A COMPARISON OF SELECTED EXPERIENCES WITHIN A SCIENCE CURRICULUM AS THEY AFFECT THE ACHIEVEMENT OF THE INTELLECTUALLY GIFTED STUDENT

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PREFACE

The research in this thesis sought to determine the educational outcome of intellectually gifted students in two separate learning environments. One group, the experimental group, received a more teacher directed method of learning while the other group, the control group, was involved in class discussion followed by independent study. Both groups were evaluated by identical pre tests at the beginning of the study and identical post tests at the end of the study. Four students from each group were chosen at random to participate in interviews at the conclusion of the study in an effort to ascertain student evaluation of the experience.

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TABLE OF CONTENTS

LIST OF TABLES

CHAPTER I

INTRODUCTION

This study was conducted to contribute to the research related to effective teaching interventions in gifted education. A major segment of the research conducted in the area of gifted education has focused on entire curriculums; that is, ideas and concepts for use in pull-out programs, not necessarily designed to evaluate different and varied teaching / learning interventions.

The best way to educate the intellectually gifted child has been a source of concern and debate since the notion of "giftedness" began. The first quantitative psychological study of giftedness was attributed to Francis Galton in 1870; "Hereditary Genius: An Inquiry into Its Laws and Consequences". The author stated that mental capacities are inherited and follow certain laws of transmission (Clendening and Davies, 1980). In the 1890's, Alfred Binet was hired by government officials to determine which children should receive special training. A test for intelligence was badly needed due to the fact that some students were placed in schools for the retarded because they were too quiet, too aggressive, or had speech, hearing, or vision problems. Today, Binet is best known in the United States for the revision of his intelligence scale, which was originally designed by Lewis Terman in 1921. This test, the Stanford-Binet Intelligence Scale, originated when no one questioned the belief in fixed intelligence (Clark, 1983).

In 1971, a report to Congress by the United States Commissioner of Education Sidney Marland defined for the first time in United States history the rights of gifted and talented children. It read as follows: "Gifted and talented children are those identified by professionally qualified persons who by virtue of outstanding abilities are capable of high performance. These are children who require differentiated educational programs and services beyond those normally provided by the regular school program in order to realize their contribution to self and society. Children capable of high performance include those with demonstrated achievement and/or potential in any of the following areas:

1. General intellectual ability
2. Specific academic aptitude
3. Creative or productive thinking
4. Leadership ability
5. Visual and performing arts
6. Psychomotor ability

Three major types of gifted education are generally found throughout the schools in the United States today. Acceleration began in the early 1900's. This type of gifted education allows the student to work at his/her own academic pace, allowing him/her to advance through the curriculum at a pace that interests and benefits the student. However, acceleration may put unnecessary stress on the student, who may lack the maturity to handle all the information given, which may cause gaps in knowledge.

Enrichment takes place in the regular classroom. More in-depth or thorough study in a certain area is a frequent occurrence. The gifted child may be enriched "horizontally"; this keeps the study in-depth, but it does not infringe upon the curriculum of the next grade.

The difference between acceleration and enrichment may be thought of as follows: Any strategy that results in advanced placement or credit may be titled "Acceleration". Strategies which supplement or go beyond standard grade level work but do not result in advanced placement or credit may be called "Enrichment".

Pull-Out is the term given to a prescribed amount of time that a gifted child spends out of the regular classroom with another teacher. In this type of program, the teacher must guard against letting his/her program be one of merely "fun and games". Many times, the child in a pull-out situation is expected to make up all of the work missed while he/she is out of the regular classroom. Thus, the child may view this special "privilege" as a punishment. Of the gifted and talented programs in the United States, approximately 72% are pull-out programs (Cox, Daniel, and Boston, 1984).

Within each of these three methods, the discussion of the effectiveness of independent study as a learning intervention has often been a concern. Do these children learn the concepts that are expected of them when left to do it on their own? How much guidance is needed to assure as best we can that what is being accomplished in an independent study environment is actually pertinent information? This consideration was an underlying issue as this study was conceptualized.

Pascal (1971) and Smith (1978) developed a research-based instrument, the Learning Styles Inventory (LSI), in which a guide was designed to help teachers plan learning experiences with their student's learning style in mind. Stewart (1979) designed some variations on the LSI which showed that the learning style preferences for gifted students were independent study and projects, while students in the general population preferred lecture and teaching games.

This study sought to determine the educational outcomes of intellectually gifted students in two separate learning environments. One group, the experimental group, received a more teacher directed approach accompanied by selected learning experiences. The other group, the control group, was involved in class discussion followed by independent study. Both groups were evaluated by identical pre tests at the beginning of the study and identical post test at the conclusion of the study. Four students from each group were selected at random at the end of the study to participate in interviews in an effort to ascertain student evaluation of their own experience in both of the groups. The results of these interviews may be found in Appendix E.

Statement of the Problem

The purpose of this study was to investigate selected experiences within a science curriculum as they affect the educational outcomes of fourth grade homogeneously grouped intellectually gifted children in two separate learning environments. These selected experiences are defined to mean one of two methods, either independent study, or a more teacher directed method in the presentation of a science unit dealing with the earth's structure. This study sought to ascertain whether several different learning experiences might enhance student achievement. The null hypothesis to be tested was, "There is no difference in the achievement of gifted students between those taught in a classroom in which the emphasis is on independent study (the control group), and those taught in a classroom in which the emphasis is on a more teacher directed approach to learning which includes special interventions (the experimental group)."

Research Questions

1. Will the experimental group score higher than the control group on the post test after a more teacher directed method of instruction?

2. Will the control group score higher than the experimental group on the post test when independent study is involved?

3. Will the results of the study show a statistical significance when the achievement of the two groups are analyzed?

4. If there is a difference on selected items on the post test, could there be factors that attributed to the difference?

5. When given the opportunity to do independent study, will the student show that he/she acquired the knowledge that the student in a more teacher directed lesson received?

6. When participating in a more teacher directed method of instruction, will the student show that he/she acquired the knowledge that the student in an independent study

method received?

Definition of Terms

The following terms which are discussed in this thesis may be defined as follows: Learning Style Preference in this study (other than when discussed in the literature review in chapter two) refers to the student's preferred learning style choice among one of the following methods: Independent study, experiments, centers, or teacher/mentor presentation. Intellectually Gifted Students in this study refer to the top three percent of the grade level population as determined from the scores on the Otis-Lennon School Ability Test or the Wechsler Intelligence Scale for Children, Revised (WISC-R). Independent Study refers to the choice that the students in the control group had when choosing their self study projects. After the chapter in the book was read and discussed, each child chose a topic for further study that was of particular interest to him/her. The role of the teacher was that of facilitator, as the teacher had no input in the topic choice. The Control Group refers to those students who read and discussed the chapter and then contracted for independent study. Since independent study is commonplace in the gifted classroom, the students who were involved in independent study were viewed as the norm. The Experimental Group refers to those students who received a more teacher directed method of study which included the following interventions: (1) Learning centers, which involved the utilization of relevant learning activities, (2) The use of technological aids such as filmstrips and videotapes, (3) A guest lecturer who discussed the earth's structure, and (4) Task sheets that challenged the students to apply what they had learned.

The remaining chapters in this study are organized as follows: In chapter two, significant excerpts from the relevant literature pertaining to learning and learning style preferences in gifted education and science education for the gifted student will be presented. The information in chapter three, Methodology, will acquaint the reader with the population studied, the purpose and the procedure, the statement of the hypothesis, as well as the statistical and instructional procedures that were used in this study. In chapter four, the analysis of data and results will be reviewed in narrative and table form. The information presented in chapter five, the final chapter in this thesis, will summarize the results of this study, address the research questions that were proposed in chapter one, and suggest areas for further research.

CHAPTER II

REVIEW OF THE LITERATURE

One of the greatest challenges facing advocates of education of the gifted is the effort to provide bright children with appropriate and challenging educational experiences throughout all the days and hours of the school year. Such a challenge must reach beyond the range of any enrichment program and address the procedures used for teaching the basic curriculum (Starko, 1986).

The gifted student needs opportunities to do individual investigating. Too often , however, students who are asked to do independent research are not given guidance in the "how to's" of investigation (McDonnel, 1981). Brandwein (1986) states that an appropriate science curriculum for the gifted should also reflect an emphasis on more independent laboratory work, more extensive reading and emphasis of the skills of using the library, and more true experimental work.

Science programs for the gifted should put a premium on student exposure to real scientific problems and inquiry as engaged by scientists, and of students setting up original experiments in proposal form. Without this kind of program, only a superficial sense of science is possible (Van Tassel-Baska and Kulieke, 1987). A key component of effective science programs for the gifted, according to Van Tassel-Baska and Kulieke (1986), is the opportunity for students to interact with practicing scientists as mentors, as teachers, and as role models. Van Tassel-Baska and Kulieke (1986) suggest that science education can and should be made more realistic and should include training in problem finding, problem solving, problem reevaluation, and scientific reporting. Thus, an effective science program for talented learners incorporates: 1) a strong emphasis on inquiry processes, 2) opportunities for real laboratory experimentation and original research work, 3) high level content-based curriculum that is conceptually strong, 4) opportunities for interactions with practicing scientists, 5) a curriculum rich in current technological advances (Van-Tassel-Baska and Kulieke, 1986). Sternberg (1982) adds that there are several key components to an appropriate science program for gifted learners. One of these is a strong emphasis on inquiry-based activities.

Gifted students need not only a stimulating environment, but also instruction in independent study (Doherty and Evans, 1981). According to D'Zamko and Raisel (1986), one drawback of individualized instruction is that a sense of isolation can develop when pupils spend the majority of their time having little contact with others. Individualized group work, on the other hand, provides the opportunity for peer interaction and encourages a feeling of belonging. In addition, directed instruction may prevent pupil mistakes. Because teachers interact more frequently with pupils, they are able to monitor pupil work, provide more immediate feedback, and give more personal attention to each pupil. Experience shows that the acceleration of gifted students tends to be most successful when it is possible to accelerate students together, rather than individuals in isolation (Morgan, Tennant, Gold, 1980). Almost a quarter of the teachers in the sample identified setting additional work or homework as the way in which able pupils could be more effectively accommodated. Another widespread theory was to set extra factual work from reference books, with the inherent dangers of children looking upon school work as simply "copying out of the telephone directory". There was, however, an alternative line of thinking in the responses which played up pupil independence. Teachers making this kind of response suggested that able students could stamp their own individuality on work, and that this should be encouraged. They could also work independently of one teacher for long periods. Some teachers went as far as to suggest that able pupils should be specifically encouraged to choose their own areas of work and develop their personal interests (Kerry, 1987).

There is much evidence accumulated to show that most very able students prefer to work on their own for at least a proportion of their time, that they want to progress at their own rate, and moreover, that they often have idiosyncratic learning styles not accommodated in group activities. It is interesting to note that most of the activities suggested (in the study described in the article) had a large component of "hands on", particularly in the light of considerable literature on able children which asserts that they can grasp theory with a minimum of practical experience (Endean and George, 1983).

When doing independent research and study, gifted children need guidance in developing an independent research plan. According to Maltby (1986), for able children to be able to make the most of project work, their study skills need to be developed. The fact that they have chosen to work on a subject or activity encourages motivation. Children appreciate when work is relevant to them as individuals, and as a result are more prepared to make an effort to overcome their own individual difficulties.

Bull and Land (1986) discuss the steps that are necessary in the development of an independent research plan. They are: selecting and delimiting of a subject or topic, discussing and brainstorming possible subject areas and questions to explore with the chosen subject or topic, determining the intended audience, formulating key questions or issues to pursue and answer, developing a commitment to a plan and a time sequence, locating and utilizing multiple resources and the development of a methodological plan, creating a product from the material learned and showing how it will be demonstrated, sharing with classmates the findings from the study, evaluating the process and the products from the study and how the time was spent, and exploring possibilities which could extend the study into new areas of learning.

Research indicates that group instruction is more effective than individualized instruction; that is, academic gains are greater when pupils are taught in groups (Dunkin and Biddle, 1974; Medley, 1977). Directed instruction leads to more pupil learning, resulting in increased academic achievement (Fisher, et. al., 1980). Pupils need a great deal of directed instruction if they are to maintain on-task behavior (Berliner and Rosenshine, 1976; Rosenshine, 1980). Although there is no research regarding the techniques of individualized directed group instruction, major components have been studied. It has been shown that directed instruction will result in greater pupil involvement in learning tasks (Brophy and Evertson, 1977; Dunkin and Biddle, 1974; Englert and Thomas, 1982; Rosenshine, 1980; Soar, 1973; Stallings and Kaskiwitz, 1974).

A good teacher wants to give as much opportunity for self-direction and responsible activity as students are able to handle. For gifted students this freedom of direction and expression is a primary goal (Doherty and Evans, 1981).

Seventy percent of a student's time can be spent in an In-Depth Study, but the remaining thirty percent needs to be involved with the development of new areas of exploration, new skills, concepts and attitudes, and the development autonomy of the individual (Betts, 1985).

Multiple resources are needed to serve the talented science student best.These resources include diverse role models such as teachers, tutors, and mentors working collaboratively with students; a curriculum /instructional delivery system that provides multiple perspectives on issues and demonstrates diverse teaching strategies to explore them; and access to multiple texts and science materials in a classroom as well as a library setting (Van Tassel-Baska and Kulieke, 1987).

Gifted students can increase their knowledge in science in the context of learning the methods of scientific inquiry in a relatively short period of time (Van Tassel-Baska and Kulieke, 1987). The problem a gifted child may encounter in an elementary science program is that it may be too limited in scope and only scratch the surface of the subject matter. The child's interests may far outreach the content available. This lack of sufficient depth and breadth in the curriculum may hinder the gifted child's learning opportunities and eventually stifle the child (Blurton, 1983).

The preferred learning style preferences for gifted students have been shown to be independent study and projects (Stewart, 1979). Recent findings suggest that gifted learners spontaneously employ more elaborate and effective learning strategies than do peers of their own age. Studies done by Dunn and Price (1980) and Stewart (1979) show that preferences among the gifted include a greater degree of independence, a desire for less structure in the learning environment, less teacher motivation, and a higher preference for independent study than their average peers. In addition, gifted students were found to be more highly motivated, persistent, and responsible, preferring less auditory learning and more tactile learning (Ricca, 1984). Stewart (1981) conducted a study using the Renzulli and Smith Learning Styles Inventory (1978) to identify the significant learning styles used by gifted students. Her results indicated that gifted students differed in their preferred styles of learning from students of the general population, that learning style preferences were influenced by certain other factors- grade level, sex, favorite subject, I. Q. , locus of control, and strongest achievement area- and that there was some preference among gifted children for instructional methods which emphasized independence (independent study, discussion).

It is pointed out by Kaplan (1986), however, that the differentiated curriculum design which follows program selection should not expect gifted students to define the entire curriculum and instruct themselves. Independence of thought and independence of action are falsely correlated. Placing too much responsibility on the gifted learner to direct his/her own education without proper teacher intervention is not in the best interest of the child.

G. Brian Thompson (1987) suggests that at six years of age gifted children may be exposed to regular classroom programs which do little other than attempt to teach them what they already know. The possibility that a creative ceiling effect may be created, where the solutions are so evident that they preclude dealing with the problem situation carefully. Efficient, effective problem solvers do not re-invent solutions for problems that they have successfully solved in the past. They simply use the solutions that have worked before (Cramond and Marlin, 1979).

A study conducted by the National School Public Relations Association (1972) suggests that self-directed learning results in more positive learning attitudes, more positive self-concepts, more positive attitudes toward classmates, and more favorable attitudes toward subject matter in general. Pupil-teacher time together has been shown to correlate with success in the classroom (Lindelow, 1983), and learning environments arranged to meet individual needs demonstrated an improvement in cognitive growth (Maker, 1982).

Self-directed learning has been particularly effective in the area of gifted education, since research shows gifted students to be independent in thought and judgment, self-starting, perseverant, and capable of abstractions and generalizations (Gallagher, 1975, Treffinger, 1975).

The study described in this thesis attempted to show the relationship of achievement to learning interventions in the gifted classroom. It can be seen from the literature presented in this chapter that gifted students need not only a stimulating environment, but also instruction in independent study (Doherty and Evans, 1981). This study sought to ascertain the educational outcomes of intellectually gifted students in two separate learning environments, one of which was a more teacher directed approach accompanied by selected learning experiences, while the other approach provided the opportunity for independent study.

In the chapter which follows, Methodology, an outline of the procedures is presented including population studied, the purpose of the study, statement of the hypothesis, and statistical and instructional procedures.

CHAPTER III

METHODOLOGY

Introduction

This study was done in an effort to determine the educational outcomes of intellectually gifted students in two separate learning environments. One group, the experimental group, received a more teacher directed approach accompanied by selected learning experiences. The other group, the control group, was involved in the traditional pattern of instruction for gifted and talented students in which class discussion and independent study are the norm. The researcher also sought to determine the learning style preferences of the students.

Population

Subjects for this study were intellectually gifted (the top three percent of the grade level population as determined from the scores on the Otis-Lennon School Ability Test or the Wechsler Intelligence Scale for Children, Revised, also known as the WISC-R) fourth grade students in two gifted classrooms in a middle class elementary school in a major city in Oklahoma. Both groups attended the examining teacher's class daily, as the two classes are taught by a two-member team. One of the classes had a membership of 27, which included 13 girls and 14 boys, while the other class contained 29 students, of which there were 16 girls and 13 boys. Fifty two of the students were white, two were black, and two were Asian. All of the children had at least one parent working out of the home. There were no children with physical handicaps, and none had identified emotional problems.

Instrument

A comparison of selected activities within a science curriculum as they affect the achievement of intellectually gifted fourth grade students will be determined by comparing two different methods of study. Identical pre tests were administered to the control group and the experimental group, and both groups were given identical post tests at the end of the study. A randomly selected cohort from each group were interviewed after the study in an effort to gain further insight into the success of the experience. Four students from each group participated in the interviews.

Purpose

The purpose of this study was to investigate the educational outcomes of fourth grade intellectually gifted children in two separate learning environments. While gifted students may be expected to learn in any teaching/learning environment, this study sought to ascertain whether several different learning interventions might enhance student achievement.

Procedure

In the fall of 1989, intellectually gifted fourth graders were randomly assigned to one of two gifted classrooms in a middle class elementary school in a major city in Oklahoma. These students participated in this study. Both classes were involved in a 12 day science unit dealing with the earth's structure. Both classes used the same textbook. The experimental group participated in enhanced, teacher directed methods of instruction. This intervention provided the students learning experiences which involved the utilization of relevant learning center activities as well as the use of technological aids such as filmstrips and videotapes. In addition, selected guest lecturers provided further enrichment information. Finally, the teacher conducted two demonstration experiments for the students in the experimental group. The control group contracted to do independent study projects. The same pre test, designed by the teacher, was given to both groups. The post test instrument administered to each group was the test designed for use with the unit in the text.

Permission from the school district for student participation in the study was obtained. Both groups received the same amount of related subject time in the classroom. The same teacher administered the unit to both groups. Both groups used the same textbook, Merrill's *Science,* Book Five, Merrill Publishing Company, 1989. Chapter 14, The Earth's Surface, was the chapter studied by both groups.

Statement of the Hypothesis

There is no difference in the achievement of gifted students between those taught in a classroom in which the emphasis is independent study (the control group) and those taught in a classroom in which the emphasis is a more teacher directed method of study incorporated with special interventions (the experimental group).

Statistical Procedure

This study sought to investigate a cause and an effect relationship between two variables. Specifically it assesses the effect of an independent variable on a dependent variable.

The experiences of both groups (the control group and the experimental group) were designed to be as equal as possible on all important variables except, of course, on the independent variable or the alleged cause. The effect of the treatment, or the difference, is the dependent variable.

The experimental group received, as described earlier, a treatment embracing several interventions not afforded the control group.

The statistical analysis used was the t test. It is a method used to ascertain the significance of two means. It functions to compare the actual mean difference with the difference that would be expected by chance. The t test was used to analyze the data from both groups, first on the results of the pre tests and again on the results of the post tests.

Although there was no statistical difference evident on the pre test scores, an analysis of co-variance was done because there was a difference on the pre test means. The analysis of co-variance adjusts statistically the post test means to what they (the post test means) would have been if the pre test means of the groups were the same. In other words, the groups have been compared after they have been equalized.

Instructional Procedure

The details of the daily instructions and activities of each group are presented in Appendix A. Certain of the specific interventions in the instruction afforded the experimental group that were not available in the control group were the following:

1. Center activities: The students received instruction and then worked on centers that reinforced information presented in the unit. The centers contained information on structure of the earth, rock identification, seismic wave activity, earthquake belts, determining properties of rocks and minerals, mechanical weathering of rocks and minerals, and the transport and sorting of rocks and minerals.

2. Use of consultants: An expert in the field of geology and physics made a presentation to the group.

3. Multi media : Filmstrips and videotapes dealing with earthquakes and volcanoes were shown and discussed.

4. Experiments conducted by the teacher: Two experiments dealing with sedimentary rocks and the chemical weathering process were directed by the teacher. Both experiments contained hydrochloric acid, and thus needed to be conducted by the teacher.

5. Activity sheets (Appendix D): The activity sheets used by the experimental group reinforced the following concepts: Identification of what is below the earth's surface, volcanoes, shockwaves, earthquakes, the plate tectonics theory, and determining the different types of volcanoes.

Both groups studied the same chapter from the same textbook, Merrill's *Science,* Book 5, published by Merrill Publishing Company, 1989. When finished with the chapter material, each student in the control group contracted to do independent study projects in an area from the chapter that was of particular interest to him/her. Class time was given for work on the independent study projects. The students in the control group were allowed time to work individually in the library, and there were numerous textbooks, resource books, and reference materials available in the classroom. Upon completion of the projects, each student was required to prepare a presentation for the class.

During the next to the last session of the unit, a review session was held. Both groups received the same review sheet, which was administered and checked at the end of this session. Both groups received equal amounts of time for both the review and the post test sessions.

In chapter four which follows, Analysis of Data and Results, a presentation of the data followed by the statistical results of this study can be found.

CHAPTER IV

ANALYSIS OF DATA AND RESULTS

Introduction

An analysis of the data in this chapter will summarize the results of this study. Responses to questions from the post test will be analyzed and compared between the experimental and control groups. The information presented in this chapter will also show that the control group scored higher on the pre test than the experimental group, and that the experimental group scored higher than did the control group on the post test, but that both groups made significant gains when post test scores were compared to the scores of the pre test.

Population Change

The population in the experimental group decreased from 27 to 25 due to absences during administration of the post test. The population of the control group dropped from 29 to 23 due to absences during administration of the post test. The population for which data was collected consisted of 48 intellectually gifted fourth graders. The experimental group contained 14 boys and 11 girls, while the control group contained 10 boys and 13 girls.

Results

A pre test (Appendix B), was administered to both the experimental and control groups. This test, covering certain basic information pertaining to the structure of the earth, was constructed by the teacher. This test was designed using the information that was presented in Chapter 14 of Merrill's *Science*, Book Five, published by Merrill Publishing Company, 1989. Since there was no pre test available, it was necessary for the teacher to design one using the information that was to be presented to both the experimental and control groups. Students had not received any classroom instruction during the current school year that related to the subject matter of the test.

The test consisted of the following elements: (1) ten questions requiring the students to define in their own words certain basic terms relating to the earth and its structure; (2) six true or false statements that required the students to rewrite and make true each false statement; (3) three statements that required the students to choose from several alternatives a correct response that would complete the statement, and (4) three specific questions that required a thoughtful response. The results of the pre test are presented in Tables 1 and 2.

A post test (Appendix C) was administered to both the experimental and control groups. This test was Test A, "Recalling Facts" and Test B, "Understanding/Applying Concepts", both of which covered Chapter 14 of Merrill's *Science*, Book Five, published by Merrill Publishing Company, 1989. This is the basic text used by both groups. It served as the background material for the classroom instruction that occurred during the period of this study.

The test consisted of the following: (1) Part A, eight questions requiring students to write the letter of a correct answer in the blank; (2) Part B, six questions requiring the completion of sentences using a correct term from among several listed. Part B of the post test instrument, "Understanding/Applying Concepts" was composed of elements that required the students to match statements to diagrams. Finally, the students were asked to respond to eight questions that required narrative responses.

The results of the post test for both the control and the experimental groups are reported in Tables 3 and 4.

Based on the results of the post test, the experimental group scored 4.73% higher than did the control group. The average score in the experimental group was 24.76 points out of a possible 28 points. The average score in the control group was 23.43 points out of a possible 28 points.

Discussion of Data Tables

The following commentary will discuss some of the data as presented in tables 1 through 15. The complete test questions as discussed in the following tables may be found in Appendices B and C.

Tables 1 and 2 are listings of the number of correct and incorrect responses from the pre test by both the experimental and control groups. As can be seen in analysis of tables one and two, both groups had similar numbers in the correct and incorrect responses to most questions, however, the control group's scores as a unit were higher. It may be interesting to note that on the question dealing with sedimentary rocks (question 10), three students missed the question in the control group, while 18 missed the same question in the experimental group. Question 7, in which the students were asked to define the Earth's mantle was missed by six in the control group and 14 in the experimental group. Since no instruction on the Earth's structure had yet begun, it was not possible to ascertain as to why there was a difference.

TABLE 1

RESPONSES OF CONTROL GROUP--PRE TEST

Questions Definition of Terms	Correct Responses	Incorrect Responses
1. Core	18	5
2. Earthquake	15	8
3. Fault	8	15
4. Igneous Rock	5	18
5. Lava	16	7
6. Metamorphic Rock	3	20
7. Mantle	17	6
8. Mineral	0	23
9. Plate Tectonics	1	22
10. Sedimentary Rocks	20	3

TABLE 1 (Continued)

	Correct Responses	Incorrect Responses
True/False Sentences		
1. Rock Texture	12	11
2. Mineral Hardness	14	9
3. Trench Formation	12	11
4. Volcanoes-Part of Crust	16	7
5. Earth's Mantle	19	4
6. Seismograph	19	4
Correct Sentence Completion		
1. Sedimentary rocks form	6	17
2. Metamorphic rock example	7	16
3. What is a fault	21	2
General Questions		
1. Rock/Mineral I.D.	9	14
2. Change in Earth's Crust	2	21
3. Why volcanoes erupt	0	23

TABLE 2

RESPONSES OF EXPERIMENTAL GROUP--PRE TEST

Questions

Definition of Terms	Correct Responses	Incorrect Responses
1. Core	17	8
2. Earthquake	12	13
3. Fault	12	13
4. Igneous Rock	1	24
5. Lava	15	10
6. Metamorphic Rock	3	22
7. Mantle	11	14
8. Mineral	0	25
9. Plate Tectonics	0	25
10. Sedimentary Rocks	7	18
True/False Sentences		
1. Rock Texture	18	7
2. Mineral Hardness	20	5
3. Trench Formation	16	9
4. Volcanoes-Part of crust	21	4
5. Earth's Mantle	19	6
6. Seismograph	21	4

TABLE 2 (Continued)

	Correct Responses	Incorrect Responses
Correct Sentence Completion		
1. Sedimentary rock forms	9	16
2. Metamorphic rock	4	21
3. What is a fault	15	10
General Questions		
1. Rock/Mineral I.D.	4	21
2. Change in Earth's Crust	3	22
3. Why volcanoes erupt	1	24

The responses of the experimental and control groups on the post test are listed in Tables 3 and 4. It can be seen that there are several questions that may have noteworthy differences. Question A-2, which discusses the movements of the Earth's crust was missed by 14 students in the control group, but by only one student in the experimental group. This may be attributed to the guest speaker's illustration of the different plate movements. He compared the movements with a piece of paraffin, and the comparison of faults and plate movements to the breaking of a piece of paraffin. This seemed to cement the plate tectonics theory into the minds of the experimental group.

Question C-7, "How did scientists locate the outlines of the large sections of Earth's crust called plates" was missed by 15 students in the control group. Seven missed this question in the experimental group. Again, this may possibly be attributed to the guest speaker's comments on plate tectonics. In addition, one of the centers completed by this group asked the students to study earthquake patterns, which helped scientists develop the plate tectonics theory.

Table 5 is a summary table of the responses of both the pre test and post test of the experimental and control groups. This information is identical to that in tables 1-4. It was presented in summary form in an effort to show better the comparison between the two groups.

Tables 3, 4, and 5 are presented on the following six pages.

TABLE 3

RESPONSES OF CONTROL GROUP--POST TEST

Questions	Correct Responses	Incorrect Responses
A. Write the letter of the correct answer		
1. Energy released from rocks	23	0
2. Movements of Earth's crust	9	14
3. Name of Earth's outer layer	23	0
4. Name of volcano with sloping sides	20	3
5. Name of rock formed by cooling magma	22	1
6. Why geologists study earthquakes	21	2
7. Earth's crust is made from	23	0
8. Speed of shock waves	22	1
B. Sentence Completion		
9. Plate movement	23	0
10. Middle layer of Earth	23	0
11. Formation of rock	21	2
12. Sliding of plates	23	0
13. Rocks changed by heat/pressure	21	2
14. Name of Earth's center	23	0
A. Matching Statements		
1. Earth's plates ride on upper layer	20	3
2. Liquid part of Earth's layer	22	1
3. Location of plates	21	2
4. Structure of San Andreas Fault	19	4
5. Formation of ocean floor crust	18	5
6. Ocean floor trenches	21	2
C. Response of questions		
7. How did scientists locate plates?	8	15
8. What causes earthquakes?	20	3
9. What is learned by studying earthquakes?	21	2
10. What is the plate tectonics theory?	17	6
11. What is the difference between intrusive and extrusive rocks?	15	8
12. What rocks are formed from buried gravel, sand, and mud?	21	2
13. What does a seismograph tell scientists?	7	16
14. Compare the shapes of composite cone and shield volcanoes.	11	12

TABLE 4

RESPONSES OF EXPERIMENTAL GROUP--POST TEST

Questions	Correct Responses	Incorrect Responses
A. Write the letter of the correct answer		
1. Energy released from rocks	25	0
2. Movements of Earth's crust	24	1
3. Name of Earth's outer layer	25	0
4. Name of volcano with sloping sides	24	1
5. Name of rock formed by cooling magma	25	0
6. Why geologists study earthquakes	25	0
7. Earth's crust is made from	25	0
8. Speed of shock waves	25	0
B. Sentence Completion		
9. Plate movement	25	0
10. Middle layer of Earth	25	0
11. Formation of rock	25	0
12. Sliding of plates	25	0
13. Rocks changed by heat/pressure	25	0
14. Name of Earth's center	24	1
A. Matching Statements		
1. Earth's plates ride on upper layer	24	1
2. Liquid part of Earth's layer	25	0
3. Location of plates	24	1
4. Structure of San Andreas Fault	16	9
5. Formation of ocean floor crust	5	10
6. Ocean floor trenches	21	4
C. Responses of questions		
7. How did scientists locate plates?	18	7
8. What causes earthquakes?	22	3
9. What is learned by studying earthquakes?	22	3
10. What is the plate tectonics theory?	20	5
11. What is the difference between intrusive and extrusive rocks?	18	7
12. What rocks are formed from buried gravel, sand, and mud?	24	1
13. What does a seismograph tell scientists?	9	16
14. Compare the shapes of composite cone and shield volcanoes.	13	12

TABLE 5

SUMMARY OF RESPONSES OF EXPERIMENTAL AND CONTROL GROUPS PRE TEST AND POST TEST

Pre test

Question	Control		Exper.	
	C	I	C	I
1. Core	18	5	17	8
2. Earthquake	15	8	12	13
3. Fault	8	15	12	13
4. Igneous rock	5	18	1	24
5. Lava	16	7	15	10
6. Metamorphic	3	20	3	22
7. Mantle	17	6	11	14
8. Mineral	0	23	0	25
9. Plates	1	22	0	25
10. Sed. Rocks	20	3	7	18
1. Rock texture	12	11	18	7
2. Minerals	14	9	20	5
3. Trenches	12	11	16	9
4. Volcanoes	16	7	21	4
5. Mantle	19	4	19	6
6. Seismograph	19	4	21	4
1. Sed. rock	6	17	9	16
2. Metamorphic	7	16	4	21
3. Fault	21	2	15	10
1. Rock I.D.	9	14	4	21
2. Crust change	2	21	3	22
3. Volcanoes	0	23	1	2
9. Earthquakes	21	2	22	3
10. Plates	17	6	20	5
11. Rocks	15	8	18	7
12. Sed. rocks	21	2	24	1
13. Seismograph	7	16	9	16
14. Volcanoes	11	12	13	12

Post test

Question	Control		Exper.	
	C	I	C	I
1. Energy	23	0	25	0
2. Movement	9	14	24	1
3. Outer layer	23	0	25	0
4. Volcano	20	3	24	1
5. Magma rock	22	1	25	0
6. Earthquakes	21	2	25	0
7. Crust	23	0	25	0
8. Shock waves	22	1	25	0
9. Plates	23	0	25	0
10. Mid-layer	23	0	25	0
11. Formation	21	2	25	0
12. Plates	23	0	25	0
13. Rock change	21	2	25	0
14. Earth center	23	0	24	1
1. Plates	20	3	24	1
2. Liquid earth	22	1	25	0
3. Plates	21	2	24	1
4. San Andreas	19	4	16	9
5. Ocean floor	18	5	15	10
6. Trenches	21	2	21	4
7. Plates	8	15	18	7
8. Earthquakes	20	3	22	3

Table 6 is a listing of the percent of correct responses by each student in both the experimental and control groups for the pre test. The highest percentage score in the experimental group was a 68.18%, and the lowest percentage in the experimental group was a 13.63%. In the control group, the highest percentage was a 77.27%, while the low was a 27.27%. The average percentage of the experimental group was 41.44%, while the average percentage of the control group was 44.26%.

TABLE 6

PERCENT OF CORRECT RESPONSES--PRE TEST

C=Correct Responses %=Percent Correct from a total of 22 points

Student	Exper. Group C	Exper. Group %	Student	Control Group C	Control Group %
1	9	40.90	1	6	27.27
2	5	22.72	2	9	40.90
3	8	36.36	3	9	40.90
4	6	27.27	4	12	54.54
5	7	31.81	5	10	45.45
6	11	50.00	6	8	36.36
7	13	59.09	7	11	50.00
8	10	45.45	8	11	50.00
9	12	54.54	9	8	36.36
10	3	13.63	10	17	77.27
11	15	68.18	11	10	45.45
12	9	40.90	12	10	45.45
13	7	31.81	13	8	36.36
14	6	27.27	14	11	50.00
15	13	59.09	15	8	36.36
16	10	45.45	16	13	59.09
17	8	36.36	17	6	27.27
18	9	40.90	18	7	31.81
19	7	31.81	19	11	50.00
20	7	31.81	20	8	36.36
21	10	45.45	21	14	63.63
22	13	59.09	22	7	31.81
23	12	54.54	23	10	45.45
24	13	59.09			
25	5	22.72			

Table 7 is a listing of the percent of correct responses by each student in both the experimental and control groups for the post test. The highest percentage score in the experimental group was 96.42%, and the lowest percentage score was 71.41%. The highest percentage in the control group was 100.00%, and the lowest score was 64.28%. The average percentage of the experimental group was 88.42%, while the average percentage of the control group was 83.69%. This is particularly noteworthy when compared to the percentages of the pre test, in that the control group scored higher than did the experimental group on the pre test, but on the post test, the experimental group scored higher than the control group.

TABLE 7

PERCENT OF CORRECT RESPONSES--POST TEST

C=Number of Correct Responses %=Percent Correct From a Total of 28 Points

Student	Exper. Group		Student	Control Group	
	C	%		C	%
1	22	78.57	1	22	78.57
2	23	82.14	2	24	85.71
3	26	92.85	3	21	75.00
4	26	92.85	4	24	85.71
5	27	96.42	5	22	78.57
6	26	92.85	6	22	78.57
7	26	92.85	7	26	92.85
8	24	85.71	8	26	92.85
9	27	96.42	9	23	82.14
10	22	78.57	10	27	96.42
11	24	85.71	11	28	100.00
12	27	96.42	12	25	89.28
13	22	78.57	13	22	78.57
14	26	92.85	14	26	92.85
15	24	85.71	15	20	71.42
16	25	89.28	16	18	64.28
17	27	96.42	17	19	67.85
18	22	78.57	18	23	82.14
19	26	92.85	19	23	82.14
20	25	89.28	20	24	85.71
21	26	92.85	21	26	92.85
22	25	89.28	22	26	92.85
23	25	89.28	23	22	78.57
24	26	92.85			
25	20	71.42			

The number of correct responses given on the pre test by the experimental group can be seen in an analysis of Table 8. The scores ranged from a low of 3 to a high of 15, with an average score of 9.12 points out of a possible 22 points. Table 9 is a listing of the percent correct for the experimental group on the pre test. As shown in this manner, the percentages ranged from 13.63% to 68.18%.

TABLE 8

NUMBER OF CORRECT RESPONSES ON THE PRE TEST--
EXPERIMENTAL GROUP

Value	Frequency	Percent	Cum Percent
3	1	4.0	4.0
5	2	8.0	12.0
6	2	8.0	20.0
7	4	16.0	36.0
8	2	8.0	44.0
9	3	12.0	56.0
10	3	12.0	68.0
11	1	4.0	72.0
12	2	8.0	80.0
13	4	16.0	96.0
15	1	4.0	100.0
TOTAL	25	100.0	

TABLE 9

PERCENT CORRECT ON THE PRE TEST--
EXPERIMENTAL GROUP

Value	Frequency	Percent	Cum Percent
13.63	1	4.0	4.0
22.72	2	8.0	12.0
27.27	2	8.0	20.0
31.81	4	16.0	36.0
36.36	2	8.0	44.0
40.90	3	12.0	56.0
45.45	3	12.0	68.0
50.00	1	4.0	72.0
54.54	2	8.0	80.0
59.09	4	16.0	96.0
68.18	1	4.0	100.0
TOTAL	25	100.0	

The percent correct on the post test for the experimental group can be seen in an analysis of Table 10. The scores ranged from 71.42% to 96.42%. The largest group (8 students, or 32%) scored at 92.85%. Forty-eight percent of the students scored 92.85% or better.

TABLE 10

PERCENT CORRECT ON THE POST TEST--
EXPERIMENTAL GROUP

Value	Frequency	Percent	Cum Percent
71.42	1	4.0	4.0
78.57	4	16.0	20.0
82.14	1	4.0	24.0
85.71	3	12.0	36.0
89.28	4	16.0	52.0
92.85	8	32.0	84.0
96.42	4	16.0	
TOTAL	25	100.0	

Table 11 is a listing of the number correct on the post test for the experimental group. Out of a possible 28 points, the scores ranged from 20 to 27. Eight students, or 32% earned a score of 26, and four students, or 16% received a score of 27 points.

TABLE 11

NUMBER CORRECT ON THE POST TEST--
EXPERIMENTAL GROUP

Value	Frequency	Percent	Cum Percent
20	1	4.0	4.0
22	4	16.0	20.0
23	1	4.0	24.0
24	3	12.0	36.0
25	4	16.0	52.0
26	8	32.0	84.0
27	4	16.0	100.0
TOTAL	25	100.0	

The number correct on the pre test for the control group is visible in Table 12. The scores ranged from a low of 6 out of a possible 22 points to 17 points. The average score was 9.7 points. Table 13 is a listing of the percent correct on the pre test for the control group. The percentages ranged from a low of 27.27% to a high of 77.27%.

TABLE 12

NUMBER CORRECT ON THE PRE TEST--
CONTROL GROUP

Value	Frequency	Percent	Cum Percent
6	2	8.7	8.7
7	2	8.7	17.4
8	5	21.7	39.1
9	2	8.7	47.8
10	4	17.4	65.2
11	4	17.4	82.6
12	1	4.3	87.0
13	1	4.3	91.3
14	1	4.3	95.7
17	1	4.3	100.0
TOTAL	23	100.0	

TABLE 13

PERCENT CORRECT ON THE PRE TEST--
CONTROL GROUP

Value	Frequency	Percent	Cum Percent
27.27	2	8.7	8.7
31.81	2	8.7	17.4
36.36	5	21.7	39.1
40.90	2	8.7	47.8
45.45	4	17.4	65.2
50.00	4	17.4	82.6
54.54	1	4.3	87.0
59.09	1	4.3	91.3
63.63	1	4.3	95.7
77.27	1	4.3	100.0
TOTAL	23	100.0	

Table 14 is a listing of the number correct on the post test for the control group. Out of a possible 28 points, the scores ranged from 18 as the low to 28 as the high. The highest number of students that scored the same point value was 21.7%, or five students at the 22 point value, and 21.7%, or five students that scored at the 26 point value.

TABLE 14

NUMBER CORRECT ON THE POST TEST--
CONTROL GROUP

Value	Frequency	Percent	Cum Percent
18	1	4.3	4.3
19	1	4.3	8.7
20	1	4.3	13.0
21	1	4.3	17.4
22	5	21.7	39.1
23	3	13.0	52.2
24	3	13.0	65.2
25	1	4.3	69.6
26	5	21.7	91.3
27	1	4.3	95.7
28	1	4.3	100.0
TOTAL	23	100.0	

The percent correct on the post test by the control group can be seen in Table 15. The scores range from 64.28% to 100%. Five students scored 78.57%, and five students scored 92.85%. Seven students scored 92.85% or above.

TABLE 15

PERCENT CORRECT ON THE POST TEST--
CONTROL GROUP

Value	Frequency	Percent	Cum Percent
64.28	1	4.3	4.3
67.85	1	4.3	8.7
71.42	1	4.3	13.0
75.00	1	4.3	17.4
78.57	5	21.7	39.1
82.14	3	13.0	52.2
85.71	3	13.0	65.2
89.28	1	4.3	69.6
92.85	5	21.7	91.3
96.42	1	4.3	95.7

TABLE 15 (Continued)

Value	Frequency	Percent	Cum Percent
100.0	1	4.3	100.0
TOTAL	23	100.0	

Statistical Results

The t Test for significance was used to test the null hypothesis, "There is no difference in the achievement of gifted students between those taught in a classroom in which the emphasis in on independent study (the control group), and those taught in a classroom in which the emphasis is on a more teacher directed approach to learning which includes special interventions (the experimental group)."

The t Test was used to test the significance first on the two randomly formed groups on the pre test and second on the same groups on the pre test. The calculatons were done by the standard computer program and the standard t Test for independent samples was used.

(a) On the pre test the treatment group had a mean of 41.45 and the control group had a mean of 44. 26. This yielded a t of -0.74 with a probability of 0.46. As a result of this analysis, the difference on the pre test is not statistically significant.

(b) The unadjusted post test means were 88.42 for the treatment group and 83.69 for the control group. This yielded a t of 2.02 with a probability of .05. This difference was statistically significant. The null hypothesis was therefore rejected.

Although the pre test did not show a statistical significance, it was decided to do an analysis of co-variance because there was a difference in the pre test means. The calculation for the analysis of co-variance was done by the standard computer program for calculating the standard F test for adjusted means in the analysis of co-variance.

(c) The analysis of co-variance adjusts statistically the post test means to what they (the post test means) would have been if the pre test means of the groups were the same.

The analysis of co-variance as a statistical means adjusts post test scores for initial differences and compares the adjusted scores. Stated another way, the groups are compared after they have been equalized. In this study pre test performances are controlled with the co-variance statistics.

(d) The "F" test of these adjusted means was 5.62 and the probability was .022. The adjusted means are 88.71 for the treatment group and 83.39 for the control group. It is statistically significant at the .02 level. The null hypothesis was therefore rejected.

In this study, too, it is important to note that the control group scored higher than the experimental group in the pre test and the experimental group scored higher on the post test than did the control group. According to the data presented it can be assumed that post test variance can be attributed to the treatment conditions, or the interventions as described earlier in this thesis.

The final chapter of this thesis, Conclusions, follows. The research questions posed in the first chapter will be reviewed. Recommendations for further research and a final analysis will be presented.

CHAPTER V

CONCLUSIONS

The results of this study demonstrated that a more teacher directed method of study led to higher achievement scores as witnessed by the comparison of two group's pre test-post test results in a science unit dealing with the study of the earth's structure. While both the experimental and control groups saw gains from the pre test scores, the experimental group, the more teacher directed group, had a higher average percentage than did the control group on the final examination.

The t Test for significance was used to test the null hypothesis, "There is no difference in the achievement of gifted students between those taught in a classroom in which the emphasis is on independent study (the control group) and those taught in a classroom in which the emphasis is on a more teacher directed approach to learning which includes special interventions (the experimental group)". On the pre test, the experimental group had a mean of 41.45, while the control group had a mean of 44.26. The difference on the pre test was not statistically significant.

The unadjusted post test means on the post test were 88.42 for the experimental group and 83.69 for the control group. This difference was statistically significant. The null hypothesis was therefore rejected.

Although the pre test did not show a statistical difference, an analysis of co-variance was done because there was a difference in the pre test means. The analysis of co-variance compared the groups after they had been equalized. The adjusted post test means were 88.71 for the experimental group and 83.39 for the control group. This is statistically significant at the .02 level. The null hypothesis was therefore rejected.

Summary

The first research question, "Will the experimental group score higher than the control group on the post test after a more teacher directed method of instruction", can be answered by referring to the data as presented in Chapter Four. Based on the results of the post test, the experimental group scored 4.73% higher than did the control group. The average score in the experimental group was 24.76 points out of a possible 28 points. The average score in the control group was 23.43 points out of a possible 28 points. When analysis of co-variance statistics are included in this discussion, it can be seen that when the post test means are statistically adjusted to what they would be if the pre test means were the same, the post test means were 88.71 for the experimental group, and 83.39 for the control group. This is statistically significant at the .02 level.

The second research question, "Will the control group score higher than the experimental group on the post test when independent study is involved" can also be answered by the above explanation. As stated in chapter four of this thesis, it is important to note that the control group scored higher than the experimental group on the pre test and the experimental group scored higher on the post test than did the control group. According to the data presented it can be assumed that post test variance can be attributed to the treatment conditions or interventions as described in the unit plans for the experimental and control groups which are located in Appendix A.

The third research question, "Will the results of this study show a statistical significance", has been answered in the Statistical Results section of Chapter Four. On the pre test, the experimental group had a mean of 41.45, while the control group had a mean of 44.26. The results were not statistically significant. Because there was a difference in pre test means, an analysis of co-variance was performed, which showed a statistical significance at the .02 level.

The fourth research question was, "If there is a difference on selected items on the post test, could there be factors or interventions that could be attributed to the difference?"

There were several post test questions that showed marked differences when the number of correct answers from the experimental and control group were compared In question A-2, students were asked to choose the answer that told how plates of Earth's crust move along ocean ridges This questions was missed by 14 students in the control group, but only one student missed the same question in the experimental group This may be attributed to the guest speaker's use of visual aids while explaining plate movement and faults to the experimental group He compared a piece of paraffin to the Earth's crust, and explained to the class how when the paraffin broke, one piece could ride up onto the other He then went on to explain the other directions in which plate movement occur When writing thank you notes to the speaker, 17 of the children in the experimental group commented on this illustration It seemed to make an impact on them

Another question with noteworthy differences was question C-7 "How did scientists locate the outlines of the large sections of Earth's crust called plates?" This question was missed by 15 students in the control group while seven missed it in the experimental group Again, the guest speaker commented on plate movement, which may explain the difference In addition, the students in the experimental group were assigned a center in which they were to study earthquake patterns and plate movements Their findings were then discussed in class

Question five, "When given the opportunity to do independent study, will the student acquire the knowledge that the student in a more teacher directed lesson will receive" can be addressed by comparing the results of the post test scores As previously indicated, the experimental group did score higher on the post test than did the control group Both groups did receive the same information from the textbook, but the experimental group had teacher directed learning opportunities that the control group did not Perhaps in the teacher directed method, the students had the opportunity to learn concepts in several different ways, thus each child could relate to the method (textbook, experiments, centers, guest speaker, or teacher instruction) that best met his/her learning style While it cannot be said that because post test scores were higher, the knowledge acquired in the experimental group was greater than that of the control group, perhaps it can be said that the students in the experimental group had more exposure to a greater variety of activities in the unit, while each student in the control group may have had more exposure to a certain area, namely his/her chosen area of independent study

Final Analysis

The results of this study indicate that a more teacher directed method of learning may be beneficial in a classroom of fourth grade intellectually gifted children This is not to say that independent study is not an option, rather independent study used with guidance, along with teacher input and monitoring may be more appropriate for this age level To insure that elementary students learn the concepts that are necessary for further learning, students at this age and younger are still in need of teacher assistance while undertaking independent study

Throughout the course of this study, it became obvious that the experimental group seemed to have a broader base of knowledge than did the control group Upon close examination of the data, it can be seen that the students in the experimental group scored higher than the students in the control group A possible reason for this result may be related to the interventions presented This, of course, could not be measured

Recommendations for Further Research

It would be beneficial to conduct a similar study to the one described in this thesis using a gifted classroom taught in the independent study method and a heterogeneously grouped classroom instructed in the more teacher directed mode Both should be given identical pre tests and post tests Results should be compared Further recommendations are as follows

1 Two heterogeneously grouped elementary classrooms , one taught in the independent study method and the other with a more teacher directed method Both groups shouldbe given identical pre tests and post tests Results should be compared

2 An independent study versus a more teacher directed mode of learning should be compared in all levels of gifted education It would be interesting to see at what age or grade independent study would positively affect post test scores

3 An independent study approach versus a more teacher directed method in math

4 An independent study approach versus a more teacher directed method in English

5 An independent study versus a more teacher directed approach in two gifted classrooms, one in an urban setting and one in a rural setting

6 An independent study versus a more teacher directed approach with groups divided according to racial groups

7 An independent study versus a more teacher directed approach with groups in a self-contained gifted classroom with groups divided by cultural background

Summary Statement

This study sought to ascertain the educational outcomes of intellectually gifted fourth grade students in two separate learning environments Both groups received the same concepts as prescribed in the science curriculum in the school system where this study was conducted Both groups used the same textbook but while one group, the experimental group, received a more teacher directed method of study, the other group, the control group, was involved in class discussion followed by independent study

While both groups saw gains from the pre test scores, the experimental group had a higher average percentage than did the control group on the final examination The results of this study demonstrated that a more teacher directed method of study led to higher achievement scores as witnessed by the comparison of the two group's pre test and post test results

It would appear that independent study, while not demonstrated in this study as leading to higher achievement scores, is an integral part of the gifted student's school experience Perhaps educators need to give guidance and reassurance to their students, especially in the elementary grades, through the planning and organizing stages of independent study Several of the students in the control group expressed the desire for more guidance, as they felt they were not yet capable of deciphering relevant and important material in their chosen topics

In the course of this investigation, the researcher observed a difference between the classroom behavior of the students in the experimental group as compared to the students in the control group The experimental group exhibited behavior that indicated a higher level of interest throughout the course of the study The students in this group drew pictures of volcanoes and earthquakes and left them on the teacher's desk, brought rocks and samples of volcanic ash from home, and several wrote stories and poetry which had earthquakes and volcanoes in them Some of the students asked to go to the library to find out more information on rocks, earthquakes, and volcanoes The different and varied activities seemed to hold the interest of the students in this group As student four (experimental group) states in question eight in the random interview (Appendix E), when comparing this science unit to previous units, "We did a lot more experiments" Several of the other children not interviewed in the experimental group expressed to the examining teacher that because of the many opportunities for learning, their interest level remained high throughout the study

The control group, on the other hand, seemed ready to end the unit Several of the students in this group expressed to the teacher that they felt as if they knew their independent subject area well, but felt less capable in some of the other areas in the unit

According to the responses given during the random interviews (Appendix E),two of the four students interviewed from the control group were challenged the most by the independent study projects The projects should have been the most challenging portion of the unit, as the students chose and directed their own learning pace The teacher at this point was a facilitator One of the students interviewed (student five, control group) chose independent study as his/her least favorite style of learning The student told the examining teacher, "I'm not sure that I'm learning everything I am supposed to be learning when I'm on my own " Several other students in the control group expressed relief when their presentations and the unit were over

The students in the experimental group had several different teacher directed learning experiences, including the use of centers, guest lecturers, and multi-media presentations The centers, in which many of the answers to the questions posed required that an inference be made, seemed to be a source of challenge and debate Several of the students in the experimental group felt uncertain of their ability to answer questions in which the responses were not easy to deduce

In analysis of the experimental and control groups, the researcher found that students in both groups felt unsure as to what was an acceptable product An attempt was made, through constant reassurance, to convey to the students that it was important for them to have a personal understanding of the subject matter In order for the concepts to be retained, students needed to be able to apply the information to their life experiences

In conclusion, it is well to note that independent study may be an important adjunct to the learning environment for gifted children It is demonstrably evident that support and guidance by the teacher tend to result in increased student learning

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APPENDICES

APPENDIX A

UNIT PLAN FOR EXPERIMENTAL GROUP

Exploring the Earth's Surface

Merrill Publishing Company

Book Five

Chapter 14

Lesson 1: Pre test administered to group. Read pages 260-263, which contains information about the earth's crust, mantle, and core, as well as a brief review of sedimentary, igneous, and metamorphic rocks.

Center I: From common objects found at center, choose the objects that could be compared in structure with the earth (objects will be such things as a golf ball, a peach, a pear, as well as objects that do not relate to the lesson). Students will also be asked to think of something not present that could also be compared to the earth's structure.

Center II: Students will be asked to identify the rocks at the center into one of the following categories: Sedimentary, Igneous, or Metamorphic, explaining why they believe as they do. Assignment: Answer the questions under "Lesson Review" on page 263.

Lesson 2: Discuss questions that were assigned yesterday. Present a variety of sealed boxes to the class containing a rubber ball, a towel, and pieces of a jigsaw puzzle. Give the class time to explore the boxes. Have them attempt to guess the contents of each box without looking inside. Discuss how difficult it is to know the contents without opening the boxes. Read pages 264-265 together, which contain information about earthquakes. Do experiment as described on page 264. Have students fill out activity worksheet that accompanies the lesson (Sheet 219 is in Appendix D). Discuss the findings at the end of the lesson.

Lesson 3: Read pages 266-267 together, which continue the study of earthquakes. Guest speaker will visit class and will discuss how earthquakes are predicted, and the damaging effects they can have. Students are assigned Challenge Activity, page 223 (Appendix D), in which they will use what they have learned to locate earthquakes in several areas.

Lesson 4: Discuss reaction to yesterday's lesson. Read pages 268-269 together, which continues with information about earthquakes. Students are assigned Curriculum Integration Activity 225 (Appendix D), in which they are to chart the earthquake statistics given on a map of the United States.

Experiment: Have students observe the waves that result from dropping a small pebble into water that fills a large, flat container. Place several large stones in the water. Drop the pebble again and have the students observe how the barriers affect the resulting waves. Relate this activity to a discussion on seismic waves. Introduce the centers that the students will continue to work on for the remainder of the unit.

1. With the use of a globe, students will trace two large earthquake belts: the circum-Pacific ring of fire and the mid-Atlantic ridge.
2. Students will research faults using science texts and /or the encyclopedia.
3. Choose an earthquake belt and prepare a chart containing the following information: locations of major earthquakes, dates each occurred, the Richter scale rating if available, names of volcanoes found in the earthquake belt, and the date each erupted.

4. Examine different types of rocks and examine the minerals found in each by determining hardness, streak test, cleavage, luster, and crystal structure and report the results.

Lesson 5: Read pages 270-272, which continues with the study of earthquakes. With each student having an outline map of the world (Appendix D), the students will cut out each continent to manipulate them into one giant continent. This will reinforce the concept of plate tectonics. Assignment: Observe a globe or a world geologic map. Have the students note how, if North and South America were moved eastward against Europe and Africa, the shapes of the continents would match quite well. Have the students draw three consecutive pictures. The first one should depict the continents as scientists think they might have appeared before they began drifting. The second drawing should be how the continents appear today. In the third picture, students may draw where they think the continents will be located 10,000,000 years from now. Continue working on the centers that were started yesterday.

Lesson 6: Discuss assignment from previous lesson. Read pages 274-276, which deal with the study of volcanoes. Show film on volcanoes. Work on graphing activity, in which the student will graph given data for various volcanoes, as well as describe and identify the volcano types from the graph (Activity Sheets 220-221, Appendix D). Upon completion of the volcano graphing activity, the class will "erupt" a volcano as described on Activity Sheet 227 (Appendix D). Assign the chapter review on pages 280-281.

Lesson 7: Continue working on the chapter review, pages 280-281. Continue work on the center activities.

Lesson 8: Review for final test. Assign Chapter Review Activity Sheet 228 (Appendix D). Check at the end of the session. Finish work in all centers and other areas.

Lesson 9: Post test Random interviews

APPENDIX A (Continued)

UNIT PLAN FOR CONTROL GROUP

Exploring the Earth's Surface

Merrill Publishing Company

Book Five

Chapter 14

Lesson 1: Read and discuss pages 260-263. These pages deal with the study of the earth's crust, mantle, and core, as well as a review of sedimentary, igneous, and metamorphic rocks. Assingment: "Lesson Review", page 263.

Lesson 2: Discuss questions assigned in previous lesson. Read and discuss pages 264-267.

Lesson 3: Read and discuss pages 268-269. Assign "Lesson Review", page 269.

Lesson 4: Discuss assignment from previous lesson. Read and discuss pages 270-272. Assign "Lesson Review", page 272.

Lesson 5: Discuss questions assigned in previous lesson. Read and discuss pages 273-276. Assign "Lesson Review", page 277.

Lesson 6: Discuss assignment from previous lesson. Read and discuss pages 278-279. Begin Independent Study Projects. These will be due the day before the review session for the final test. The day before the test is to be administered, there will be a review session. The day the projects are due, assign the chapter review on pages 280-281. These will be checked on the day of the review. After the chapter review has been checked and discussed, the Chapter Review Activity Sheet 228 (Appendix D) will be assigned and checked at the end of the session.

After the final test has been administered, a random group will be interviewed.

APPENDIX B

UNIT PRE TEST

Pre test Chapter 14 The Earth's Structure   Name_______________________

Define each of the following:

1. Core:

2. Earthquake:

3. Fault:

4. Igneous Rock:

5. Lava:

6. Metamorphic Rock:

7. Mantle:

8. Mineral:

9. Plate Tectonics:

10. Sedimentary Rocks:

Determine whether each of the following sentences is true or false. If the sentence is false, rewrite it to make it true. If the sentence is true as it is, rewrite it on your paper.

1. All rocks have a course-grained texture.

2. The hardness of minerals can be determined by scratching them.

3. Trenches are sometimes formed when two adjoining plates move toward each other.

4. Volcanoes are not a part of the earth's crust.

5. The innermost part of the earth is the mantle.

6. An instrument used to measure the speed of shock waves is a seismograph.

Choose the word or phrase that correctly completes each of the following sentences.

1. Sedimentary rock is formed from:

   a) loose rock particles
   b) liquid rock
   c) soil

2. An example of a metamorphic rock is:

   a) soil
   b) slate
   c) sandstone
   d) granite

3. A ________ is a break in the earth's crust along which movement can occur.

   a) syncline
   b) cone
   c) fault
   d) plate

Answer each of the following:

1. How could you identify a rock or mineral?

2. Why is the earth's crust constantly changing?

3. Why do volcanoes erupt?

APPENDIX C

POST TEST--CHAPTER 14

TEST A Recalling Facts **Chapter 14**

Name ______________________________

Total Points	100
Your Score	___

Part A ***Write the letter of the correct answer in the blank.***

_____ 1. Energy released from rocks in Earth's crust causes destructive vibrations called
a. faults. c. structures.
b. earthquakes. d. seismographs.

_____ 2. Along the mid-ocean ridges, plates of Earth's crust move
a up and down. c. together.
b sideways. d apart.

_____ 3. Earth's thin outer layer of rock is called the
a. crust c. outer core
b. mantle. d. inner core.

_____ 4. A broad volcano with gently sloping sides like those found on Hawaii is called a
a. cinder cone. c. shield volcano.
b. composite cone. d. lava plain.

_____ 5. Rocks that form when melted magma cools slowly are called _____ rocks.
a sedimentary c. metamorphic
b. mantle d igneous

_____ 6. Geologists study earthquakes so that some day they may be able to
a. control large tsunamis. c. see inside Earth.
b. predict future earthquakes. d. measure shock waves.

_____ 7. Earth's crust is made of moving sections or pieces called
a plates. c ridges
b. faults. d. trenches

_____ 8. Scientists measure the speed of earthquake shock waves with a
a. crust meter c. seismograph
b. shock meter. d. faultograph.

Part B ***Complete the sentences using the words below.***

core	metamorphic	sedimentary
mantle	pushed together	volcanoes

9 Places where plates move together or apart have many earthquakes and

____

10. The thick middle layer of Earth is called the ______________________________.

11. Rocks that form from buried and cemented soils, sand, or gravel are called ______________________________ rocks.

12 Plates of Earth's crust may slide past each other, be pulled apart, or be

____

13 Rocks that are changed by heat and pressure are called ______________________________ rocks

14 Earth's center part, made of iron and nickel, is called the ______________________________

TEST B Understanding/Applying Concepts — Chapter 14

Name ____

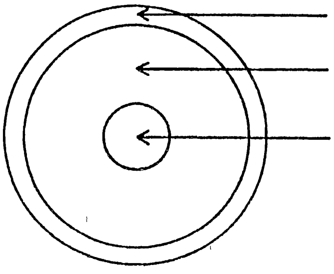
Total Points	100
Your Score	___

Part A ***Match the statement on the left with the correct Earth layer in the diagram.***

_____ 1. Earth's plates ride on the puttylike upper part of this layer.

_____ 2. Made of iron and nickel, its outer part is a liquid.

_____ 3. It is made up of large sections called plates.



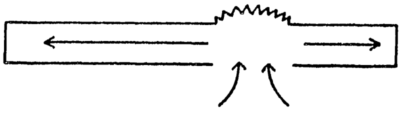
Part B ***Match the statement on the left with the correct diagram on the right.***

_____ 4. San Andreas Fault in California

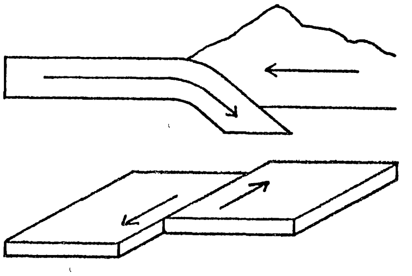
_____ 5. New ocean floor crust forms along these boundaries

_____ 6. Ocean floor trenches and volcanoes are formed near these boundaries.

a.



b.



c.

Part C ***Answer the questions in the space provided.***

7. How did scientists locate the outlines of the large sections of Earth's crust called plates?
____
____

8 What causes earthquakes? ________________________________
____
____

9. What do geologists hope to learn by studying earthquakes? ______________
____
____

Name ______________________

10. What does the plate tectonics theory explain? ______________________

11. What is the difference between intrusive and extrusive igneous rocks? ______________________

12. What kind of rocks are formed from buried and cemented gravel, sand, and mud?

13. What does a seismograph tell scientists about earthquakes? ______________________

14. Compare the shapes of composite cone volcanoes and shield volcanoes. ______________________

APPENDIX D

ACTIVITY SHEETS

Name ______________________________

Activity 14–1 Clues to Earth's Interior

QUESTION ______________________________

Observations and data

Hole Depth Table					
Hole	A	B	C	D	E
Depth (cm)					

Hole Depth Graph						
Hole		A	B	C	D	E
Depth (cm)	0					
	2					
	4					
	6					
	8					
	10					
	12					

What did you learn?

1. How was the straw probe used to observe the inside of the box? ______________________________

2. Describe the shape of the bottom of the box. ______________________________

3. How could you gain more accurate information? ______________________________

Using what you learned

1. What senses did you use to observe the floor of the model box? ______________________________

2. How is the inside of Earth like the floor of the box? ______________________________

CHALLENGE Chapter 14

Name ______________________________

LOCATING AN EARTHQUAKE

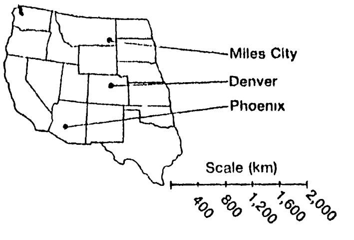
An earthquake causes three different kinds of shock waves These waves are called P-, S-, and L-waves These waves travel at different speeds. Scientists can calculate the distance between the center of an earthquake and a seismograph recording station if they know the difference between the P- and S-wave arrival times Study the difference between the P- and S-wave arrival times and the distance from the earthquake based on these times.

Time difference	Distance to earthquake center from station
1 minute, 16 seconds	500 kilometers
2 minutes, 8 seconds	1,000 kilometers
2 minutes, 50 seconds	1,500 kilometers
3 minutes, 27 seconds	2,000 kilometers

These stations recorded the difference in P- and S-wave arrival times of one earthquake. Determine how many kilometers away from each station the earthquake occurred.

Station	Time difference	Distance to earthquake center
Denver, CO	2 minutes, 50 seconds	1,500 km
Phoenix, AZ	2 minutes, 8 seconds	1,000 km
Miles City, MT	3 minutes, 27 seconds	2,000 km

Use a drawing compass to draw a circle around each recording station The circles should have the same radius as the distance to the earthquake centers you determined above. The point where all three circles intersect is the epicenter of the earthquake. The epicenter is the point on the surface directly over the point where the earthquake occurred below the surface. Where is the epicenter of the earthquake described above? ______________



Why are data from three recording stations needed in order to locate the epicenter of an earthquake? ______________________________

____

CURRICULUM INTEGRATION Social Studies Map Skills Chapter 14

Name ____________________

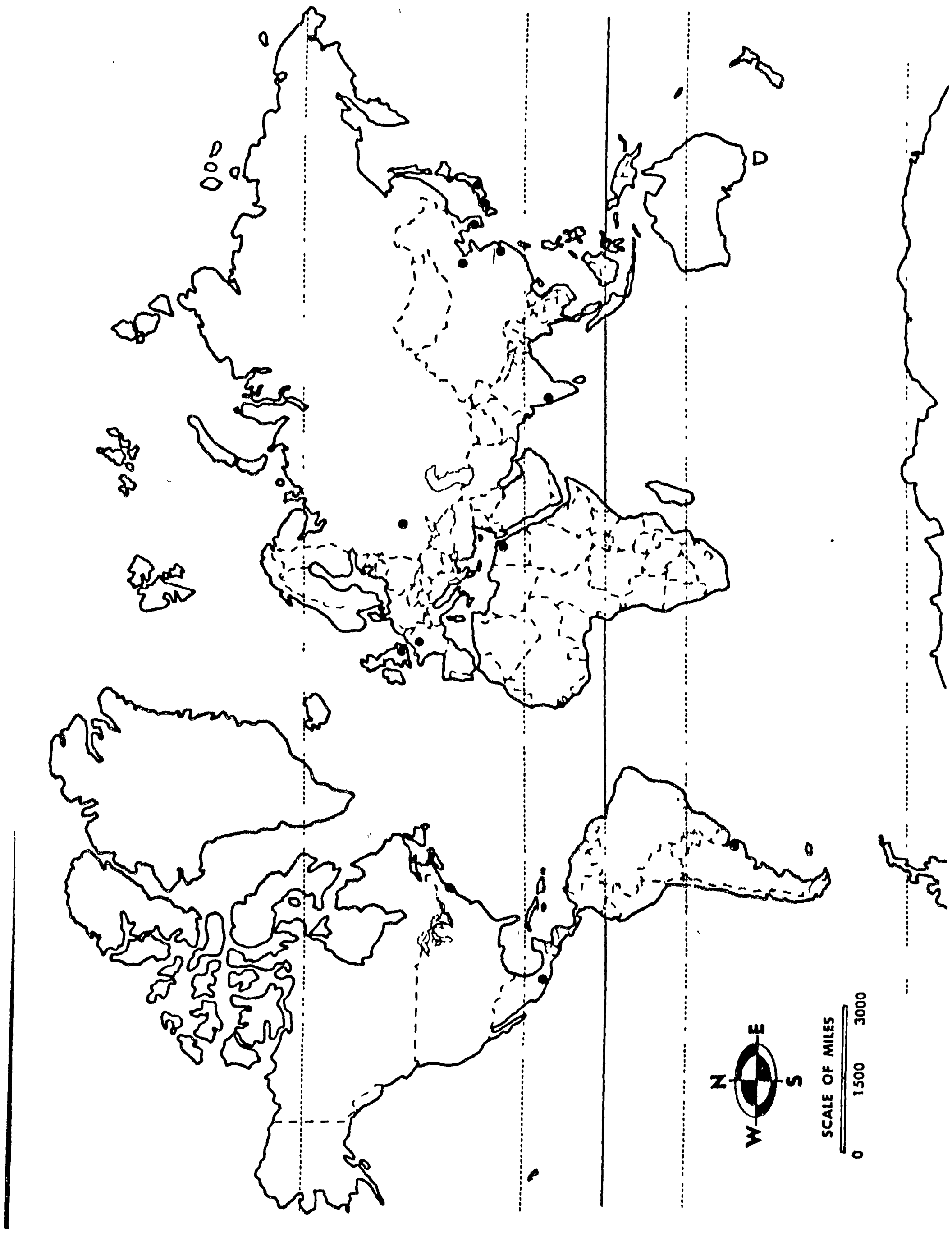
EARTHQUAKES IN THE UNITED STATES

Some areas of the United States seem to be affected by more earthquakes than others. Study the earthquake statistics on the chart below You may wish to

A. obtain a large map of the United States and pin it to a bulletin board. Mark earthquake locations on the map with colored pins.
B. use a small map of the United States and mark earthquake locations on it with colored pencils or pens.

State	Damaging Earthquakes Recorded	State	Damaging Earthquakes Recorded
Alabama	2	Montana	10 (3 intense)
Alaska	12 (2 intense)	Nebraska	3
Arizona	4	Nevada	12 (3 intense)
Arkansas	3	New Hampshire	0
California	over 150 (8 intense)	New Jersey	2 (1 intense)
Colorado	1	New Mexico	5
Connecticut	2	New York	5 (1 intense)
Delaware	0	North Carolina	2
Florida	1	North Dakota	0
Georgia	2	Ohio	7
Hawaii	12 (2 intense)	Oklahoma	2
Idaho	4	Oregon	1
Illinois	10	Pennsylvania	1
Indiana	3	Rhode Island	0
Iowa	0	South Carolina	6 (1 intense)
Kansas	2	South Dakota	1
Kentucky	6	Tennessee	7
Louisiana	1	Texas	3 (1 intense)
Maine	4	Utah	9 (2 intense)
Maryland	0	Vermont	0
Massachusetts	4 (1 intense)	Virginia	5
Michigan	1	Washington	11 (2 intense)
Minnesota	0	West Virginia	1
Mississippi	1	Wisconsin	1
Missouri	9 (2 intense)	Wyoming	3

THE WORLD—MAP Name



ACTIVITY WORKSHEET Chapter 14

Name ______________________________

Activity 14–2 Volcano Types

QUESTION ______________________________

Observations and Data

What did you learn?

1. What type of volcano is X? ______________________________
2. Where could you find a volcano like X? ______________________________

   ____
3. What type of volcano is Y? ______________________________
4. Name a volcano like Y. ______________________________
5. What type of volcano is Z? Name one. ______________________________

   ____

Using what you learned

1. Why are X and Y so different in shape? ______________________________

   ____

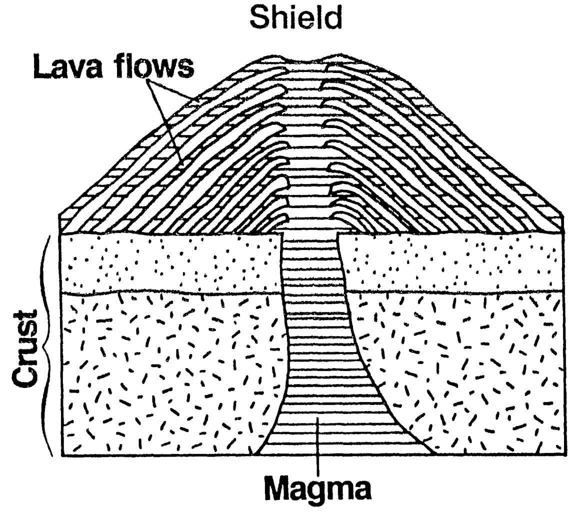
   ____

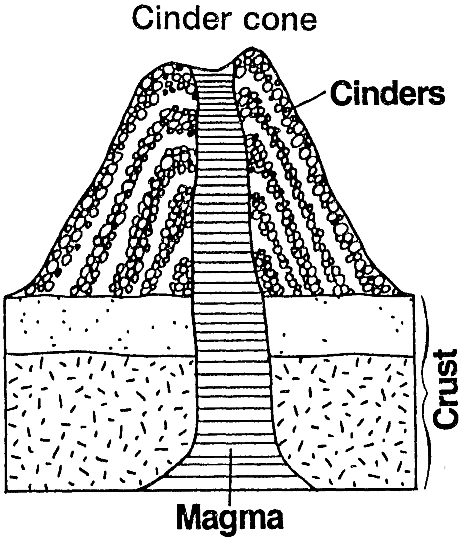
   ____
2. How does Z form? ______________________________

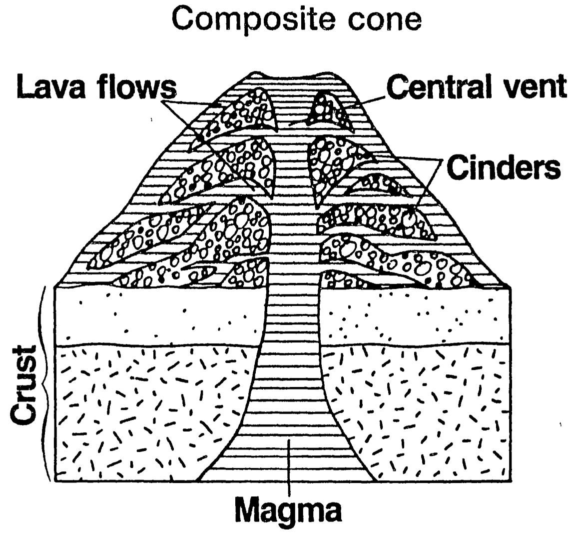
   ____

   ____

TYPES OF VOLCANOES







PARENT INVOLVEMENT Chapter 14

Name ______________________________

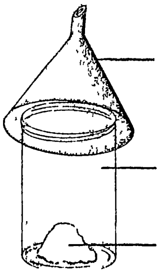
DEAR PARENT. Your child is studying Earth patterns in science. In this home activity, your child will observe how a volcano erupts by using a safe model.

VOLCANIC ERUPTION

Materials

½ cup of baking soda large plastic funnel jar
½ cup of vinegar pencil and paper

What do do



1. Place the jar in the kitchen sink.
2. Put the baking soda into the jar.
3. Place the funnel over the top of the jar.
4. Lift the funnel slightly. Add all the vinegar to the baking soda.
5. Replace the funnel.

What did you learn?

1. Observe and explain what happens.

____

2. How is this activity like the eruption of a real volcano? ______________________________

____

____

Using what you learned

1. What volcano has recently erupted in the United States? ______________________________

____

2. Do further research and find out what caused the model volcano to erupt. ______________________________

____

____

____

CHAPTER REVIEW — Chapter 14

Name ______________________________

Total Points	100
Your Score	___

Lesson 1 Earth's Layers Pages 261 to 263

Match the statement on the left with the words on the right.

______ 1 Earth's thin outer layer of solid rock
______ 2. Thick middle layer, upper part is partially melted
______ 3 Liquid outer part surrounds a solid iron and nickel center
______ 4. Form from hot melted magma
______ 5. Form from buried and cemented soils, sand, and gravel
______ 6 Formed from other rocks changed by heat and pressure

a sedimentary rocks
b core
c. metamorphic rocks
d crust
e igneous rocks
f. mantle

Lesson 2 Studying Earth's Interior Pages 264 to 269

Complete the sentences using the words below.

earthquake predict seismograph shock waves

7 The vibration of Earth caused by a sudden release of energy in Earth's crust is called an ______________________

8 Scientists measure the speed of earthquake shock waves with an instrument called a ______________________

9 Geologists study earthquakes so that they will be able to ______________________ future earthquakes

Lesson 3 Moving Earth Pages 270 to 273

Complete the sentences using the words below.

apart plates San Andreas Fault together

10. Earth's crust and upper mantle are divided into separate moving sections called ______________________

11 Plates on either side of the mid-ocean ridges move ______________________ from each other.

12. Crustal plates slide past each other along the ______________________

Lesson 4 Volcanoes Pages 274 to 279

Complete the sentences using the words below

earthquakes composite cone shield

13 Along places where Earth's plates move together or apart, there are many volcanoes and ______________________

14 Mount Saint Helens in the state of Washington is an example of a ______________________ volcano

APPENDIX E

RANDOM INTERVIEW RESULTS

In an effort to assess the student's reactions to the unit, four students from the experimental and four students from the control group were selected at random to participate in interviews with the examining teacher. Each student was told that he/she would be asked a few questions that were designed to give the evaluating teacher his/her feelings about the science unit that had just been completed. Each student has been given a number to assure anonymity. Students in the experimental group were assigned numbers one through four, while students in the control group were assigned numbers five through eight.

Question one, "What did you like the most" received the following responses:

Student 1- "Earthquakes--That was fun!"

Student 2: "Learning the shapes of volcanoes"

Student 3: "Learning about earthquakes"

Student 4: "Definitely the experiments"

Student 5: "Studying volcanoes"

Student 6: "The Plate Tectonics Theory"

Student 7: "Learning more about earthquakes"

Student 8 : "Volcanoes"

Earthquakes or volcanoes were mentioned by three of the four students in each group. Both groups seemed to find the study of earthquakes and volcanoes interesting and exciting. Many students in the control group chose one of these areas for their independent study projects. Many students in the experimental group found the filmstrip as well as other interventions about earthquakes and volcanoes very interesting as well.

Question two, "What did you like the least", received the following responses:

Student 1 - "Volcanoes"

Student 2 - "Learning about what comes out of volcanoes"

Student 3 - "Learning about faults"

Student 4 - "The centers--they were sort of fun, but hard, but I learned quite a bit."

Student 5 - "Seismographs"

Student 6 - "Volcanoes"

Student 7 - "Nothing!"

Student 8 - "Earthquakes"

It may be interesting to note that several of the student's least favorite activities directly related to their most favorite activity. For example, student 2 stated in question one that he/she liked "learning the shapes of volcanoes" the most, while in question two, he/she liked "learning what comes out of volcanoes" the least. Student three replied that he/she liked "learning about earthquakes" the most, but liked "learning about faults" the least. It is possible that, since both of these students were in the experimental group, perhaps the interventions introduced challenged the students to search for and then apply new knowledge and information.

Question three asked each student to rate the following four methods of instruction from most favorite to least favorite : independent study, centers, experiments, and lecture (1= most favorite, 4= least favorite).

Student 1 - 1. Lecture

2. Experiments

3. Independent Study

4. Centers

Student 2 - 1. Experiments

2. Independent Study

3. Lecture

4. Centers

Student 3 - 1. Independent Study

2. Lecture

3. Experiments

4. Centers

Student 4 - 1. Experiments

2. Independent Study

3. Centers

4. Lecture

Student 5 - 1. Experiments

2. Centers

3. Lecture

4. Independent Study

Student 6 - 1. Experiments

2. Centers

3. Independent Study

4. Lecture

Student 7 - 1. Independent Study

2. Experiments

3. Lecture

4. Centers

Student 8 - 1. Independent Study

2. Experiments

3. Centers

4. Lecture

All of the students interviewed in the experimental group had a different first choice response. It is interesting to note that "centers" was the least favorite of three of the four students in the experimental group. Several of the students interviewed indicated that the centers were time consuming, but that they did learn quite a bit from them.

Two of the students polled in the control group chose independent study as their favorite style for learning, while the other two chose experiments. Student five chose independent study as his/her least favorite method of instruction. He/she told the examining teacher that "I never feel sure that I'm learning everything I am supposed to be learning when I'm on my own."

Question four, "What was the most interesting thing that you learned" received the following responses:

Student 1 - "Earthquakes"

Student 2 - "How plates move"

Student 3 - "Volcanoes"

Student 4 - "The Plate Tectonics Theory"

Student 5 - "How plates move"

Student 6 - "How the Richter Scale works"

Student 7 - "The three types of volcanoes"

Student 8 - "How rocks are formed and made"

The students seemed to think that a number of items were interesting, as witnessed by the variety of responses. The most popular item was related to the plate tectonics theory. Perhaps this was due to the fact that most of the students had not studied plate tectonics before, thus the information was new and interesting.

Question five, "What was the most important thing you learned" received the following responses:

Student 1 - "How rocks are made"

Student 2 - "How to tell volcanoes apart"

Student 3 - "How to survive an earthquake"

Student 4 - "How earthquakes occur and how to be safe"

Student 5 - "What earthquakes can do"

Student 6 - "What damage earthquakes can do"

Student 7 - "How long earthquakes can last"

Student 8 - "How earthquakes occur along faults"

Seven of the eight responses related to the study of earthquakes. Many of the students showed a concern for knowing how to survive an earthquake. Perhaps this was due in part to the fact that shortly before this study began, a major earthquake hit San Francisco, California.

The responses to question six, "What did you learn that you didn't know before were as follows:

Student 1 - "What blows out of the three types of volcanoes"

Student 2 - "A lot of stuff--Mostly about the three types of plate movements"

Student 3 - "Plate tectonics"

Student 4 - "I learned a lot--that's hard! I guess I really learned about epicenters."

Student 5 - "How volcanoes erupted"

Student 6 - "The Plate Tectonics Theory"

Student 7 - "The three types of volcanoes"

Student 8 - "The three types of rocks"

Again, there seemed to be a variety of responses. Plate tectonics was the response of three of the eight students, and volcanoes was mentioned by three students as well. One student mentioned that he/she learned about sedimentary, metamorphic, and igneous rocks, while another chose epicenters as information not known previously.

The responses to question seven, "What from this unit challenged you the most" were as follows:

Student 1 - "Earthquakes and volcanoes"

Student 2 - "Volcanoes-how they are shaped"

Student 3 - "Faults"

Student 4 - "The centers!"

Student 5 - "Getting ready to give my presentation"

Student 6 - "The three different kinds of volcanoes"

Student 7 - "I just couldn't believe that earthquakes can last only a few seconds and still can be so damaging!"

Student 8 - "The reports you had to do"

Two of the four students in the control group mentioned that their independent study was the most challenging part of the unit. The project, of course, was designed to be the most challenging segment of the unit for the control group, as it was the least directed phase for this group. Only one student in the experimental group chose centers as the most challenging item. The centers were probably the most challenging part of the the unit for the experimental group, as it was the least directed segment. Perhaps the other three students in the experimental group chose other areas as the most challenging because a lot of novel information was presented to them in many of the subjects studied in the unit.

Question eight, "Was this unit different from any other science units you have had? If so, how", received the following responses:

Student 1 - "We talked a lot about earthquakes and volcanoes."

Student 2 - "We learned a lot about volcanoes and earthquakes."

Student 3 - "I learned about the environment and all that."

Student 4 - "We did a lot more experiments."

Student 5 - "We talked about earth movements and what's inside the earth."

Student 6 - "I'd never done projects before."

Student 7 - "I'd never presented a project before."

Student 8 - "We studied a lot of things. It was more interesting to study a lot of different things."

The overall consensus seemed to be that most of the students polled felt that this unit was different than other science units because there were different and varied techniques present for both groups. The experimental group had many interventions throughout the course of the unit, while the control group was allowed to take a part of the unit in which they were interested and research it. Two of the four students interviewed in the control group stated that this was a different procedure than usual in a science unit.

Question nine, "What was the hardest thing to understand" received the following responses:

Student 1 - "The different types of rocks"

Student 2 - "How composite cones can grow so quickly>"

Student 3 - "Why plates move"

Student 4 - "Nothing. With you around I learned a lot."

Student 5 - "How earthquakes occur"

Student 6 - "How the Earth's crust is made up of plates"

Student 7 - "Earthquakes"

Student 8 - "How volcanoes form in different shapes."

Six of the eight students responses to this question were directly related to a questions that he/she missed. The responses were quite varied.

Question ten, "What was the most difficult test question" received the following responses;

Student 1 - "What does a seismograph tell scientists about earthquakes" (number C-13)

Student 2 - "What kinds of rocks are formed from buried and cemented gravel, sand, and mud" (number C-12)

Student 3 - "What does a seismograph tell scientists." about earthquakes" (number C-13)

Student 4 - "The San Andreas Fault question" (Question B-4).

Student 5 - "How did scientists locate the outlines of the large sections of Earth's crust called plates" (number C-7).

Student 6 - "Rocks that form when melted magma cools slowly are called _______ rocks" (number A-5)

Student 7 - "What does the plate tectonics theory explain" (number C-10)

Student 8 - "What kinds of rocks are formed from buried and cemented gravel, sand, and mud" (number C-12)

The students not only chose question they missed, but six of the eight chose short response questions as the most difficult items. Several of the students told the examining teacher that they sometimes felt unsure when asked to answer this type of question, and they preferred a question in which there was a more definite right or wrong answer.

The final question, "What did you learn about in this unit that you would like to investigate further on your own" received the following responses:

Student 1 - "Volcanoes"

Student 2 - "Earthquakes"

Student 3 - "Volcanoes"

Student 4 - "Faults"

Student 5 - "Volcanoes"

Student 6 - "Earthquakes"

Student 7 - "Volcanoes"

Student 8 - "Volcanoes"

All of the students polled chose either earthquakes or volcanoes, or something that related to earthquakes or volcanoes. The students seemed to find both of these areas of study fascinating. Many students from both groups continued research in these areas after the unit had been concluded.

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Thesis: A COMPARISON OF SELECTED EXPERIENCES WITHIN A SCIENCE CURRICULUM AS THEY AFFECT THE ACHIEVEMENT OF THE INTELLECTUALLY GIFTED STUDENT

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