO CLASSES OF MATTER

Questions	Answers	
1. What is an element?		
2. What is a compound?		
3. Name six compounds you use in daily life.	1.	4.
	2.	5.
	3.	6.
4. Name six elements you have seen.	1.	4.
	2.	5.
	3.	6.
5. Give two ways by which you could tell a mixture from a compound.	1.	
	2.	
6. Make a labeled diagram at the right of the electrolysis of water.		
7. How does this show that water is a compound?		

WHAT PRINCIPLE HAS BEEN DEVELOPED IN THIS SHEET?

GENERAL SCIENCE - Grade 9

SUGGESTIONS FOR THE TEACHER

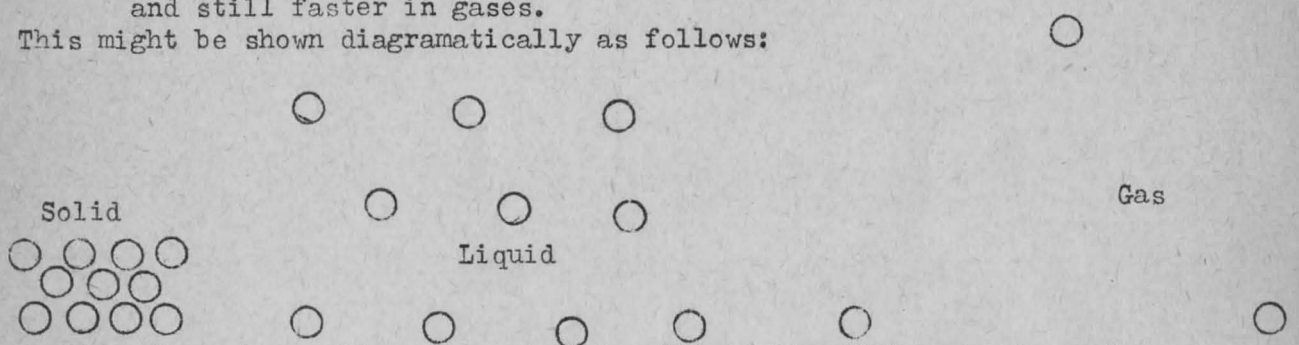
SHEET 4 OF WHAT IS MATTER MADE UP?

Ref: "What Matter Is Built Of"--pp. 104, 105, 106.
Morton Mott-Smith--This Mechanical World--pp. 26-29.

Part 1 It is suggested that the teacher explain the molecular theory bringing out the following points:

(1) All matter is made up of small particles called molecules. All the molecules of one kind of matter are alike.
(2) In a solid these molecules are very close together, in a liquid they are farther apart, and in a gas they are still farther apart.
(3) The molecules are moving, slowly in solids, faster in liquids, and still faster in gases.

This might be shown diagramatically as follows:



Explain that when matter changes from solid to liquid to gas, the molecules move faster and push farther apart, and when it changes from gas to liquid to solid, the molecules move more slowly and come closer together.

Part 2 Let the pupils study section "What Matter Is Built Of", pp. 104-105. Do Experiment 36, p. 111. Discuss both with the class.

Part 3 Demonstrate the three forms of water. Heat one small crystal of iodine in a test tube to show how much space is used by a gas, because the molecules push so far apart. Put some melted paraffin in a test tube. Then freeze it with dry ice to show contraction on solidifying, or freeze some mercury the same way.

WHAT PRINCIPLES HAVE BEEN DEVELOPED IN THIS SHEET?

1. Matter is made up of molecules.
2. In a solid the molecules are close together and moving slowly. In a liquid they are farther apart and moving a little faster. In a gas they are very far apart and moving very rapidly.

9 GRADE - GENERAL SCIENCE

Name_____ WORK SHEET 4

OF WHAT IS MATTER MADE UP?

Questions	Answers
1. What is a molecule?	
2. Is one molecule of sulfur like another molecule of sulfur?	
3. Is a molecule of sulfur like a molecule of water?	
4. Can we have anything smaller than a molecule of water that looks like water?	
5. What are the molecules in ice doing?	
6. What are the molecules in water doing?	
7. What are the molecules in steam doing?	
8. What would happen if we tried to change water to steam by heating it in a test tube with a stopper in it?	
9. Explain why this happens.	
10. Using a dot to represent a molecule, make drawings in the space below to represent a solid, a liquid, a gas.	

WHAT PRINCIPLES HAVE BEEN DEVELOPED IN THIS SHEET?

GENERAL SCIENCE - Grade 9

SUGGESTIONS FOR THE TEACHER

SHEET 5 WHAT IS ENERGY?

Ref: pp. 137-140.
Meister--Energy and Power--pp. 2-8.

Part 1 Assign for home study at the previous period pp. 137-140.

Discuss locomotion and other simple manifestations of energy in man and animals. Discuss energy manifestations in plants such as raising water, splitting rocks.

Discuss energy display in wind, waves, volcanoes, light from heavenly bodies and motion of stars. Bring out the fact that in all the above cases matter has been pushed or pulled. Energy is the ability to do work. It pushes or pulls matter. If there were no energy there could be no movement, not even molecular movement.

Part 2 Recall from the Grade 7 and 8 course how energy is released on oxidation, Air and Fire Units, how living things get energy from oxidation of foods. Then discuss the difference between the movement of living and non-living things. Living things can move themselves with the energy produced in their bodies. Non-living things must have energy applied to them, in order to move them.

Man is the only living creature that can make use of energy not released in his own body. He burns fuel, harnesses the wind, water and even the sun to supply energy for moving heavy matter. Examples: gasoline engines, steam engines, electric motors, etc., for doing the world's work of building, hauling, etc.

WHAT PRINCIPLE HAS BEEN DEVELOPED IN THIS SHEET?

1. Energy is ability to do work. It pushes or pulls matter.

9 GRADE - GENERAL SCIENCE

Name_____ WORK SHEET 5

WHAT IS ENERGY?

Questions	Answers
1. Tell one way a cave man uses energy.	
2. Tell one way an animal uses energy.	
3. Tell one way a plant uses energy.	
4. Name three ways non-living forces of nature display energy.	1.
	2.
	3.
5. Give one example of an energy display beyond our earth.	
6. In the above examples how did you know energy was produced?	
7. What would the earth be like if there were no energy?	
8. What is the difference between the movement of living things and non-living things?	
9. What is the difference between the way man uses energy and the way other living things use energy?	

WHAT PRINCIPLE HAS BEEN DEVELOPED IN THIS SHEET?

SUGGESTIONS FOR THE TEACHER

SHEET 6

KINDS OF ENERGY

Ref: "Where We Get Energy"--pp. 140-141.
Wood and Carpenter--Book 3--Section 36 in 1937 edition.

Part 1 After the class has studied the references recall to them the Grade 8 sheet on the sun as the source of all the energy on the earth. Discuss its relation to the making of starch in plants and to the use of this starch as food by animals, or its use as fuel when burned.

Part 2 Discuss different kinds of energy such as electrical, chemical, heat, light and the energy of motion. Show that each moves matter. Examples: a moving hammer drives the nail in, electricity runs a street car, burning coal changes water to steam and in so doing lifts the steam shovel, a stick of dynamite is capable of moving a large mass of matter, gasoline can move an automobile, light will turn the radiometer. (Show it.)

Part 3 Discuss the "Law of Conservation of Matter", bringing out the fact that energy is neither created nor destroyed. It simply changes from one kind to another. Discuss examples of changes of energy from one kind to another. Follow the energy changes involved in passing from sunlight to an electric bulb.

WHAT PRINCIPLES HAVE BEEN DEVELOPED IN THIS SHEET?

1. The sun is the source of all energy.
2. Heat, light, electricity, chemical energy and energy of motion are different kinds of energy.
3. Energy can be changed from one kind to another.
4. Energy cannot be created or destroyed.

9 GRADE - GENERAL SCIENCE

Name_____ WORK SHEET 6

KINDS OF ENERGY

Questions	Answers	
1. What is the source of all energy?		
2. Explain in three sentences how the energy you use in running is obtained from this source.		
3. Name four kinds of energy.	1.	3.
	2.	4.
4. Explain why each is a kind of energy.		
5. Can energy ever be created?		
6. Can energy ever be lost?		
7. What happens to it when it seems to be lost?		
8. What is the name of this law about energy?		
9. State the law.		
10. Take the four kinds of energy named in question 3 and show how each can change into another kind of energy.		

WHAT PRINCIPLES HAVE BEEN DEVELOPED IN THIS SHEET?