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A STUDY OF THE CURRICULUM DESIGN PROCESS
IN THE FIELD OF SCIENCE FOR
INTERMEDIATE GRADES OF HILTON CENTRAL SCHOOL
1959 - 1962

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SUBMITTED IN PARTIAL FULFILLMENT OF REQUIREMENTS LEADING TO THE DEGREE OF
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CHAPTER I
BACKGROUND

The years since World War II have been characterized by more intense concern for and more insistent criticism of American educational endeavor than any previous period. The reasons for this are not far to seek: Scientific and technological revolution, the responsibilities of world leadership, personnel shortages in the most critical professional fields, a population increasingly the product of twelve or more years of formal education, a suddenly and unexpectedly advanced birth-rate, and, perhaps most important, growing moral anxieties—these and other factors make it clear that an intensive re-examination of education was inevitable, unquestionably necessary, and, when properly conceived, altogether healthy.

Public Education In America

Public education in America is generally recognized as a state function. In New York State, as in other states, however, the practice has been to delegate much of the responsibility to the local school boards. As a result, schools are not identical. They differ according to the needs of the particular community and children. Nevertheless, there must be general agreement as to the functions that all schools perform and a general framework for the development of programs applicable to all schools. Good schools everywhere in the United States have many features in common.2

2. The University of the State of New York, A Design for Improving Elementary Education in New York State, p. 1.
Changes Affecting Curriculum Design

The program of elementary education is not static but is constantly changing under the influence of two forces:

1. Changes in society and in world relationships. Society itself is continuously changing—locally, nationally, internationally. There is general agreement that the tempo of this change has been increasing. Inventions, emphasis on democratic citizenship, the trend toward greater industrialization, new patterns of community life, and broadening world interests inevitably affect the program of elementary education. Good schools cannot be static in a society which is dynamic. The welfare of the society and the effective learning by pupils depend upon keeping the program in step with these changes.

2. Increase in knowledge of how children grow and learn. Knowledge of how children grow and learn is constantly increasing. Far more is known today than was known a generation ago about how children differ from one another, about those characteristics common to all children, about the ways children develop, about the conditions influencing their behavior, and about how they learn. This increase in knowledge makes it possible to teach children more effectively and to prepare them for living in a changing society.

1. The University of the State of New York, op. cit., p. 2.
Society Provides The Broad Guides For Accomplishment

Society creates and maintains schools in large part for its own preservation and enhancement. It sets for the school the task of developing in children its ideals, customs, and procedures. Society, therefore, truly determines the aims and purposes of an educational program and indicates the areas in which accomplishments are expected.

In some instances society may impose very specific requirements, but more frequently it sets its aims in broad terms. An important task of the school is to restate the broad aims of society in terms of specific objectives that can more readily be organized for learning. Two of the chief problems involved in stating specific expectations of accomplishment are to keep them relevant to the broad aim of society from which they stem and to state them in terms of a behavior or an understanding which can be observed in children or inferred from observation. These specific expectations should also be stated in such a way that they are recognized as steps toward attaining the goals society has set.¹

A Broad Concept of The Curriculum

The term "curriculum" has come to mean all the experiences of children which are utilised by the school. These experiences are used not only to help children

¹. The University of the State of New York, op. cit., p. 2.
achieve mastery of subject matter, but also to help them toward emotional stability, social competency, desirable personal development, optimum health and physical development, creativeness, and appreciation. In the main, this broader concept of curriculum reflects changes in our social life which make new requirements of adults. The broader curriculum better prepares children to meet these new demands. Since parents' and citizens' groups and educators alike realize the need for an expanded curriculum, most schools have already revised their programs in this direction.¹

Background of Study For Curriculum Development

Although great curriculum uniformity is not characteristic of American schools, there are similarities to be noted in the types of curriculum experiences, their patterns of organization, and, despite diversity of provision and emphasis, their relationship to certain broad categories or areas.

It has been said that the curriculum is the sum total of school. Therefore, whatever the teacher does to motivate and direct pupils' experiences and learning must be considered in curriculum planning. The fallacy of this is that sometimes teachers must plan the activities to only reading, writing, speaking, and listening because of limitations of facilities, tradition, and imagination. To round

¹. The University of the State of New York, op. cit., p. 2.
out the activities in the preceding sentence Saylor and Alexander add the basic sensory activities of touch, taste, and smell.¹

Range of Possible Activities

**READING:** Books, magazines, pamphlets, newspapers, letters, signs and directions, charts, graphs, maps

**WRITING:** Letters, stories, poems, essays, advertisements, newspaper articles, reports, minutes, summaries, outlines, notes

**SEEING:** Pictures, paintings, photographs, drawings, filmstrips, slides, movies, television, museum pieces, demonstrations, animals, plants, nature specimens, scientific apparatus, tools, machinery, farms, businesses, industries, institutions, processes, persons, groups, dramatic presentations

**LISTENING:** Directions, stories, conversation, discussions, speeches, plays, music recordings, radio, movies

**TALKING:** Answering and asking questions, conversation, reporting, discussing, debating, speaking formally

**CREATING:** Drawings, paintings, clay modeling, woodworking, metalworking, cartoons, cooking, clothing, murals, floats, playhouses, friezes, maps, charts

**PLAYING:** Dramatic play, rhythms, games, dances

**PRACTICING:** Reading, writing, spelling, number skills, memorizing, study skills, music skills, art skills, use of tools and machines, typing, cooking, sewing, farm operations

PROBLEM-SOLVING: Reflecting, experimenting, demonstrating, calculating, evaluating, generalizing.

Classroom Activities

1. Reading
2. Writing
3. Oral reporting
4. Projects

All-school Activities

1. Assembly programs
2. Visual-arts room
3. Library
4. Study hall
5. Cafeteria
6. Gymnasium
7. Playground

Out of School Activities

1. Churches
2. Theaters
3. Libraries
4. Museums
5. Parks
6. Social centers
7. Homes

Thus the experiences which may be included in the curriculum are necessarily limited only by the scope of activities appropriate and possible for children and by the resources of school and community. In practice, they may also be limited by parent indifference or opposition, restrictive school policies and schedules, costs, size of groups and of rooms, and by the lack of training, experience, and imagination of the teachers.

Appraising the Curriculum Practice

To identify problems in curriculum practice an instrument is needed to give some basis for appraising the

2. Ibid., p. 9.
curriculum. The check list shown in table 1 is a guide that if applied in a general nature to the school's total pro-
gram, should yield important information as to the appro-
priateness of the curriculum.

Table 1

A Check List for Appraising a School's Curriculum

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<th>Criteria</th>
<th>Appraisal items to note strengths - weakness - needs</th>
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<tr>
<td>I. A good curriculum develops social understandings</td>
<td></td>
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<tr>
<td>A. The school program includes opportunity for pupils to participate in government and other institutional functions of the school.</td>
<td></td>
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<tr>
<td>B. Social studies and other classes emphasize understandings of social backgrounds and problems as appropriate to pupils' maturities.</td>
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<tr>
<td>C. Children acquire facts and skills required for making group and individual decisions and judgments.</td>
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<tr>
<td>D. Rules and regulations recognize the rights and responsibilities of both groups and individuals.</td>
<td></td>
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<tr>
<td>E. The school activities exemplify social principles discussed in classrooms.</td>
<td></td>
</tr>
<tr>
<td>II. A good curriculum promotes maximum personal development</td>
<td></td>
</tr>
<tr>
<td>A. Teachers have adequate information about each learner.</td>
<td></td>
</tr>
<tr>
<td>B. Learning situations provide maximum consideration to the unique characteristics of each learner.</td>
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<tr>
<td>C. The school determines individual interests and abilities through varied exploratory experiences.</td>
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</tr>
<tr>
<td>D. The program fosters desirable personality traits.</td>
<td></td>
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<tr>
<td>E. Provision is made for the various</td>
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phases of individual development—emotional, social, intellectual, physical.

F. The curriculum promotes individual development rather than conformity to some hypothetical standard of development.

G. The school offers a wide range of special-interest opportunities.

III. A good curriculum promotes continuity of experience

A. Classroom practices indicate concern for the maturity and learning of each learner.

B. Teachers consult interests, past experiences, and other leads from learners in planning next experiences.

C. Teachers identify the relationships between present, past, and future experiences of a related type.

D. Teachers of the same learners, and past and present teachers of the same learners, exchange information regarding these learners’ experiences.

E. If repeated, group experiences, such as excursions, serve different purposes.

IV. A good curriculum provides for all educational goals

A. The faculty has defined comprehensive educational goals.

B. The total curriculum provides learning experiences for achieving each goal.

C. In planning the experiences of pupils from year to year, teachers consider the total scope of goals.

D. Teachers select instructional units in terms of the specific goals to be served.

E. Goal-serving experiences provide for the varying abilities and needs of all learners.

V. A good curriculum maintains balance among all goals
A. The school program provides for attention to each goal commensurate with its importance.
B. The total plan of curriculum areas, required and elective subjects, and school activities reflects careful planning with respect to all goals.
C. Guidance of each individual provides for him a program which is well balanced in terms of his needs and capacities.
D. The school plant and facilities provide for attention to each goal commensurate with its importance.

VI: A good curriculum emerges in learning situations

A. Written curriculum plans encourage curriculum development in learning situations according to their unique possibilities.
B. The plans for instructional units include alternative procedures and provision for pupil-teacher planning.
C. The selection of learning experiences reflects careful preplanning by teachers and equally careful attention to the demands of the learning situation.
D. Pupil-teacher relations encourage pupil participation in the planning of learning experiences.
E. The teaching and learning groups modify their plans as needs arise.

VII. A good curriculum uses effective learning experiences and needed resources

A. Learning experiences employ the most effective situations available.
B. Learning experiences are planned and developed so that pupils see purpose, meaning, and significance in each activity.
C. Learners select their own materials and activities as frequently as possible and desirable.
D. Learning experiences utilize all needed resources that are available.
E. Teachers use resources as efficiently as possible to bring about maximum outcomes of the learning experience.

Thus, this instrument can be built around three sets of goals as stated by Saylor and Alexander: (1) the purposes and objectives of the pupils as they participate in the learning experience; (2) the pupil outcomes sought by the teacher as he guides and directs and also participates in the learning situation; and (3) the personal goals and objectives of the teacher.

To illustrate, a learning experience going on in the school in the second grade involving the addition of simple numbers can be described. Possibly some of the objectives may be as follows:

Objectives of Pupils

1. To learn to add simple numbers
2. To please the teacher and secure her approval
3. To get a good mark
4. To do as well as or excel classmates
5. To be able to write the problems neatly on the paper
6. To do what the teacher demands so as to avoid punishment or criticism

Pupil Outcomes Desired by the Teacher

1. To learn to add simple numbers correctly
2. To learn to place problems neatly on the paper
3. To achieve a feeling of success on assigned responsibilities
4. To work diligently on assigned tasks
5. To add to the pupils' skill and stock of knowledge

The Teacher's Purposes and Objectives

1. To provide a learning experience that will contribute significantly to the growth and development of second-grade pupils
2. To comply with the prescribed course of study
3. To win the approval of supervisory and administration officials
4. To be a success as a teacher
5. To contribute to the realization of the over-all purposes and objectives of the school.

It is readily apparent that the program of a school must be planned and organized on some basis; it would be highly wasteful of the capacities, energy, time, and effort of pupils if teachers and school officials simply permitted them to carry on educational experiences willy-nilly or on a hit-and-miss basis. Moreover, if basic curriculum goals such as those stated above are to be achieved, there must necessarily be some planned procedure for seeking these goals through learning experiences. It is essential that these experiences be selected, planned, and carried forward on the basis of some pattern of organization that will give continuity, meaning, and significance to the educational program. The organization of the curriculum brings to a direct focus, then, the entire question of how we shall achieve the basic purposes and outcomes desired from the education program. It is one of the most pivotal concerns in the whole area of curriculum planning.

Who is Responsible For Curriculum Improvement - Administration or Teaching Staff?

Although it is assumed or at least expected that any individual connected with the school system would consider curriculum improvement at integral phase of his position, it is, nevertheless, important to discuss the responsibility of curriculum development. Since the development of conditions for learning is the responsibility of everyone from the custodian who heats and cleans the building to the administrator who must coordinate the functions of the entire building, it follows that curriculum improvement is the responsibility of everyone. However, as in all walks of life, someone is needed to trigger the action.

Leadership

An administrator in most cases can be looked to for possessing the ability to create an opening or opportunity from which curriculum development can evolve. However, as the name indicates, it is the curriculum director who would be more directly responsible in providing the over-all conditions for curriculum development. But, the person most involved with the actual "doing" of curriculum development is the classroom teacher for this person is the one who works directly with the child.

With the above reference to administrators, curriculum directors, and teachers we must assume that there is no hierarchical arrangement in the development of a curriculum.
Establishing Working Relationships With Teachers

Although it is assumed that the principal, as leader, has certain goals in mind as well as vision and understanding with regard to the nature of curriculum development and implementation, he must establish a position of mutual operation by relating his vision and understanding to that of the teachers. Mackenzie and Cory give emphasis to this position in indicating alternative roles of the leader as follows:

(1) the leader's goals must be those of the group, and he must be seen by the group as helping or potentially helping it to achieve its goals.

(2) the leader's goals must be sufficiently compatible with those of the group so that the group sees him as helping or potentially helping to achieve its goals.

(3) the group must recognize the leader as helping to avoid destruction of a desired status quo or offering the least threat to its goal achievement.

(4) the goals toward which the leader is viewed by the group as being able to contribute essential help must be important enough to effect or outweigh his refusal or inability to help the group achieve some of its other goals.¹

Curriculum Leader Must Provide for Teacher Goal Realization

"One way in which the principal can exert leadership

¹ Philo T. Pritzkau, Dynamics of Curriculum Improvement, pp. 9-10.
which is recognized by teachers is to see to it that their suggestions or proposals are realized. His position with teachers or other individuals would be jeopardized if he provides the occasions for hearing suggestions and does nothing more. Such a condition would lead to a withholding of suggestions or ideas in the future. It is, therefore, highly important for the principal to develop the conditions whereby there is decision and action relative to at least some of the ideas furnished by teachers. He is thus indicating an understanding and insight relative to the goals of the teachers. This strengthens their confidence in him not only with respect to his sympathetic consideration of their goals but also regarding his ability to bring about a fulfillment of them.¹ This idea taken from Philo Pritzkau's book is also the thinking of many other leaders in the field of education.

Limitations of Curriculum Leader

As in any field a person must be aware of his limitations. This also applies to the curriculum worker. It would be impossible to know all the functions that relate to leadership. He needs to seek the resources of others to promote leadership. As he indicates his limitations he is being honest with himself and with others.

Developing a Desirable Group Climate

Teachers, school principals, supervisors, and other

¹ Philo T. Pritzkau, op. cit., p. 10.
curriculum workers have identified four areas which generally affected the climate for group projects. They are:

1. Satisfactory problem definition
2. Coordination of the work between the consultant's visits
3. Freedom for exploration and work
4. Free-flowing communication within the group and with the consultant.

Four areas of communication identified as important by the above same people are:

1. Communication within the work or study group
2. Communication within the group and the consultant and those carrying on the study
3. Clarification of terminology
4. Responsibility of leadership to facilitate communication.
CHAPTER II
THE PROBLEM

The problem of this research project is concerned with the science program at the intermediate level in the Hilton Central School District.

When this school system became a centralized district a curriculum problem became apparent in teaching science. Three main causes can be cited: multiple sections with grouping, teacher background, and state mandated time for the teaching of science.

Multiple Sections

With the increase in enrollment in the school district, the number of children at each grade level necessitated a change in grouping to allow for more effective learning. The grouping was changed from complete heterogeneous grouping to skimming off the high achievers and low achievers at each grade level. These form two groups that are supposedly homogeneous groups and are named the "rapid progress" and "slow progress" groups. The remaining children are put into what are called heterogeneous classes. If this is done in fourth grade, the rapid and slow progress sections may remain about the same when they progress to fifth grade, but the other children are again shuffled so one complete class does not go to the same fifth grade teacher.

The same procedure is followed in the fifth and sixth grades. Thus, by the time a group is in sixth grade, some
students may have been fortunate enough to have had science background, others had no science at all, and others may have had repetition in the same area; i.e. dinosaurs, studied in fourth and fifth grades. Therefore, a sixth grade teacher that could and wanted to teach science had a difficult area to teach. The teacher had to teach for the average cross-section of the class as far as science background was concerned. Therefore, the children with a better background were bored because they were not challenged, and the children without a background found it difficult to keep pace. If a sixth grade teacher did not choose to teach science, the children were not aware of the omission until they reached seventh grade.

Teacher Background

Increased enrollment has increased the number of classes at each grade level. Instead of one or two teachers at one grade level with heterogeneous classes, there are four to six teachers at each grade level with at least two groups of homogeneous classes. Arbitrarily these teachers taught what they wanted to teach in science. Each teacher had little regard to what other teachers at the same grade level were teaching.

Up until 1958 science class was regarded as the extra class period. If there were a few free minutes in the busy elementary day, a science class could be taught. This was left up to the discretion of the teacher.
The point of view the teachers held in regard to teaching science mainly depended upon their background in science. Many elementary teachers hold a Life Certificate and have had no further graduate work. Few, if any, credits for this certificate were obtained in the science field. A teacher having only a few years in the education field may have had more science background in college but, no doubt, not the necessary preparation to teach the science needed today.

If science was taught the units covered could be chosen by the teacher. One teacher may have had a hobby of plants. This teacher might feel secure in teaching about plants and would accordingly have a lengthy unit. The same class the following year might have a teacher who enjoys flowers, thereby, decides to have the class study plants in science class. The repetition would be devastating to the motivational aspects of science. The next year the class might be fortunate enough to have a teacher keenly interested in animals so that the science class would consist of learning in this area, rather than plants and flowers for the third consecutive year.

There were no guides for these teachers to follow. The teacher could find little help in textbooks, because few elementary science texts had been published. Many of the science texts in use were considered poorly written because they did not meet the needs of a growing desire on
the part of the children in the field of science.

State Mandate

In 1958 because of state-wide curriculum planning the New York State Education Department mandated that science be taught as a basic subject. This meant more work for the teacher to plan for this class on a weekly schedule. Most teachers reacted by asking, "What will I teach?", "Where do I find the information to teach?", or "What do I know about science?" This feeling of inadequacy is understandable when any abrupt change takes place. However, a study of table 2 will indicate to the reader the limited science backgrounds of the teachers in the intermediate level of Hilton Central School. Table 2 also shows a desire on the part of some teachers to become better qualified to teach in this area by participating in in-service training and further graduate study.

Statement of Problem

The objective of this Science Committee will be that of coordinating the multiple sections of the fourth, fifth, and sixth grades in science by using the following four hypotheses as guides.

Hypothesis #1. An instrument can be developed which can be used as a guide for all three grade levels, (4, 5, and 6) with required areas to be taught at each grade level.

Hypothesis #2. Science will be treated as a step-by-step process possessing continuity with
the basic units being taught at each grade level (using the children's previous years' learning as a foundation for instruction).

Hypothesis #3. Each teacher will know which areas have been covered and to what extent in the previous years.

Hypothesis #4. Increased student interest in science will result.

Table 2

Teachers' Experience and Science Background Information

Intermediate Grades

Hilton Central School

<table>
<thead>
<tr>
<th>Science Background</th>
<th>1959</th>
<th>1960-on</th>
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<td>Experience and Science Background</td>
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<td>1</td>
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<td></td>
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</tr>
<tr>
<td>Teacher 2</td>
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<td></td>
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</tr>
<tr>
<td></td>
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</tr>
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<td></td>
<td></td>
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</tr>
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<td>Teacher 4</td>
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<td>4</td>
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<td>18</td>
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CHAPTER III
RESEARCH DESIGN

Description of School District

In 1949 before centralization the Hilton School was the picturesque "little red school house" known as the Henry Street School. The plant facility was a village school building that housed all grades kindergarten through twelfth. With centralization in 1950 the Hilton Central School District brought together all the one-roomed school houses scattered throughout Parma, plus the one-roomed schools in parts of Clarkson, Hamlin, and Greece.

The centralization necessitated the building of an eight hundred student high school plant. At this time all the district students were transported by school bus to the centrally located schools in the village of Hilton.

Growth in the population in the area by 1954 necessitated the building of a twenty unit primary school which was named the Hazel Jenkins School. Further growth by 1957 brought about the building of a junior high school wing on the high school. By 1959 the school population required an additional twenty-five classroom unit school to be built. It was named the Jonathan Underwood School. In the school year 1960-61 Hilton had a student population of 2,432.

Hilton School has experienced a growth in student population from less than four hundred students in a one building school in 1949 to almost 2,500 students housed in
four separate buildings in 1960. The population is still increasing at the rate of 10% a year. The school year of 1962-63 finds all existing schools over crowded. The immediate need of a 1,000 student junior high school building is apparent to take care of the overcrowded conditions and the projected school population of 3,250 students by the school year 1963-64.

Additional Factors Necessitating Change

Due to the crowded conditions of the school year 1958-59 it was impossible to house grade levels in neat categories and break downs. Three of the six sections of third grade were housed in the Henry Street School. The entire compliment of the fourth grade along with five of the six sections of fifth grade were also housed in the Henry Street School. The remaining fifth grade and all six sections of sixth grade were housed in the newly completed junior high wing of the high school.

The intermediate level of the elementary school of Hilton Central School District was scattered between two buildings. Therefore, problems arose due to the large number of multiple sections compounded by the fact that they were housed in different buildings. The teachers found it difficult to communicate with one another and there was no continuity of program.

These problems in addition to the teachers' backgrounds (see Table 1, page 20) and the state mandate (as stated in
Chapter 2) made it apparent that a curriculum study and renovation was necessary in the field of science for the elementary grades.

In January of 1959 this writer requested and was granted permission to start a science committee for the improvement of the science program in the intermediate school at Hilton. With administrative assistance a committee of five (all volunteers) was formed.

Procedure

At the first Science Curriculum Committee meeting it was decided that the following procedure would be pursued:

1. Publicly establish through an administrative bulletin that teacher #3 (see Table 3) would act as representative for all fourth grades, teacher #5 act as representative for all fifth grades, and teachers #2 and #4 as representatives for the sixth grades. All reports and comments would be channeled through grade representative. Teacher #1 would act as coordinator and group chairman.

2. Each grade representative would present to their grade level bulletins, questionnaires, and reports at grade level meetings and collect information requested.

3. Grade representatives would convey the information to the committee at weekly Science Curriculum

1. Minutes of Science Curriculum Committee, pp. 3-4.
meetings. At which time the information would be discussed, evaluated, and acted upon by the entire committee.

4. When composing bulletins, questionnaires, and reports the committee decided to be extremely careful to avoid over-simplification by using "educational jargon" and "blanket" coverage of terms such as:

1) Make work interesting to children.
2) Base your instruction on the needs of the youngsters.
3) Adapt instruction to individual differences.
4) Take the child where he is.
5) Develop a permissive atmosphere.

Note: Due to the rather superficiality of the above five statements, nothing has really been said to help the teacher because basic meanings have not been identified.

5. With committee and administration sanction the committee chairman was to develop public relations between teaching staff, children, and parents in the form of a Science Fair.

As a result of the above procedure the next chapter will describe the development of:

1) a guide for the use of intermediate teachers in
teaching science

2) a step-by-step process providing for continuity of teaching science in grades four, five and six

3) the value of each teacher possessing a curriculum designed to show what has been taught in science previous to a particular grade level

4) an increase in student interest in science.

Table 3

BACKGROUND OF SCIENCE COMMITTEE MEMBERS

<table>
<thead>
<tr>
<th>Teacher</th>
<th>Sex</th>
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<th>Experience</th>
<th>Science Background</th>
</tr>
</thead>
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<td></td>
<td></td>
<td></td>
<td>Years</td>
<td>Under-grad. Hrs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Grad. Hrs.</td>
</tr>
<tr>
<td>1</td>
<td>M</td>
<td>6</td>
<td>1</td>
<td>24</td>
</tr>
<tr>
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<td></td>
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<td>2</td>
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<td></td>
<td></td>
<td></td>
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<td>3</td>
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</table>

Note: Each grade level has a teacher representative.
CHAPTER IV
PRESENTATION OF DATA

Hypothesis #1. An instrument can be developed which can be used as a guide for all three grade levels, (four, five, and six), with required areas to be taught at each grade level.

Phase 1. Not knowing exactly what had to be done, but firm in their belief that something must be done, the Science Committee prepared an outline (see Appendix B) to guide the classroom teacher in organizing a year's program and to utilize science textbooks and reference books available to the classroom teacher.

The outline as presented, only for the teacher's use, was not intended to be construed as the ultimate science curriculum, but must be constantly revised and evaluated. The committee also stated that it was eager to hear teachers' comments and suggestions with the hope of arriving at the best possible program for the children. It was further hoped by the committee that the four areas (Solar System, Biology, Weather, and Electricity) included in the outline would become an integral part of each teacher's science program.

The program was then submitted to the Board of Education, administration, and the teachers of the elementary and junior high school for approval. It was accepted with the
recommendation that it be tried for the following school year.

Phase 2. The program was tried the following year and the teachers evaluated the program by writing suggestions on their programs throughout the year. At the years end this information was rewritten on a report sheet. The following recommendations were presented to the science committee:

1. revise outline to be more specific
2. provide more experiences submitted by the teachers in the line of experiments
3. to incorporate as much as possible reference material within the guide
4. evaluate and recommend new text books for use in the program.

Following these suggestions submitted by the teachers the science committee rewrote the program (see Appendix C). This guide was presented once more to the Board of Education, administration, and teachers for approval. It was received with a great deal of enthusiasm by everyone. It was noted at the time that administrative direction was not needed for the program's acceptance by the teachers. The science committee again urged the teachers to evaluate the program with the hope in mind of developing an even more acceptable program.

Phase 3. After two years of evaluation it was decided by the committee to experiment in rewriting the program in the
form of a study guide to be used by the children of the sixth grade (see Appendix D). This program is now being prepared for use later this school year.

Hypothesis #2. Science will be treated as a step-by-step process possessing continuity with the basic units being taught at each grade level (using the children's previous years learning as a foundation for instruction).

By determining the limits on the concepts that are to be taught in each unit at each grade level the teachers can now rely on the previous years learning experiences. It is now possible to eliminate or at least control repetition and proceed to develop new concepts within the same unit (see Appendix C).

Hypothesis #3. Each teacher will know which areas have been covered and to what extent in the previous years.

Each teacher will have in his or her possession a science curriculum for the fourth, fifth, and sixth grade. The teacher will feel secure in knowing what science facts the class have been exposed to in the previous years.

Hypothesis #4. Increased student interest in science will result.

Exposure to wider variety of science experiences provided the children with an interest in scientific hobbies.
These interests were developed as shown by the following:

- **Science Fair 1958-59**: 200 participants
- **Science Fair 1959-60**: 350 participants
- **Hobby Show 1961-62**: 300 participants

The participation in these programs was on a voluntary basis.

Further evidence of increased interests on the part of the student was indicated by verbal reports from school librarians. It was reported that requests from students for supplementary reading materials in the science area had increased since the inauguration of this science program.

Higher achievement test results would be another form of evidence indicating increased student interest in science. The scores of a cross-section of students who have participated in this program for three years indicate, in most cases, a higher grade placement than called for by the Stanford Achievement Test (see Table 4).
Table 4

TEST RESULTS

Twenty students participating for three years in this program, picked at random, to show Stanford Achievement and teacher-made test scores.

<table>
<thead>
<tr>
<th>Sex</th>
<th>4th</th>
<th>5th</th>
<th>6th</th>
<th>Growth in mo.</th>
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<tr>
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<td>82.2%</td>
<td>86.1%</td>
</tr>
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*Stanford Achievement Test showing grade placement in science

**Stanford Achievement Test and teacher-made comprehensive test not given in fourth grade, school year 1959-60

***Transfer student
CHAPTER V
CONCLUSIONS, OBSERVATIONS, AND RECOMMENDATIONS

Conclusions

Hypothesis #1: A science curriculum was developed and is serving as a guide for three grade levels (four, five, and six). This instrument has been approved by the Board of Education, administration, and teachers of the Hilton Central School, to be used as required material to be taught in science for the intermediate grades. This is to be used until such time as the science committee recommends further changes.

Hypothesis #2: Science is being treated as a step-by-step process using the children's previous years learning as a foundation for instruction. Four areas of instruction are required as basic at each grade level. They are solar system, weather, electricity, and biology. Appendixes B, C, and D show the continuity of a three year program for grades four, five, and six in one area, the solar system.

Hypothesis #3: Each teacher of the intermediate grade level has in his or her possession a curriculum for science covering grades four, five, and six. By mutual agreement between teachers in the intermediate grades and administration it was established that each grade level would work within the framework designated by the curriculum for the duration of the experiment.
Hypothesis #3: Increased interest and understanding on the part of the student has been evidenced by the following:

1. A larger number of voluntary participants in school-wide programs, e.g., science club and science fair exhibits. A noted increase in quality and understanding of student-made projects was observed and reported by the teachers.

2. As reported by school librarians, there has been a greater voluntary demand on the part of the students for supplementary reading materials in the science area.

3. Higher test results in standardized tests in science (see Table 4, page 30).

Researcher's Observations:

1. Teachers must be considered as individuals in a program of this nature and one must never assume the axiom, "what is good for one is good for all". Although all the teachers complied with the request of the science committee to teach from this program outline, the teachers exhibited varying degrees of enthusiasm. Some teachers openly admitted that the program was too extensive and demanding of their own ability in the field of science. The same teachers further stated that they were not interested in pursuing graduate study in this field. Other teachers felt the program was adequate and were thankful that the work in
the science area was complied for them. Most teachers, however, accepted this change as a challenge and were most helpful in recommending suggestions for improvement of the instrument. This same group of teachers were interested enough to utilize all available resources, e.g., in-service training (Genesee Valley Study Council and workshop groups) and graduate study at nearby universities, to give them a better background in the science field. Table 2, page 20, gives evidence of the above statement.

2. It has been stated in Chapter I that there is no hierarchial arrangement in the approach to curriculum questions. This is true as far as getting underway in developing a curriculum. Top administration must be counted on to provide the encouragement and direction needed to see that the program is completed. It also has been stated that the only way that a principal can assert leadership as recognized by the teachers is to see that the teachers' and curriculum study groups' suggestions or proposals are realized.

With this particular study group the building principal kept the executive principal informed to the progress and needs of this curriculum study group. The executive principal in turn informed the Board of Education of the same progress and needs. The Board of Education provided the following:

1. money necessary to pay the members of
the Science Committee for two weeks
work during the summer

2. additional money for in-service study

3. further stimulation for the teachers by a
letter stating their sincere endorsement
of the program.

In this manner the necessary circle of communication
was completed, teacher to building principal, building
principal to executive principal, executive principal to
Board of Education, Board of Education to teacher.

3. As stated in Chapter II the teaching of science in
multiple sections of each grade level has been a great
problem. However, with the use of this instrument the prob-
lem has been alleviated. Even with the reshuffling of
classes each teacher still knows what the child has covered
the previous year in science. We must not forget that each
child is an individual. We cannot expect that each child
will retain all subject material taught from this curriculum
with the same degree of competency. It appears, however,
that each child regardless of his scholastic ability has a
better background in the field of science as a result of
this experiment.

4. With a greater number of students possessing a
better background in science changes must be made in the
junior high school science program to meet the students' needs. In Appendix B the junior high science department
has indicated new problems that have arisen and how they plan to cope with them.

5. The modest success of this program has been the needed stimulant for the organization of other study groups, sanctioned by the Board of Education in the fields of English, arithmetic, and social studies.

Recommendations for Further Study

1. A teacher-made testing program should be devised to be given at each grade level. Appendix E includes two teacher-made tests to meet the needs of this program. It is recommended that a diagnostic type test be given in September and a comprehensive type test be given in January and June. This writer is of the opinion that children at this grade level cannot be expected to retain all of the information that would be required in a comprehensive type testing program covering one school year period.

2. Continual development and revision is necessary in any course of study. It would be pure fancy on the part of any curriculum study group to assume or intend that their program would be all inclusive.

3. Participation on the part of the entire school science faculty with each grade level represented by a grade chairman or department head is recommended in a curriculum study.

This program has indicated that attempting to solve a problem for one segment of a school system in curriculum
development creates new problems in other segments. Therefore, it is recommended that curriculum planning and revision be the responsibility of the entire school, with all grade levels represented in connection with a science study group.

4. It is further recommended that a systematic research plan be followed. This plan consists of three steps—pre, "pure", and post. The following table (Table 5) gives an indication as to procedure in developing a curriculum in any area.

Table 5

<table>
<thead>
<tr>
<th>Historical</th>
<th>Experimental (controlled)</th>
<th>Applications</th>
</tr>
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<tbody>
<tr>
<td>Descriptive Survey</td>
<td>School Lab</td>
<td>Demonstrations</td>
</tr>
<tr>
<td>School Public opinion</td>
<td>Industry On job Class</td>
<td>Follow-up</td>
</tr>
<tr>
<td>Social Market Case study Community studies</td>
<td></td>
<td>Trend</td>
</tr>
</tbody>
</table>

Proposals
APPENDIX A

BIBLIOGRAPHY


Minutes of Science Curriculum Committee, Hilton Central School, February, 1959.


The University of the State of New York, The State Education Department, *A Design for Improving Elementary Education in New York State*, Albany, The State Education Department, 1958.
APPENDIX B


This unit is one of four basic units and is used to show the continuity of the program in the grade levels listed above.
Fourth Grade

SOLAR SYSTEM and the UNIVERSE

A. People first wondered about the sky and things they saw there.

B. The term astronomy and its Greek derivation — use of telescope

C. The Constellations and stars
   1. Myths of their formations
   2. The composition of a star
   3. The varying sizes of stars
   4. The constant shining of stars
   5. The changing positions of stars
   6. Differences between stars and planets
   7. Show how lenses of telescope make things appear larger
      a. 2 reading glasses — candle — white paper
      b. use first one glass — then two (MacMillan p. 87)

D. The Solar System
   1. The Sun
      a. center of the system
      b. source of light and heat
      c. distance from earth
   2. Earth
      a. one of the planets
      b. shape of earth
      c. axis — rotation — revolution — orbit
      d. earth’s movement from West to East
      e. night and day
      f. seasons
      g. gravity
         1) the sun’s and earth’s pull
         2) weight of objects
         3) use of ball on string for demonstration
   h. earth’s surface
      1) proportion of land and water
      2) how soil is made and kinds
      3) erosion, irrigation
      4) rocks and fossils (this leads to new unit)
   3. The Moon
      a. meaning of satellite and reflected light
      b. the moon compared to U. S. as to size
      c. distance from earth
      d. phases of the moon and their causes
      e. surface of the moon
      f. reasons for no life on moon
REFERENCE MATERIALS ON SOLAR SYSTEM AND THE UNIVERSE:

I. Stars and Constellations

<table>
<thead>
<tr>
<th>Letter</th>
<th>Pages</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>pp. 123-131</td>
</tr>
<tr>
<td>B.</td>
<td>73-91</td>
</tr>
<tr>
<td>C.</td>
<td>112-125</td>
</tr>
<tr>
<td>D.</td>
<td>7-21</td>
</tr>
<tr>
<td>E.</td>
<td>173-178</td>
</tr>
<tr>
<td>F.</td>
<td>36-42</td>
</tr>
<tr>
<td>G.</td>
<td>176-191</td>
</tr>
<tr>
<td>H.</td>
<td>143-150</td>
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</tbody>
</table>

II. Solar System

1. Sun

<table>
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<tbody>
<tr>
<td>E.</td>
<td>pp. 7-21</td>
</tr>
<tr>
<td>H.</td>
<td>161-178</td>
</tr>
<tr>
<td>I.</td>
<td>23-28</td>
</tr>
<tr>
<td>J.</td>
<td>204-211</td>
</tr>
<tr>
<td>L.</td>
<td>271-274</td>
</tr>
<tr>
<td>N.</td>
<td>129-134</td>
</tr>
</tbody>
</table>

2. Earth

<table>
<thead>
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<th>Pages</th>
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<tbody>
<tr>
<td>A.</td>
<td>pp. 111-121</td>
</tr>
<tr>
<td>C.</td>
<td>91-111</td>
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<td>D.</td>
<td>4-19, 65-85</td>
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<tr>
<td>E.</td>
<td>37-41</td>
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<td>G.</td>
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<td>J.</td>
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<tr>
<td>L.</td>
<td>275-279</td>
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<tr>
<td>N.</td>
<td>151-175</td>
</tr>
<tr>
<td>O.</td>
<td>5-20</td>
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</table>

3. Moon

<table>
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<th>Letter</th>
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<tbody>
<tr>
<td>C.</td>
<td>pp. 125-129</td>
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<td>E.</td>
<td>27-36</td>
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<td>H.</td>
<td>161-178</td>
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<td>K.</td>
<td>201-224</td>
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<tr>
<td>L.</td>
<td>279-286</td>
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<tr>
<td>M.</td>
<td>107-125</td>
</tr>
</tbody>
</table>

Arey- Science Experiences for Elementary Schools - pages 34-36, 39-49
EARTH'S COMPOSITION AND SURFACE:

I. An understanding of the following terms and ideas:

A. erosion
B. irrigation
C. fossils
D. Kinds of soil: gravel, clay, loam, humus
E. soil is produced by the break up of rocks with the
   additions of living and dead animals, water and air
F. water dissolves minerals

Text Book Sources:
G. pp. 191-194
H. 93-104
J. 193-203
K. 43-49, 57-69, 259-262
L. 185-200
M. 187-216

Ginn 5 pp. 181-201

Teachers' References:
Arey. - pp. 34-36
Hubler - pp. 254-275
Unesco chapter 5 - section B

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Rey, Find the Constellations
Zim, The Sun
Fenton, Worlds in the Sky

Earth
Hamilton, 1st Book of Caves
Sterling, The Story of Caves
Zim, What's Inside the Earth

REFERENCE BOOKS - as used in various units as to capital
letters preceding

A. Baker, Maddux, Warrin, Here and Away, Rand McNally & Co.,
   1955 (C.R.)
B. Barnard, Stendler, Spack, Science, Health and Safety,
   Macmillan Co., 1959 (C.R.)
C. Beauchamp, Williams, Blough, Discovering Our World,
   Scott, Foresman & Co., 1952 (C.L.)
D. Craig, Gerald and Hurley, Beatrice, Discovering With Science, Ginn & Co., 1954 (C.L.)

E. Craig, Gerald and Baldwin, Sara, Our Earth and Sky, Ginn & Co., 1940 (C.L.)

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C.R. = classroom
C.L. = curriculum library
L. = general library
FIFTH GRADE

Our Solar System

I. Content:

A. Introduction #4 p. 205-207
   #5 p. 65-69

C. The Earth-Time #5 p. 89-95
   #6 p. 259-265

D. The Moon #4 p. 216-220
   #5 p. 69-73

E. Planets #4 p. 208-209, 212-216, 210, 212
   #5 p. 74-78, 79-88

F. The Galaxy #4 p. 203-204

II. The Earth's Composition and Surface

1. The Earth's Interior A. p. 147-154
   B. p. 249-270
   C. p. 25
   D. p. 300-305
   E. p. 160-192, 193-210
   F. p. 50-61
   III. p. 254-275
   XI. p. Chapter 5, Section D
   Arey p. 36-38

2. Kinds of Rocks III p. 306, 26-228
   IX p. Ginn manual p. 71
   XI Chapter 5, sections A., B., C.
   B. p. 92-101
   D. p. 285-289
   E. p. 160-192
   F. p. 62-63
SIXTH GRADE

SOLAR SYSTEM AND UNIVERSE

General References:

A. 52-71
B. 50-87
C. 259-263, 279-281
D. 204-235
E. 91-119
F. 163-191
G. 70-128
H. 77-93
I. 151-178
K. 235-256
M. 227-232

I. History

A. Theory of the gods G90-91
B. Fixed Earth Theory C255-259, E94
C. Copernican Theory C259-261, D217-219

II. Universe and Solar System

A. What is the Universe
B. What is the Solar System
C. Immensity of size of Solar System and Universe

III. Review and Pertinent Information Regarding Universe

A. Stars and Constellations

1. What is a galaxy?
2. What is a light year?

B. The Sun

1. size
2. distance from the earth
3. effect on planets
   a. energy
   b. light
   c. gravity

C. Planets

1. teach names of known planets
2. teach order of distance from sun
3. teach common characteristics of planets

a. fixed orbit
b. revolution (counter clockwise)
c. rotation (from west to east)
d. reflection of light

4. discuss and develop appreciation for

a. size
b. number of moons
c. distance from sun
d. atmospheric conditions
e. duration of rotation and revolution
f. possibility of life

D. The Earth - a planet

1. General Information

a. size and shape
b. distance from sun (avg. 93,000,000)
c. duration of revolution
d. duration of rotation
e. natural satellite (moon)
f. artificial satellites
g. atmosphere

   1) sustains life as we know it
   2) acts as an insulator

2. Inclination of the Earth on its Axis

a. effect on seasons
b. effect on length of daylight and darkness

3. Composition of the Earth

a. theory of the earth's origin: mass of gasses separated from the sun and cooled and solidified forming a crust on the surface. As various gasses combined and cooled either water or land was formed. Land is composed of mud, humus, clay, sand, rocks and minerals.

4. Elements in the Earth

a. Oxygen - comprises 50% of the earth's weight. It combines with silicon to form quartz and sand.
b. Silicon - comprises 26% of the earth's weight. It combines with oxygen to form silicon dioxide which is found as quartz and sand.

c. Aluminum - comprises 7% of the earth's weight and is the most abundant metal in the earth's crust.

d. Iron - comprises 4% of the earth's weight and combines with oxygen to form oxides.

e. Calcium - comprises 3% of the earth's weight and combines with oxygen and carbon as limestone.

(Ref. Sec. 4 - Unit Review of General Science, Cambridge Book Co., 1952, pp. 264-265)

5. Rocks and Minerals

a. Igneous
b. Sedimentary
c. Metamorphic

(Ref. Sec. 5 - Unit Review of General Science, Cambridge Book Co., 1952, pp. 264-265)

WORD LIST: All children should have a working knowledge of the following words:

- Universe
- Solar System
- Sun
- planet
- atmosphere
- year
- axis
- constellation
- galaxy
- light year
- orbit
- season
- revolution
- igneous
- Satellite
- (natural and artificial)
- star
- inclination
- day
- rotation
- sedimentary
- metamorphic
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B. Ginn, New Ideas In Science, 1946
C. Heath, Science for Today and Tomorrow, 1956
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J. Lippincott Co., Science Beneath the Skies, 1956
K. Hubler, Working with Children in Science, 1957
M. Craig, Science for the Elementary School Teacher, 1958
APPENDIX C


This unit is one of four basic units and is used to show the continuity of the program in the grade levels listed above.
FOURTH GRADE

SOLAR SYSTEM

I. Introduction
   A. Early people first wondered about the sky and things they saw there
   B. The term astronomy from the Greek meaning the study of the heavenly bodies
   C. Development of the telescope to study the heavenly bodies

II. The Constellations and Stars
   A. Myths told about the constellations
      1. Winston - pgs. 175-76
      2. Old Singer - pgs. 176-191
      3. Rand McNally - pgs. 125-128
   B. A star is a burning ball of gas that glows constantly
   C. A planet is a cold mass that has no light of its own
   D. Stress location of north star by the study of pointer stars

III. Solar System
   A. Sun - average star
      1. center of system
      2. source of light and heart of heat
      3. distance - 93,000,000 miles from earth
   B. Moon
      1. satellite of the earth
      2. shines by reflected light
      3. acquaint the pupils with the following information:
         a. the moon is approximately the same size as the United States
         b. the moon is approximately 250,000 miles from the earth
         c. the moon appears to have various shapes as it travels around the earth (phases)
         d. the surface of the moon is rough and jagged with mountains, craters, and volcanic dust
         e. there is no life on the moon as we know it because of the lack of atmosphere and water
C. Earth

1. The Earth is the third planet in distance from the sun, located between Venus and Mars.

2. Discuss the shape of the earth.
   
   Experience: use of globe and model boat to show the appearance and disappearance of a ship on the horizon.

3. The Earth's rotation is from west to east as it spins on its axis (sun seems to rise in east and set in the west).

4. The period of revolution is about 365 days as the Earth orbits the sun.

5. Night and day are the result of the Earth's rotation.

6. Seasons are brought about by the tilt (inclination) and revolution of the Earth. Use with study of zones in Cit. Ed.

7. Gravity
   
   a. Discuss the effect of the Earth's gravity on objects.
   
   b. Discuss the Sun's gravity as the center of the solar system.
   
   Experience: use an object (ball, chalk) tied to the end of a string and spin from a fixed position to demonstrate the balance of gravity and centrifugal force.

8. The Earth's surface
   
   
   b. Use with study of the 4 hemispheres.
   
   c. Soil is made by breaking of rock.
   
   Experience: gather soft rock and pound into small particles.
   
   d. Erosion is the wearing away of rock and soils.
   
   Experience: prepare a tray with soil - plant one half with grass and leave the other barren. Also contour farming shown by planting grass down and around the slope.
   
   e. Fossils are prints of remains of animals and plants found in rocks.
As a result of this unit children should know the following words and definitions:

- **astronomy** - the study of the heavenly bodies
- **axis** - a fixed point on which a rotating object spins
- **constellation** - a group of stars that seem to make a picture in the sky
- **eclipse** - when the moon or earth blocks light from the sun
- **erosion** - is the carrying away of rock and soil
- **gravity** - the force that pulls things toward the center of the earth. Sun, moon, planets and stars also have gravity
- **irrigation** - the watering of land by artificial means
- **orbit** - the path of any heavenly body (satellite) revolving around another body
- **planet** - one of the larger bodies that moves around a star
- **reflect** - to bounce back light rays from a smooth surface
- **revolve** - to move around in a curved path
- **rotation** - the turning around of an object on its axis (earth)
- **satellite** - a small object that revolves around a larger heavenly body (distinguish between natural and artificial)
- star - a mass of burning gas
- **telescope** - a scientific instrument used to observe distant objects
FIFTH GRADE

OUR SOLAR SYSTEM

I. Our Solar System consists of 9 (nine) known planets revolving around the sun of which we are one.

A. Four different types of bodies are:
   - stars, planets, moons, comets
   - a. artificial planets - go around sun
   - b. artificial moons - go around earth
   - c. pupils should learn spelling of these terms

B. The sun is the Center of our Solar System and is a star.

C. The earth is part of the Solar System

D. Moon's effect on Earth
   1. phases
   2. eclipse
      - a. lunar
      - b. solar

Experience: Demonstration of eclipse of the moon and the sun

#1
flashlight
sun
large ball earth yellow moon bl white small ball

#2
sun
moon wh bl earth
E. There is tremendous distance between stars even in a galaxy. Our sun is a star in a galaxy called the Milky Way.
F. Galaxy - a large group of stars in a gravitational field

II. The Earth - Our Place in the Solar System
A. Third planet from the sun
B. Diameter - 8,000 miles, shape - round
C. Characteristics - all conducive to life
   1. Orbit - path - 1 year to go around sun
   2. Gravity - determined by the size of the planet
      Example - boy weighing 60 lbs. would weigh 10 lbs. on the moon
   3. Rotation - day and night - 24 hours
   Experience: Use colored ball to show day and night.
   4. Revolution - Earth's orbit around the sun
   5. Air and atmosphere
      1. oxygen
      2. nitrogen
      3. water vapor
      4. carbon dioxide
      5. other rare gases

III. Finding Locations on Earth
A. Poles - parts of Earth's surface that do not move
B. Equator - equal distance from poles
C. Parallels or Latitudes - distance north and south of the Equator
D. Meridians or Longitudes - distance east and west of Prime Meridian
E. Prime Meridian - 3 fixed points - 2 poles and Greenwich, England
   Experience: Have each child bring in a brown rubber ball. Mark with chalk (colored if possible) and draw on different lines.
IV. The Earth’s Composition and Surface

A. The Earth’s Interior

1. hot
2. semi-solid (jell-like)

Experience: Draw a diagram to illustrate the composition of the earth’s crust and interior.

- Dome mountains (blister on the earth)
- Magma (liquid) flows into crack
  - When liquid comes to surface - semi-solid
  - When out - lava

C. Change and shift

1. mountain formation - result from unequal pressure on the earth’s surface
2. volcano
3. earthquake
4. geysers
5. hot springs

V. The Earth’s Moon - review of 4th grade material

VI. Supplementary Information

A. Other planets

1. interesting facts about each
2. place and order in distance from the sun

B. Meteors, meteorites, comets, asteroids
C. Stars - as suns
D. Our Galaxy and the Milky Way
As a result of this Unit children should know the following words and definitions:

**Atmosphere** - a blanket of air covering the earth

**Earthquake** - sudden movement of Earth's crust due to unequal pressure

**Equator** - a great imaginary circle on the earth's surface, everywhere equally distant from the two poles

**Galaxy** - a large group of stars in the gravitational field

**Geyser** - source of water, flowing near or into magma, which is very hot

**Hot spring** - same as geyser except there isn't enough pressure to force it above ground level

**Meridians** - reference points used to measure distance, East and West from the Prime Meridian

**Orbit** - the path of any heavenly body (satellite) around another body

**Parallels** - reference points used to measure distance North and South of the equator

**Prime Meridian** - an imaginary line on the Earth's surface with three fixed points, the two poles and Greenwich (near London), England

**Revolve** - to move around in a circular path

**Rotation** - the turning around of an object on its axis

**Solar System** - a group of 9 known planets revolving around the sun

**Volcano** - an opening in the earth's crust from which molten or hot rock, steam, etc. pass
SIXTH GRADE

SOLAR SYSTEM

I. History - use for motivation
   A. Theory of gods
      1. wandering stars
      2. named for ancient gods
   B. Fixed Earth Theory
      1. Believed that the earth was in the center of a crystal ball and the moon, sun, and stars are attached to the side. The earth stands still and the crystal ball with the moon, sun, and stars would revolve around it.
   C. Copernican Theory
      2. Theory of the solar system - sun is the center with the earth and other planets revolving around it.

II. The Universe and the Solar System
   A. What is the Universe? All matter and the space between it.
      1. Write "UNIVERSE" across the top of the entire blackboard. Craw saucer shaped figures leaving space between them. These are called galaxies. One of these galaxies is the Milky Way. Our solar system is one speck in the Milky Way. Stress the galaxy concept and that there are no limitations to space. Children can make these drawings on paper using glue and glitter for stars.
   B. What is the Solar System? A star and all the heavenly bodies within its gravitational field.
      1. Activity for our solar system. Make a model of our solar system to scale and correct distances apart. Model can be three dimensional or flat on the wall. Use various materials, e.g. paper, paper maché, plasticene, or clay.
   C. Immensity of the size of our solar system and the Universe
1. (See II A) Outside on the field, set a basket ball (sun) in the center. Using 12" balloons as planets, set them correct distances from the sun. (Scale: 1" = 1 million miles). Get a chart and try to set up as the planets are positioned the day you are doing this. (Earth - golf ball or ping-pong ball).

D. A Galaxy - is a group of stars in a gravitational field.

E. Lightyear - is the distance light travels in a year.
   1. Light travels 186,000 miles per second.
   Experience: Multiply 186,000 by 60 seconds; the product by 60 minutes; the product by 24 hours; the product 365 days.

F. Stars and Constellations
   1. Find and locate the North Star, Venus, and Sirius.
   *Note: Teach constellations only if there is an interest.

III. The Sun

A. The sun has an atmosphere which is the only part we see.
   1. This atmosphere is at different temperatures. The cool parts are sun spots.
   2. This atmosphere is made up mostly of hydrogen and helium.

B. The sun's matter is going out into space in the form of energy.
   1. Matter is energy. (Proven mathematically by Albert Einstein)
   2. Because the sun is giving off energy and/or matter, it will eventually use itself up.

C. Size - Diameter 864,000 miles

D. Distance from the earth 93,000,000 miles

E. Effect of the sun on planets
   1. We get energy from the sun. Light is a form of energy.
   2. Gravity pulls planets in.
   *Note: Centrifugal force pulls planets out equally.
IV. Planets
A. Know names, spelling and order of (distance from the sun) of known planets.

<table>
<thead>
<tr>
<th>Mercury</th>
<th>Mars</th>
<th>Uranus</th>
</tr>
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<tbody>
<tr>
<td>Venus</td>
<td>Jupiter</td>
<td>Neptune</td>
</tr>
<tr>
<td>Earth</td>
<td>Saturn</td>
<td>Pluto</td>
</tr>
</tbody>
</table>

B. Teach common characteristics of the planets.
1. fixed orbit
2. revolution (counter clockwise)
3. rotation (from west to east)
4. reflection of light

C. Discuss and develop an appreciation for:
1. size
2. number of moons
3. distance from sun

V. The Earth - a planet
A. General information
1. size and shape
2. distance from the sun (avg. 93,000,000 miles)
3. duration of revolution
4. duration of rotation
5. natural satellite (moon)
6. artificial satellites
7. atmosphere
   a. sustains life as we know it
   b. acts as an insulator

B. Inclination of the Earth on its axis
1. Point of reference - sun's perpendicular ray. At this ray have 12 hours of daylight.
2. Effect on seasons
3. Effect on length of daylight and darkness.

C. Composition of the Earth
1. Theory of the earth's origin:
   mass of gasses separated from the sun, cooled and solidified forming a crust on the surface. As various gasses combined and cooled either water or land was formed.
2. Land is composed of mud, humus, clay sand, rocks, and minerals.
VI. The Moon

A. Size: The moon's diameter is \( \frac{1}{4} \) (one-fourth) the diameter of the earth (approximately).

B. Tides: The rise and fall of the ocean's level caused by the moon's gravity.

C. The moon keeps the same side facing the earth.

D. Phases of the moon.

[Diagram of moon phases]

New moon  Crescent  1st quarter  Full moon

3rd quarter  Crescent  New moon

Experience: Use ball painted half black and half yellow. (Children are clustered in the middle. Walk around them holding the ball and rotate it. Begin with new moon - no light reflected toward earth; rotates around the earth west to east (counter-clockwise); crescent between new and full moon is to the right of the observer; the first quarter is half of the moon (facing us) lighted to the right of the observer; the full moon is all of the moon (facing us) lighted; the third quarter is half of the moon (facing us) lighted to the left of the observer. Repeat this demonstration a number of times. As you repeat, explain the following terms:

- **Waxing** - phases from new moon to full moon
- **Waning** - phases from full moon to new moon
E. Eclipse

1. Solar
   Experience: Use flashlight (or slide projector) and two spheres (one larger than the other) painted black and yellow. Source of light represents the sun; the small ball represents the moon. Move the moon between the sun and the earth.

   ![Diagram of solar eclipse]

2. Lunar
   Experience: Use the same experience as in #1. Move the earth between the sun and the moon slowly.

   ![Diagram of lunar eclipse]

F. Surface conditions

1. Why is the moon hit with more meteors than the earth? No atmosphere to burn them up.

2. Why can't you talk to one another on the moon as you do on earth? No atmosphere to carry sound.

3. Why are mountains jagged? No atmosphere.
As a result of this Unit children should have a working knowledge of the following words:

atmosphere - blanket of air surrounding the earth
axis - an imaginary line about which the earth spins
day - the length of time for the earth to rotate once
eclipse - to block out light
galaxy - a group of stars in a gravitational field
inclination - tilt of the earth's axis
light year - the distance light travels in a year
lunar - referring to the moon
matter - anything that has weight or is attracted by gravity
moon - heavenly body revolving around a star
orbit - path of one heavenly body
planet - heavenly body revolving around a star
revolution - the time it takes one heavenly body to travel around another
rotation - spinning
satellite - (natural and artificial) traveling companion to another body
solar - referring to the sun
solar system - a star and all the heavenly bodies within its gravitational field
star - a heavenly body that gives off its own light
sun - an average star
universe - all matter and the space between it
year - the length of time for the earth to revolve once
APPENDIX D

A Revised Course of Study Prepared
by the Science Committee for the Students
SIXTH GRADE

We read a great deal, lately, about travel in space, about men trying to get to the moon, and about the plans of some scientists to send a man to another planet in the future. Have you ever wondered how helpful it would be if we knew about the moon and the planets! The more we know about the planets and other heavenly bodies, the better we can understand our own planet, Earth, and the better we can understand and appreciate the problems of travel into space.

Our Earth is a part of the Solar System, which is a member of a galaxy called the Milky Way which is located in or part of the universe. Confused? You should be, because we have used several terms which you may not be familiar with at this time. So, let's start again and this time we'll find out what these new words mean as we go along!

The Universe: The word "universe" came to us from Latin, the language of the ancient Romans. It is made up of two smaller words, "uni", and "vertere" and means "to combine into one". We use this word to mean everything that exists and the space between these things, all combined into a single thing called the Universe. All the stars, all the planets, all space, everything is included when we talk about the universe. As a matter of fact, there are so many stars, and the distance between them is so great, that we cannot even imagine the size of the universe. We say, then, that there is no limitation to the size of the universe. Later in this chapter we will talk about "light years" and then we'll get a better idea of what we mean when we say the universe is limitless.

A Galaxy: A galaxy is a large group or "cluster" of stars which form a pattern. There are millions of stars in a galaxy, each one close enough to one another so that they
form a gravitational field, that is, the stars stay in and maintain the pattern of the Galaxy. Remember that there are millions of stars in a galaxy and then consider the fact that there are billions of galaxies.

The Solar System: We have just finished learning about galaxies. One of the galaxies is called the Milky Way. One of the stars that make up the Milky Way is the Sun. You can see now, we’re getting closer to home! Traveling around the sun are several planets and some smaller bodies known as comets, meteors, asteroids, and moons. All these make up the Solar System. If we were looking for a good definition of Solar System, we could say that it is the sun and all the heavenly bodies that revolve around it. Our earth is one of the planets in the Solar System.

Let’s go back now to that confusing sentence we met a page ago and try it again. The sentence was, "Our Earth is a part of the Solar System, which is a member of a galaxy called the Milky Way which is located in or part of the universe". Any clearer now? Let’s see.

Use the word list below and fill in the blanks in each of the following sentences:

1. The Earth is a _________.
2. A large group or cluster of stars is called a _______.
3. The sun is a ________.
4. The _________ is all matter and the space between it.
5. The _________ is the sun and all the heavenly bodies which revolve around it. Some of these bodies are: _________, _________, and _________.
6. The size of the Universe is _________.

UNIVERSE  GALAXY  METEORS  ASTEROIDS  STAR
COMETS  PLANET  LIMITLESS  SOLAR SYSTEM

Are you ready to go on?
Living in the twentieth century has many advantages. Ancient man had not accumulated the vast storehouse of knowledge we have available today. Much of what he knew was largely guesswork and accepting what appeared to be true. It is no wonder, then, that men had some incorrect notions about the Solar System.

Before the time of Christ, man knew about some of the planets but could not explain what they were or why they were in the heavens. The earliest theory about the planets was that they were wandering stars. Another theory said that they were gods with supernatural powers. As men began to learn more and investigate more closely, they drew the conclusion that the Earth was the center of the universe. It stood still, while all other heavenly bodies revolved around it. We can see why this theory appeared to be true. We cannot feel the earth moving; we say that the sun "rises" in the morning and "sets" in the evening, even though we know that it is the earth that is moving.

A scientist by the name of Copernicus was the first to conclude that the sun was the center of the Solar System and the Earth and the other planets revolved around it. It seems hard to understand why now, but people at first thought Copernicus was crazy for saying anything as ridiculous as the earth moved around the sun. But, remember — most people that thought the idea of the earth being round were foolish and ten or twenty years ago, we did not believe that man could travel into space.

The Planets

Revolving around the sun are ten planets that we know of. How many can you name? In the order of their distance from the sun they are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. Before studying about any one of the planets, let's consider planets in general. From our discussion, we should have figured out
that a planet is a heavenly body that revolves around a
star, and the planets which we're talking about here re-
volve around the star we know as the sun.

There are certain statements we can make which are true
of all planets. These statements will be just as true of
Mercury, the closest planet to the sun as they are of
Pluto, the farthest planet from the sun and they are also
true of the earth. These are important, so learn them
well:

1. Every planet has a fixed orbit. By this we mean that
the planets do not just travel around the sun but each has
a definite path which it follows. This path is called an
orbit. Each time a planet revolves, it follows exactly the
same path or orbit. We can see, then, that it is possible
to predict exactly where any planet will be next week, next
year, or a hundred years from now. Just as surely as spring
follows winter, a planet always travels in its own orbit.

2. All the planets revolve in a counter-clockwise direction.
There are really two important points to remember here.
The first, and this has been mentioned several times from
the beginning, all the planets do revolve, that is, they
travel around the sun in a path that roughly resembles a
circle. Actually there are times when the planet is closer
to the sun than it is at other times. The point in a
planet's orbit when it is closest to the sun and the point
when it is the farthest away have a name. See if you can
find these names in an encyclopedia, almanac, or library
book. The second thing to remember is that all the planets
travel in the same direction - counter-clockwise. Explain
what is meant by "clockwise and counter-clockwise".

3. All the planets rotate from west to east. As each
planet moves around the sun, it also rotates or spins. You
have all seen a globe which turns because axes are attached
at the north and south poles. Let us consider this for a
moment. We know that the earth is biggest around or "fat-
est" at the equator. Can we conclude that the equator
travels faster than the Tropic of Cancer or the Tropic of
Capricorn? It does. Since this is true, the further north
or south we go, the slower the earth travels until we reach
an imaginary point at the poles that does not move at all.
Each of these two points is called an Axis. We say, then,
that the earth, and as a matter of fact all the planets
rotate on their axes. It is relatively easy to see that the
Earth turns from west to east since the sun appears to rise
in the East and sets in the West, People in London, England,
which is further east than the United States, see the sun
before we do.

4. All planets reflect the light of the sun. We know that
the sun is made of burning gasses and therefore gives off
light. We also know that the moon seems to shine on a
clear night but that the light the moon gives off is not
its own. It reflects the light of the sun. Planets, too,
reflect sunlight. We cannot see the earth reflecting the
light of the sun, but if we were on the moon, the earth
would appear very much like a large moon. When we say that
something reflects light, we mean that light shines on it
and the light bounces off in such a manner that the object
itself seems to be giving off the light. Have you ever
seen a mirror pick up the sunlight and reflect it so it
shines in someone's eyes? I thought so! This is reflection
of light.

Let's summarize. We can make four general statements
which apply to all the planets. Every planet:

1. has a fixed orbit
2. revolves in a counter-clockwise direction
3. rotates from west to east
4. reflects the light of the sun.
A study of the individual planets can be very interesting and perhaps as a class report your teacher will ask you to find information on one of the planets. Where would be the best place to look for such information?

Let's take a look at some of the important facts about each of the planets:

**Mercury:**
- Size - 3,000 miles in diameter
- Distance from sun - 36,000,000 miles
- Number of moons - none
- Time of rotation - 88 days
- Time of revolution - 88 days

**Venus:**
- Size - 7,700 miles in diameter
- Distance from sun - 67,000,000 miles
- Number of moons - none
- Time of rotation - uncertain
- Time of revolution - 225 days

**Earth:**
- Size - 7,913 miles in diameter
- Distance from sun - 93,000,000 miles
- Number of moons - 1
- Time of rotation - 24 hours
- Time of revolution - 365 days

**Mars:**
- Size - 4,200 miles in diameter
- Distance from sun - 141,000,000 miles
- Number of moons - 2
- Time of rotation - 24½ hours
- Time of revolution - 687 days

**Jupiter:**
- Size - 88,000 miles
- Distance from sun - 489,000,000 miles
- Number of moons - 12
- Time of rotation - 10 hours
- Time of revolution - 12 years

**Saturn:**
- Size - 72,000 miles
- Distance from sun - 886,000,000 miles
- Number of moons - 9
<table>
<thead>
<tr>
<th></th>
<th>Time of rotation - 10½ hours</th>
<th>Time of revolution - 29½ years</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uranus</strong></td>
<td>Size - 31,000 miles in diameter</td>
<td>Distance from the sun - 1,782,000,000 miles</td>
</tr>
<tr>
<td></td>
<td>Number of moons - 5</td>
<td>Time of rotation - 11 hours</td>
</tr>
<tr>
<td></td>
<td>Time of revolution - 84 years</td>
<td></td>
</tr>
<tr>
<td><strong>Neptune</strong></td>
<td>Size - 33,000 miles in diameter</td>
<td>Distance from the sun - 2,800,000,000 miles</td>
</tr>
<tr>
<td></td>
<td>Number of moons - 2</td>
<td>Time of rotation - 16 hours</td>
</tr>
<tr>
<td></td>
<td>Time of revolution - 165 years</td>
<td></td>
</tr>
<tr>
<td><strong>Pluto</strong></td>
<td>Size - 3,000 (?) miles in diameter</td>
<td>Distance from the sun - 4,000,000,000 miles</td>
</tr>
<tr>
<td></td>
<td>Number of moons - probably none</td>
<td>Time of rotation - uncertain</td>
</tr>
<tr>
<td></td>
<td>Time of revolution - 248 years</td>
<td></td>
</tr>
</tbody>
</table>

There are some rather interesting facts about some of the planets. For instance, as indicated above, Mercury rotates and revolves in the same length of time. This means that the same side of the planet has always faced the sun. Since this planet has no atmosphere the side facing the sun reaches a temperature of over 700 degrees Fahrenheit while the side away from the sun is more than 400 degrees below zero.

The diameter of Jupiter is about 1,318 times as large as the earth. It is so large that if it were hollow all the other planets would easily fit inside.

A beautiful ring appears to surround Saturn. Actually, scientists have found that there are two rings, one inside the other. These rings are find particles revolving around the planet. An interesting report would be to find what scientists believe caused these rings.

There is quite a bit of uncertainty about Pluto. This
is because it is so far away. It was not even discovered until 1930, and was originally called Planet X. Its orbit is so large that it has not even completed one revolution since the United States became a nation.

What other interesting facts about the planets have you discovered?

The Sun

The Sun is the center and most important body in our Solar System. It is a huge ball of burning gasses 864,000 miles in diameter. An atmosphere, made up mostly of hydrogen and helium surrounds the sun. As a matter of fact, it is the sun's atmosphere that we see, rather than the sun itself. The sun is the source of energy for the earth and the other planets. Since the sun gives off energy it will eventually burn itself out. The gravity of the sun keeps the planets from hurling into outer space. The rotation, or spinning motion of the planets, keeps them from being drawn in by the sun's gravity. The sun is so large that about one million of our earths could fit inside of it. As you already know, the sun is 93,000,000 miles away. This may sound like a very great distance, but the next closest star to the earth is over 24 trillion miles away.

Moons, Comets, Asteroids, and Meteors

In our original definition of the Solar System, we learned that it includes not only the Sun and the Planets, but also other bodies that revolve around either the sun or one of the planets. The most important of these bodies are the moons.

There are 31 known moons in the Solar System. A moon is a heavenly body that revolves around a planet and shines by the reflected light of the sun. Of course, the moon we are most interested in, is the Earth's moon. Our moon is about 2,160 miles in diameter and is approximately 240,000 miles from the earth, and it takes the moon about 28 days
to complete one revolution around the earth. Since the same side of the moon always faces the earth, what does this mean?
APPENDIX E

A Proposal For Change In the Science Program In the Junior and Senior High Schools at Hilton.

This program includes an operational sequence for teaching science in the above mentioned grade levels.
The lethargy exhibited by high school students for science is a result of the evolution of the CONCEPT OF A "JUNIOR" HIGH

This has resulted in two general symptoms

1. The GENERAL SCIENCE CURRICULUM
   a. The curriculum ignores a teacher's subject preference and background.
   b. It ignores omissions and inadequacies in his training.
   c. It prevents genuine year to year continuity and depth.
   d. No provision for experimentation for new and better ways of challenging and stimulating both student and teacher.
   e. It offers little possibility for on-the-job training of new teachers.
   f. It cannot take advantage of the potential of team-teaching between junior-senior levels.
   g. It systematically spends 3 years discouraging students and training them to dislike science.

   1. Close to 100% lose interest and enthusiasm for science.
   2. Majority of students avoid chemistry and physics
   3. Those taking them experience difficulties far beyond that which the content warrants.

2. The lack of status and prestige existing among junior high teachers
   a. A teacher qualified to teach General Science must have majors in:
      1. Earth Science
      2. Biology
      3. Chemistry
      4. Physics
      Such people are not out looking for jobs teaching General Science.
   b. The frustrating demands of the curriculum drive out the new potentially good teachers.
   c. Teachers less well qualified must fill the jobs.
   d. Absence of prestige, adequate training, and love for teaching science cannot produce science minded students in the numbers demanded from our schools in this age.

   * This is not referring to a teacher "certified" to teach General Science,
A BASIS FOR A SCIENCE CURRICULUM

PURPOSE: This outline is presented as the basis for preparing an introductory science curriculum which is intended primarily to stimulate intelligent and critical thinking in the minds of the youngsters.

Objectives: The following four points are based on the assumption that to understand science, one's mind must be gradually developed to the point where he can go from the practical to the abstract or theoretical and back to reality again. This, being characteristic of young minds, would be much easier to develop in students than it would in adults.

The objectives of such a curriculum would be to:

1. Teach the basic principles of science from the start.

2. Develop an attitude in the student where he promptly starts his thinking on a problem with a clinical diagnosis by probing his mind in search of a basic truth. To omit this is to omit scientific thought.

3. Employ the use of problem solving early and persistently. This is essential in developing understanding, and it will accustom the student to the indispensibility of mathematics to understanding science.
4. Persistently incorporate into the curriculum, laboratory and demonstration problems which necessitate relating the problem to a basic law or theory.

Basic Principles: Listed below are six basic laws, theories, or principles which encompasses much of our science teaching.

1. Atomic Theory of Matter
2. Kinetic Molecular Theory of Matter
3. Electromotive force and magnetism
4. Gravity
5. Electromagnetism
6. Nuclear Forces and Radioactivity

Conclusion: When a basic principle of science is omitted or is not understood by the student, his education on the topic is arrested at that point. Any further pursuit of the problem beyond this point in his development can only be superficial and can be concerned only with the obvious. From that point on since the youngster's mind cannot be stimulated he only continues his study as a spectator. He will continue to make courageous attempts and master impressive amounts of facts, but he can no longer pursue this topic scientifically. They continue to display fascination over spectacular demonstrations and new
observations, but once the experiment ends so will their interest.

On the following page are listed a group of familiar topics generally taught and the basic principles to which they are related.
## BASIC PRINCIPLES OF SCIENCE AND SOME RELATED TOPICS *

<table>
<thead>
<tr>
<th>Atomic Theory</th>
<th>Kinetic Molecular theory</th>
<th>Gravity</th>
<th>Electromotive Forces</th>
<th>Radiant energy</th>
<th>Nuclear forces</th>
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<tbody>
<tr>
<td>1. elements</td>
<td>1. Heat + work</td>
<td>1. weather + climate</td>
<td>1. light</td>
<td>1. Energy of sun and stars</td>
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<td>2. molecules,</td>
<td>2. molecules, valence</td>
<td>2. Work of</td>
<td>2. infra red</td>
<td>2. nuclear energy</td>
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<td>3. bonding</td>
<td>3. chemical reactions and compounds</td>
<td>3. water</td>
<td>3. work + friction</td>
<td>3. gamma and high energy</td>
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<tr>
<td>4. Periodic</td>
<td>4. Periodic Table</td>
<td>4. weather + climate</td>
<td>4. satellites</td>
<td>4. atomic bomb</td>
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<tr>
<td>5. states of matter</td>
<td>5. expansion</td>
<td>5. expansion</td>
<td>5. generators</td>
<td>5. hydrogen bomb</td>
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<td>a. solids</td>
<td>a. solids</td>
<td>6. function of the ear</td>
<td>6. electricity</td>
<td>6. the eye</td>
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<td>b. liquids</td>
<td>b. liquids</td>
<td>7. diffusion</td>
<td>7. color + spectrum</td>
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<td></td>
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<tr>
<td>c. gases</td>
<td>c. gases</td>
<td>8. density</td>
<td>8. density</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. acids-bases-salts</td>
<td>10. principles of air flight</td>
<td>10. principles of air flight</td>
<td>10. principles of air flight</td>
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<td></td>
</tr>
<tr>
<td>8. digestion</td>
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<td>8. digestion</td>
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<tr>
<td>a. conductors</td>
<td>a. conductors</td>
<td>11. heat energy in machines</td>
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<tr>
<td>b. non-conductors</td>
<td>b. non-conductors</td>
<td>12. work energy</td>
<td>12. work energy</td>
<td>12. work energy</td>
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</tr>
</tbody>
</table>

*Note: This obviously is a cursory list made only for illustration, but many familiar topics have been included.
## OPERATION SEQUENCE

**Hilton Central School District**

**Science Department**

<table>
<thead>
<tr>
<th>7th</th>
<th>8th</th>
<th>9th</th>
<th>10th</th>
<th>11th</th>
<th>12th</th>
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<tbody>
<tr>
<td>(A) non-college Earth Sci.</td>
<td>Introduction to Chemistry (20 wks.)</td>
<td>Introd. to Introduction to Physics (fall sem.)</td>
<td>End for most in Biology-Health (Spr. Sem.)</td>
<td>Group A1</td>
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<tr>
<td>(A2)</td>
<td>Introd. to</td>
<td>Biology</td>
<td>Physical Science</td>
<td>End</td>
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<tr>
<td>(B2) Non-chemistry</td>
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<td>Intro. to</td>
<td>Physics (40 wks.)</td>
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<td>Biology (regents)</td>
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<td>(B) college ability</td>
<td>Non-physics</td>
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<td></td>
<td>Intro. to Non-physics (spr. sem)</td>
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</tbody>
</table>

Advanced science electives:
- a. BSOS Bio,
- b. CHEM.
- c. PSSC
APPENDIX F

Teacher-made Tests

This is the result of a cooperative effort on the part of the teachers of grades five and six in trying to develop a teacher-made test that is geared to meet the needs of the present science program.
FIFTH GRADE
June 1962
Name: _______________________

Final Examination   Science   Grade 5   Teacher ______

READ AND FOLLOW ALL INSTRUCTIONS CAREFULLY

I. Write True in the space before each sentence if the statement is true; write False if it is false. (1 point each)

______ 1. Mushrooms grow from seeds.
______ 2. Dry cells have a + and - terminal.
______ 3. Amoeba is a one-celled plant.
______ 4. Sun spots have no direct effect on the weather.
______ 5. Arteries carry blood to the heart.
______ 6. A compass does not point true north.
______ 7. The stem is the anchor of the plant.
______ 8. Water is a good conductor of electricity.
______ 9. There are three different types of levers.
______ 10. Steel and coal are natural resources.
______ 11. Contour plowing and strip farming prevent soil erosion.
______ 12. The door knob is a wheel and axle.
______ 13. Wild life is never affected by polluted water.
______ 15. Unlike charges attract, like charges repel.
______ 16. A barometer measures the amount of moisture in the air.
II. Choose the words in Column II which match the words in Column I and write the correct letter in the space provided:

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The condition of the atmosphere</td>
<td>a. eclipse</td>
</tr>
<tr>
<td>in a specific area over a long period of time</td>
<td></td>
</tr>
<tr>
<td>2. a kind of cloud</td>
<td>b. conservation</td>
</tr>
<tr>
<td>3. liver</td>
<td>c. climate</td>
</tr>
<tr>
<td>4. zero degrees longitude</td>
<td>d. electrons</td>
</tr>
<tr>
<td>5. blotting out of light</td>
<td>e. organ</td>
</tr>
<tr>
<td>6. small, negative charges of electricity</td>
<td>f. cirrus</td>
</tr>
<tr>
<td>7. saving and wise use of natural resources</td>
<td>g. Prime Meridian</td>
</tr>
</tbody>
</table>

III. Choose the word which makes the sentence correct and write it on the line before the statement.

(1 point each)

1. The earth makes a complete turn in (12 hours, 24 hours, a little less than a month).

2. Nature's green factory where a plant manufactures its own food is the (root, stem, leaf).

3. When water freezes it (contracts, expands, no change takes place).

4. We say the earth (revolves, rotates, gravitates) around the sun.

5. The age of a tree can be told by counting its (leaves, annual rings, root system).
6. The machine used in prying something open is the (pulley, wheel and axle, lever).
7. The lungs are protected by the (skull, ribs, stomach).

IV. Complete the following statements by adding the proper words or word: (2 points each)

1. Another name for molten rock is ____________.
2. If one light in a circuit goes out and all others remain lighted, this is an example of a _________ circuit.
3. A blanket of air covering the earth is the _________.
4. The part of the plant on which pollen is found is called the ____________.
5. Zero degrees latitude is the ____________.
6. An insect that is a carrier of disease is a ________
7. The two major gases of the atmosphere are _______ and ________.
8. The body can make use of food only after it has been ________.
9. A ball will always fall to the earth because of the law of ________.
10. Our normal body temperature is ________.
11. Meat and fish are examples of ________ foods.
12. The support of a lever is called the ________.
13. An instrument used to make objects look larger is a ____________.
14. $\text{H}_2\text{O}$ is the symbol for __________.
15. The wearing away of land by wind and water is called __________.
V. Choose from the list of words below the word or words to answer the following questions. (1 point each)

1. sun 7. screw 13. nucleus
2. digestion 8. humidity 14. short circuit
3. moon 9. fertilizers 15. rubber
4. cell 10. pulley 16. fuse
5. aluminum foil 11. expand 17. respiration
6. saliva 12. mountains 18. contract
19. chlorophyll

1. A good material for insulation in electricity is

2. Two bare wires touching each other cause a

3. When water freezes it

4. A digestive juice found in the mouth is

5. The

6. The amount of moisture in the air is known as

7. The process of breathing is called

8. The changing and shifting of the earth’s surface makes

9. A safety device used in an electric circuit is a

10. A small living unit of which all living things are made is a

11. An example of a circular inclined plane is a

12. gives plants their green color.

13. A simple machine used to raise and lower a flag is

14. Every living cell has a

15. Man has learned to enrich the soil by using
VI. Thought questions.
There are seven questions below. You may answer only five of them. (5 points each)

1. List three ways in which living things differ from non-living.
   1. 
   2. 
   3. 

2. Name five things necessary for plant growth.
   1. 
   2. 
   3. 
   4. 
   5. 

3. The following organs are part of the Digestive System. Put them in the correct order.
   1. mouth 
   2. large intestines 
   3. stomach 
   4. esophagus 
   5. small intestines

4. A. List three ways by which our natural resources have been misused.
   1. 
   2. 
   3. 

   B. List two ways we have learned to conserve our natural resources.
   1. 
   2.
5. List 5 ways in which seeds are dispersed.
   1.
   2.
   3.
   4.
   5.

6. Here are five simple machines, give an example of each.
   1. lever -
   2. pulley -
   3. wheel and axle -
   4. inclined plane -
   5. wedge -

7. A. Name two harmful insects and tell how each is harmful.

   B. Helpful insects - name two such insects and tell how each is helpful.
I. Write the word TRUE if the statement is true.
Write the word FALSE if the statement is false.

(15 points)

1. Plants that are green cannot make their own food. True

2. The earth spins from west to east on its axis. True

3. The smallest part in a magnet that still has a N and S pole is called a molecule. True

4. Earthworms are very valuable to have in the soil. False

5. Rubber, glass, popcorn, wood, paper and plastic are good conductors of electricity. False

6. The planet Venus is the closest to the Sun. True

7. Nimbus or nimbo means rain cloud. True

8. Weather means the average weather over a given period of time. True

9. It takes the earth about 365 days to make one rotation. False

10. Electrical circuits in homes and factories are connected in series. False

11. Humidity refers to the amount of moisture in the air. True

12. All animals have some method of reproduction. True

13. From our discussions we discovered that the sun has little effect upon the earth. True

14. The control center of a cell is the nucleus. True
15. A magnet which has force only when an electric current is passing through it is called a permanent magnet.

II. Fill the blanks in the sentences with words from the following list. As soon as you have used a word, cross it out. (30 points)

<table>
<thead>
<tr>
<th>STRATUS</th>
<th>PHASES</th>
<th>25½</th>
<th>12.7</th>
</tr>
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<tbody>
<tr>
<td>CELL</td>
<td>14.7</td>
<td>PLUTO</td>
<td>MICROSCOPIC</td>
</tr>
<tr>
<td>COMPLETE</td>
<td>CONDUCTOR</td>
<td>EXPANDS</td>
<td>TISSUE</td>
</tr>
<tr>
<td>CUMULUS</td>
<td>SUPPORT</td>
<td>FOGL</td>
<td>PRESSURE</td>
</tr>
<tr>
<td>13%</td>
<td>MARS</td>
<td>CIRRUS</td>
<td>TROPOSPHERE</td>
</tr>
<tr>
<td>REFLECTED</td>
<td>FUSE</td>
<td>BROKEN</td>
<td>BATTERY</td>
</tr>
</tbody>
</table>

1. If you connect two or more electric cells together you have a _________.

2. The planet farthest from the sun is called _________.

3. Something too small to be seen with the naked eye is called _________.

4. The smallest living portion of anything is called a _________.

5. Every 29½ days the moon passes through a series of ________, from the usually invisible new moon to the quarter moon, to full moon, to quarter moon, to new moon again.

6. At sea level a vertical column of air exerts a pressure of ______ pounds per square inch.

7. The earth's tilt (inclination) is about ______ degrees.

8. A cloud that is close to the ground and causes poor visibility is called _________.

9. The planets shine by ________ light.

10. A safety device in electrical circuits is called a _________.

11. A low, flat cloud covering a large area would be called _________.

12. A powder-puff type of cloud would be called _________.

13. A high, feather type of cloud would be called _______.
14. When a current of electricity makes a complete trip (from its source, through an appliance, and back to its source) we say we have a ___________ circuit.

15. The human skeleton is used for ___________.

III. Cross out the wrong word or group of words in parentheses (7 points)

1. Zoology is the study of (plant) (animal) life.

2. Man is (a vertebrate) (an invertebrate).

3. Our atmosphere is divided into four layers. The layer that we are living in is called the (exosphere) (troposphere) (stratosphere) (ionosphere).

4. Unlike poles of a magnet (repel) (short) (attract) (positive) each other.

5. A magnet which keeps its force constantly is (an atomic) (a permanent) (an electro) magnet.

6. A parasite lives (with) (on) a host or another living thing.

7. Blood is returned to the heart by (arteries) (veins).

IV. In each of the following items, select the best answer and write the letter in the space to the left of the number.

_____ 1. A magnet will not pick up a (a) needle (b) paper clip (c) copper penny (d) pocket knife.

_____ 2. Which of the following numbers represents the number of miles light travels per second? (a) 186,000,000 (b) 1,100 (c) 186,000 (d) 250.

_____ 3. Rocket motors currently being used in launching satellites use which of the following fuels? (a) solid (b) atomic (c) turbo-prop (d) liquid.

_____ 4. The man who made the first successful electric light bulb was (a) Volta (b) Edison (c) Faraday (d) Galvain.

_____ 5. The living substance of a cell is called (a) protoplasm (b) calyx (c) food vacuoles (d) cytoplasm.
6. The first man to make a successful space flight in a rocket was (a) Allen Shepard (b) David Brinkley (c) Yogi Bear (d) Udell (e) Yuri Gagarin.

7. A device to step up or step down the voltage of AC current is a (a) dynamo (b) transformer (c) generator (d) centrifuge.

8. An instrument which measures the pressure of air is called a (a) barometer (b) thermometer (c) nephoscope (d) altimeter.

9. An example of a single celled animal is (a) an amoeba (b) a mold (c) a lichen (d) bacteria.

10. Botany is the science which deals with the study of (a) birds (b) plants (c) beavers (d) stars.

11. The most abundant gas by volume in our atmosphere is (a) oxygen (b) hydrogen (c) nitrogen (d) helium.

12. Electricity which is formed by rubbing objects together is called (a) current electricity (b) static electricity (c) magnetism (d) direct current.

13. All of the world's weather occurs in the (a) troposphere (b) exosphere (c) stratosphere (d) ionosphere.

14. The female organ of a plant which receives the pollen is called the (a) petal (b) pistil (c) stamen (d) spore.

15. After a celestial mass of either stone or metal has gone through the atmosphere and hit the surface of the earth, the mass is called (a) a planet (b) a meter (c) meteor (d) an asteroid (e) a meteorite.

V. Match column B with Column A and write the letter of the correct answer in the space at the left of each item in Column A.
Colmum A                        Column B

1. Patterns in the sky formed a. galaxy
   by a group of stars
2. Measure of electrical b. invertebrate
   energy
3. An instrument which records d. vertebrate
   the amount of water vapor
   in the air
4. An animal that has no e. volt
   backbone
5. A large group of millions f. constellations
   of stars
6. An animal with a backbone g. hygrograph or
7. A unit of electrical h. watt
   pressure

VI. Answer any five (5) of the following questions
    Follow the directions given with each question you
    select to answer.          (25 points)

1. There are four (4) main differences between plant
   cells and animal cells, list them below.

   Plant Cells                               Animal Cells
   1.                                          1.
   2.                                          2.
   3.                                          3.
   4.                                          4.

2. List the known planets, in order, starting with the
   one nearest the sun.
3. In the box below, diagram and label three (3) lights in parallel; wired to two (2) cells in a series. (Include a switch so the lights are on.)

4. We have winds which are called "Continental Polar or Tropical", "Maritime Polar or Tropical". On the map below name the wind that goes with the arrow.
5. How many pounds of air would be pushing down on this page at sea level? (This page measures about 8" x 11")

6. Label the parts of the cell below using the following: cell wall, food vacuole, nucleus, cytoplasm, protoplasm

7. Write what five (5) of the following words mean in connection with weather.
   a. wind vane -
   b. anemometer -
   c. rain gauge -
   d. thermometer -
   e. barometer -
   f. nephoscope -
   g. hygrometer -