DOCUMENT RESUME

ED 073 940 SE 015 847

AUTHOR	Arganian, Mourad P.; And Others
TITLE	Acquisition of the Concept "Biodegradable" Through Written Instruction: Pretest and Age Effects.
INSTITUTION	Wisconsin Univ., Madison. Research and Development Center for Cognitive Learning.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C. Research and Development Centers Branch.
REPORT NO	TR-226
BUREAU NO	BR-5-0216
PUB DATE	Jun 72
CONTRACT	OEC-5-10-154
NOTE	34p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Cognitive Processes; *Environment; Environmental Education; *Fundamental Concepts; Instruction; *Intermediate Grades; Reading Materials; *Research; Statistical Data; Tests

ABSTRACT

The primary purpose of this study/experiment was to determine whether children in the middle elementary grades would be able to learn the concepts "biodegradable agent," "biodegradable material," and "biodegradable process" from a short written lesson. Secondary purposes were to examine the degree to which a pretest, grade level, and sex of the student influenced the amount learned. The three concepts were analyzed to determine their relevant and irrelevant attributes. Examples and nonexamples of each concept were also selected. On the basis of these analyses a 5 1/2 page lesson was written. Information given in the lesson for each concept included a definition in terms of the relevant attributes of the concept, and both examples and nonexamples of the concept. A 12-item testing instrument was also developed. The basic design was a Solomon Four-Group Design with pretest and lesson as factors. The design was replicated at two grade levels, fourth and sixth, and sex of the student was also included as a factor. Concluding statements indicate that both fourth- and sixth-grade students gained information about the concepts by studying a short written lesson and retained a significant amount of that information for a three-month period. The reading lesson and tests are included. (Author/BL)

NCERD

ACQUISITION OF THE CONCEPT BIODEGRADABLE THROUGH WRITTEN INSTRUCTION: PRETEST AND AGE EFFECTS

RESEARCH
COGNITIVE LEARNING
DEVELOPMENT

WISCONSIN RESEARCH AND DEVELOPMENT
CENTER FOR
COGNITIVE LEARNING

Technical Report No. 226

ACQUISITION OF THE CONCEPT BIODEGRADABLE THROUGH WRITTEN INSTRUCTION: PRETEST AND AGE EFFECTS

by
Mourad P. Arganian, Dorothy A. Frayer, Jane A. Goldman,
Steven K. Lubin and Patricia A. Storck

Report from the
Conditions of Learning and Instruction
Component of Program 1

Herbert J. Klausmeier, Principal Investigator

Wisconsin Research and Development
Center for Cognitive Learning
The University of Wisconsin
Madison, Wisconsin

June 1972

Published by the Wisconsin Research and Development Center for Cognitive Learning, supported in part as a research and development center by funds from the United States Office of Education, Department of Health, Education, and Welfare. The opinions expressed herein do not necessarily reflect the position or policy of the Office of Education and no official endorsement by the Office of Education should be inferred.

Center No. C-03 / Contract OE 5-10-154

Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

Acknowledgments

The authors are deeply indebted to Barbara Marten, Project Specialist at the Wisconsin Research and Development Center for Cognitive Learning, for her many suggestions and generous assistance in preparing the experimental lesson and test. Also, we are grateful to Fred A. Heal for assuring the scientific accuracy of the lesson and test through careful review and perceptive comments. We wish to give special thanks to Dr. Frank Hooper, Associate Professor of Child Development, who encouraged us to use the Solomon Four-Group Design and who advised us throughout the duration of the research. We thank Thomas Fischbach, Technical Specialist at the Center, for designing the statistical analysis. Special mention is deserved by Dr. Herbert Klausmeier, Director of the Center and Professor of Educational Psychology, who kindled our interest in concept learning and who invited us to consult with his staff in the course of our project.

We are indebted to Harold Anderson, Project Director, Individualized Instruction, Area F, Madison, Wisconsin, for his assistance in selecting the schools as well as to John Benka, Assistant Administrator of Milton Junction (Wis.) District No. 1 for the opportunity of carrying out the pilot study at Milton West Elementary School. We are especially grateful to the staff of the Oregon (Wis.) Middle School, namely Mr. Frank Nauyokas, Principal; Mrs. Eleanor Albertson, Mrs. Judith Figlio, Miss Lynn Graebner, and Miss Norma Melby, the teachers of Unit D; Miss Mabel Dummer, Mrs. Verdelle Heady, Mrs. Magdalene Hennessey, and Mr. Lyle Laufenberg, the teachers of Unit B; and their students, who together allowed our study and gave us their fullest cooperation.

Contents

		Page
	Acknowledgments	iv
	List of Tables	vii
	Abstract	ix
I	Introduction	1
	Teaching and Testing for Concept Mastery	1
	Age and Concept Mastery	2
	Pretesting and Concept Mastery	2
II	Method	5
	Purpose	5
	Subjects	5
	Lesson	5
	Test	6
	Experimental Design	6
	Pilot Study	6
	Procedure	6
III	Results	9
	Posttest	9
	Retention	11
	Pretest	15
	Gain	15
IV	Discussion and Conclusions	17
	Conclusions	18
	References	19
	Appendix A Analyses of the Concepts Biodegradable Agent, Biodegradable Material, and Biodegradable Process	21
	Appendix B Lesson on the Concepts Biodegradable Agent, Biodegradable Material, and Biodegradable Process	25
	Appendix C Test on the Concepts Biodegradable Agent, Biodegradable Material, and Biodegradable Process	29
	Appendix D Instructions to Students	33

List of Tables

Table		Page
1	Solomon Four-Group Design	3
2	Experimental Design of the Study	6
3	Means and Standard Deviations of Posttest Scores as Functions of Lesson, Pretest, Grade, and Sex	9
4	Analysis of Variance of Posttest Scores	10
5	Mean Posttest Scores as a Function of Lesson and Grade	10
6	Means and Standard Deviations of Retention Scores as Functions of Lesson, Pretest, Grade, and Sex	11
7	Analysis of Variance of Retention Scores	12
8	Mean Retention Scores as a Function of Lesson and Grade	12
9	Means and Standard Deviations of Pretest Scores as Functions of Grade, Sex, and Lesson	13
10	Analysis of Variance of Pretest Scores	13
11	Means and Standard Deviations of Gain Scores as Functions of Grade, Sex, and Lesson	14
12	Analysis of Covariance of Gain Scores Using Pretest Score as a Covariate	14

Abstract

The purpose of this experiment was to determine whether children in the middle elementary grades would be able to learn the concepts biodegradable agent, biodegradable material, and biodegradable process from a short written lesson. In addition, the experiment was designed to explore the effects of pretesting, grade level, and sex of student on the amount learned.

The three concepts to be taught were analyzed to determine their relevant and irrelevant attributes. Examples and nonexamples of each concept were also selected. On the basis of these analyses a 5 1/2-page lesson was written. Information given in the lesson for each concept included a definition in terms of the relevant attributes of the concept, and both examples and nonexamples of the concept. A 12-item testing instrument was also developed. This instrument, used as both a pretest and posttest, consisted of multiple-choice items requiring recognition of examples and nonexamples of all three concepts, and recognition of the relevant and irrelevant attributes of biodegradable process.

The basic design was a Solomon Four-Group Design with pretest and lesson as factors. The design was replicated at two grade levels, fourth and sixth. Sex of student was also included as a factor in the design.

Before studying the lesson, half of the students received a pretest. Students were then given the lesson to study independently for approximately 10 minutes. After studying the lesson, all students received a posttest.

The essential findings of the study were:

1. Students who studied the lesson attained higher scores on an immediate posttest and on a three-month retention test than students who did not study the lesson.

2. Students who took a pretest prior to studying the lesson did not differ in their scores on an immediate posttest or on a three-month retention test from students who did not take a pretest.

3. Sixth-grade students attained higher scores on an immediate posttest and on a three-month retention test than fourth-grade students.

4. Sixth-grade students exhibited higher gain scores from pretest to posttest than fourth-grade students.

5. Boys did not differ from girls in their scores on an immediate posttest or on a three-month retention test.

I
Introduction

A recent issue of National Geographic focused on the ecological crisis and the imminent threat to our planet's life-support systems. In a concluding statement Russell E. Train, Chairman of the President's Council on Environmental Quality, said, "But no policies will work unless people understand them and stand behind them. Our citizens must be informed, urgently and accurately. We need new attitudes: not those of endless abundance, of the ever-expanding frontier, but those of a mature, responsible society" (Young & Blair, 1970, p. 780).

The following study was motivated in part by beliefs, parallel to those of Mr. Train, that the public needs information in order to change attitudes so that a mature responsible society can make the policies and decisions required to enable biological survival and to reverse the decline in the quality of life. Some of the information necessary for individual and collective action is of a technical nature. Previously, higher-order scientific concepts were accessible only to college students or biologists. It is the authors' belief that preservation of our environment will ultimately depend on the acquisition of such concepts as early as possible in the educational careers of children.

In agreement with this belief, the Wisconsin Research and Development Center is developing an instructional program for elementary school children which focuses on environmental problems. To insure the success of this instructional program, Center staff are determining experimentally at what age and in what manner such concepts can be mastered most effectively by elementary school students.

To answer questions such as these, research dealing with the learning of subject matter concepts must be carried out in actual classroom settings. Applied research in concept learning has been neglected or, more accurately, has been overshadowed in the literature by the exposition of grander developmental theories of cognition. This is consistent with the current psychological focus on learning processes and the devaluation of content. Clearly, content needs greater emphasis if the results of educational research are to be translated into educational practice. In the classroom, it is not enough for a child to demonstrate the acquisition of cognitive skills consistent with a specified developmental stage. He must also demonstrate acquisition of certain critical subject matter concepts.

Teaching and Testing for Concept Mastery

In studying the acquisition of subject matter concepts, one of the most difficult problems confronted is to develop an approach to teaching and testing which will be applicable to a wide range of concepts. Such an approach has been developed at the Wisconsin Research and Development Center. Concepts are "analyzed" in terms of their defining attributes. Based on this analysis, examples and nonexamples of the concept are selected systematically. Also, the concept to be taught is related to both more general and more specific concepts.

As an illustration of this type of analysis, consider the concept triangle. The defining attributes of the concept are: (a) the figure is a polygon, and (b) the figure has three sides. Examples are chosen which have the defining attributes but vary in other attributes which are not relevant to the concept—length of sides, size of angles, orientation of the figure, and so on. Nonexamples are chosen which do not exhibit one of the defining attributes—are not polygons or do not have three sides. The concept triangle is identified as a member of the general class or concept polygon. Right angle triangles, equilateral triangles, and isosceles

triangles are identified as specific members of the class or concept triangle. Work at the Wisconsin R & D Center has shown that many concepts in subject matter areas as divergent as science, social studies, language arts, and mathematics can be analyzed in this manner (Golub, Fredrick, Nelson, & Frayer, 1971; Romberg, Steitz, & Frayer, 1971; Tabachnick, Weible, & Frayer, 1970; Voelker, Sorenson, & Frayer, 1971).

The analysis of a concept can form the basis for writing lessons to teach the concept. The writer may tell the student the defining attributes of the concept (which is equivalent to giving a definition), provide examples and/or nonexamples of the concept, or point out the relationships among various concepts. Since the information presented about a concept can be clearly described, lessons which differ from one another in specified ways can be compared with regard to their effectiveness in teaching the concept.

In an analogous manner, the analysis of a concept can form the basis for testing concept mastery. Questions can be written to determine whether the student recognizes examples and nonexamples of the concept, knows the defining attributes of the concept, and understands the interrelationships among concepts. A paradigm for writing such items to test concept mastery has been developed by Frayer, Fredrick, and Klausmeier (1969).

Thus, a promising approach for carrying out research on the acquisition of subject matter concepts is to construct lessons which can be described with regard to characteristics such as the number of examples and nonexamples presented, whether the definition is given, and whether interrelationships between concepts are pointed out. In turn, the effects of these lessons should be measured by tests designed to measure various aspects of concept mastery such as discrimination of examples from nonexamples, and knowledge of the defining attributes of the concept.

The present experiment utilized this analytic approach to examine the question of whether elementary school children can learn complex abstract concepts related to environmental problems. Concepts selected for this study were biodegradable agent, biodegradable material, and biodegradable process. These concepts were selected since they are relatively new in terms of popular usage, yet are fundamental ecological concepts. Each of the three concepts was analyzed to determine its relevant and irrelevant attributes. Based on these analyses, examples and nonexamples were selected and a lesson and test were developed.

Age and Concept Mastery

A question of interest to both educational psychologists and science educators is whether young children can master difficult abstract concepts such as those related to the biodegradable process. Theorists differ in their beliefs concerning this question. Gagné (1970), for example, presents a cumulative learning model which implies that one can teach a child anything provided that prerequisite concepts are already in the child's repertoire. Gagné states this view explicitly when he says,

> ...beyond a certain age (perhaps three) developmental readiness for learning is primarily determined by previously acquired intellectual skills, and therefore by the cumulative effects of learning and learning transfer. [P. 279]

In discussing learning in the schools, Gagné asserts,

> The educational implications of the latter view are both clear and simple. Children can learn any intellectual thing we want them to learn, provided they have learned the prerequisites. [P. 300]

On the other hand, stage theorists such as Piaget and Bruner imply that children may be unable to master abstract concepts until they have reached a certain maturational stage (Bruner, Olver, & Greenfield et al., 1966; Flavell, 1963).

It is of interest, therefore, to see when complex environmental concepts such as biodegradable can be taught to children of different ages. In the present study, the lesson was presented to both fourth and sixth graders. The relative amount of learning at each grade level was determined by comparing posttest, retention, and gain scores for the two groups. Following the reasoning of either the behaviorists or stage theorists, one would predict better performance for sixth graders than fourth graders.

Pretesting and Concept Mastery

The current trend in education is toward individualization of instruction. This individualization is often accomplished by pretesting children to determine their level of mastery of various concepts and skills, then assigning students to instruction in concepts and skills they have not yet mastered (see, for example, Klausmeier, Quilling, Sorenson, Way, &

Glasrud, 1971). Considering the frequent use of pretesting, it is desirable to determine its influence on the instructional process.

There are two possible effects of pretesting which are of interest. Learning may occur as a result of taking the pretest, or the pretest may focus attention in such a way as to influence what the child learns from the lesson. If a control group is used in addition to the group which receives a lesson, it is possible to determine whether learning is due to the lesson or the pretest. It is still impossible, however, to determine whether learning is due to the lesson or to an interaction between the pretest and lesson. To isolate the effects of the pretest, the lesson, and the interaction between the two, this study utilized the Solomon Four-Group Design (Solomon & Lessac, 1968). Use of this design permitted evaluation of the amount learned from the lesson. The design is presented in Table 1.

Campbell and Stanley (1963) note that while anecdotes frequently suggest that pretesting has the effect of sensitizing the learner to material, published research shows either no effect or a dampening effect. Since there is no reason to surmise that there would be a depression of performance due to pretesting in the present study, it is predicted that pretesting will have no effect.

Table 1
Solomon Four-Group Design

	Pretest	
Treatment	Yes	No
Yes	I	II
No	III	IV

Source: Solomon and Lessac, 1968, p. 147.

II
Method

Purpose

The purpose of this experiment was to determine whether children in the middle elementary grades would be able to learn the concepts biodegradable agent, biodegradable material, and biodegradable process from a short written lesson. In addition, the experiment was designed to explore the effects of pretesting, grade level, and sex of student on the amount learned. On the basis of logical analysis and related research, five hypotheses were formulated:

1. Students who study the lesson will attain higher scores on an immediate posttest and on a three-month retention test than students who do not study the lesson.

2. Students who take a pretest prior to studying the lesson will not differ in their scores on an immediate posttest or on a three-month retention test from students who do not take a pretest.

3. Sixth-grade students will attain higher scores on an immediate posttest and on a three-month retention test than fourth-grade students.

4. Sixth-grade students will exhibit higher gain scores from pretest to posttest than fourth-grade students.

5. Boys will not differ from girls in their scores on an immediate posttest or on a three-month retention test.

Subjects

The subjects in this study were 110 fourth-grade and 109 sixth-grade children at Oregon Middle School in Oregon, Wisconsin, a small rural community. Oregon Middle School includes Grades 4-6, organized into four units. The fourth-grade children included in the study comprised the population of one unit, the sixth-grade children the population of another unit. Children in each unit were heterogeneous with regard to ability. Initially, 128 fourth-grade children and 128 sixth-grade children were included in the experimental sample. Eighteen fourth graders and 19 sixth graders were dropped because of absences.

Lesson

The concepts biodegradable agent, biodegradable material, and biodegradable process were presented in a 5 1/2- page lesson. The content of this lesson was developed in an analytical manner. First, the three concepts were analyzed by subject matter experts to determine their relevant and irrelevant attributes. Examples and nonexamples of each concept were also selected by these experts. The analyses of the concepts, which were used as a basis for writing both the lesson and the test, are presented in Appendix A.

Since the lesson was to be read independently by each student, an attempt was made to minimize reading difficulty. The lesson was written in a narrative style intended to be interesting to fourth- and sixth-grade children. Information given in the lesson for each concept included a definition in terms of the relevant attributes of the concept, and both examples and nonexamples of the concept. Following the presentation of a concept, the child was asked to give two examples of it. The lesson is presented in Appendix B.

Table 2
Experimental Design of the Study

Grade	Sex	Treatment			
		No Lesson		Lesson	
		No Pretest	Pretest	No Pretest	Pretest
4	Male	N = 16	N = 10	N = 13	N = 11
	Female	N = 12	N = 16	N = 16	N = 16
6	Male	N = 17	N = 13	N = 15	N = 13
	Female	N = 12	N = 13	N = 12	N = 14

Test

A 12-item multiple-choice test was used to measure knowledge of the concepts biodegradable agent, biodegradable material, and biodegradable process. Test questions were based on the analyses shown in Appendix A and were developed according to a paradigm for testing the level of concept mastery which was proposed by Frayer, Fredrick, and Klausmeier (1969). This paradigm suggests types of questions to determine knowledge of a concept's defining attributes as well as recognition of concept examples and nonexamples.

For each of the three concepts, two items required recognition of examples of the concept and one item required recognition of a nonexample of the concept. The concept biodegradable process was seen to entail knowledge of biodegradable agent and biodegradable material. Thus, only for this concept were questions developed to test knowledge of defining attributes. Two items required recognition of relevant attributes of the concept and one item required recognition of an irrelevant attribute. The resulting 12-item test is included in this report as Appendix C. This same test was used as a pretest, posttest, and retention test.

Experimental Design

The basic design was the Solomon Four-Group Design, replicated at two grade levels, fourth and sixth. Subjects at each grade level were randomly assigned to the four treatment groups. Sex was also included as a factor in the design. The resulting design and the number of subjects in each cell are shown in Table 2. Dependent measures were scores on an immediate posttest and on a three-month retention test. In addition, gain scores from pretest to posttest were calculated for subjects who were pretested.

Pilot Study

A pilot study was carried out to achieve three objectives:

1. To determine the characteristics of the test items as a basis for possible revisions

2. To isolate any problems in the instructions or procedures

3. To determine time requirements for the main study

The subjects for the pilot study were 167 fourth-grade students and 137 sixth-grade students at the Milton West Elementary School (Milton, Wisconsin). On the basis of the pilot study, minor revisions were made in the instructions, procedures, and lessons. The 12-item test had a Hoyt internal consistency reliability of .60. Item analysis revealed that 3 of the 12 items were poorly constructed. These items therefore were revised prior to the main study.

Procedure

The schedule for the study was as follows: Day 1 morning, administration of pretest to all

subjects; Day 1 afternoon, administration of lesson followed immediately by posttest to half of the sixth-grade unit; Day 2 morning, administration of lesson followed immediately by posttest to the fourth-grade unit and to one-fourth of the sixth-grade unit; Day 2 afternoon, administration of lesson followed immediately by posttest to the remainder of the sixth graders.

The experimenter was a female graduate student who was familiar with the procedures and materials prior to the study. On the first day of the experiment the children were given general information concerning the purpose of the study and procedures to be followed in completing the pretest. The children were reminded of the purpose of the study and given further directions at the time of the administration of the lesson and posttest. These instructions comprise Appendix D.

Although in the traditional Solomon Four-Group Design one group would receive no pretest, in the present study this group received an irrelevant pretest dealing with animals and their homes. This modification in procedure was utilized to minimize disruption of classroom procedures. Likewise, students who were assigned to a group which traditionally would receive no lesson in this study received an irrelevant lesson dealing with animals and their homes.

New vocabulary was reviewed prior to the beginning of the lesson, using a numbered vocabulary list which was included in each lesson booklet. The same vocabulary list was presented to all children. This list contained a random arrangement of difficult words from both the biodegradable and irrelevant lessons. The experimenter read aloud each word on the list and had the children repeat it after her. While the children studied the lessons, the experimenter proctored to be sure directions were followed. No assistance was offered to the children other than pronouncing words (two such requests were made, both in the fourth grade) or for clarifying procedure.

Three months after the lesson was administered, the experimenter returned to the school and readministered the same test as a measure of long-term retention.

III
Results

Two dependent measures, the total score on the posttest and the total score on the retention test, were obtained for each S. Ss in half of the groups also had pretest scores. Separate analyses were carried out on scores for the posttest, retention test, pretest, and on the gain scores from pretest to posttest.

Posttest

The means and standard deviations of posttest scores as functions of lesson, pretest, grade, and sex are presented in Table 3. An analysis of variance was carried out on the posttest scores. Since the number of Ss in the cells varied, the design was nonorthogonal and the effects were not independent. The procedure followed was to remove the effects of grade and sex first. These factors have been found to be related to learning, and it would not be desirable to make the presence or absence of a treatment effect depend on the number of fourth graders as opposed to sixth graders, or on the number of boys as opposed to girls in each group. It was presumed that all other

Table 3
Means and Standard Deviations of Posttest Scores as Functions of Lesson, Pretest, Grade, and Sex

Grade	Sex	Treatment: No Lesson, No Pretest	No Lesson, Pretest	Lesson, No Pretest	Lesson, Pretest
4	Male	6.13 (1.71) N = 16	4.80 (2.44) N = 10	5.92 (1.89) N = 13	7.00 (2.86) N = 11
	Female	4.33 (1.07) N = 12	5.81 (1.76) N = 16	7.06 (2.17) N = 16	6.13 (3.14) N = 16
6	Male	6.18 (2.53) N = 17	6.46 (2.76) N = 13	7.53 (3.31) N = 15	7.92 (2.99) N = 13
	Female	7.00 (1.41) N = 12	6.92 (2.53) N = 13	8.42 (2.27) N = 12	8.36 (2.31) N = 14

Note.—Standard deviations are given in parentheses.

Table 4
Analysis of Variance of Posttest Scores

Source	df	MS	F	p <
Sex (S)	1	2.44	< 1	.52
Grade (G)	1	102.57	17.65	.0001*
Lesson (L)	1	88.38	15.21	.0002*
Pretest (P)	1	.30	< 1	.82
S X G	1	8.84	1.52	.22
S X L	1	1.19	< 1	.65
G X L	1	1.27	< 1	.64
S X G X L	1	1.28	< 1	.64
L X P	1	.11	< 1	.89
S X P	1	.03	< 1	.94
G X P	1	.15	< 1	.87
S X G X P	1	1.77	< 1	.58
S X P X L	1	20.19	3.47	.06
G X P X L	1	.04	< 1	.93
S X G X P X L	1	18.72	3.22	.07
Within Cells (Error)	203	5.81		

*Significant at or beyond the .05 level.

Table 5
Mean Posttest Scores as a Function of Lesson and Grade

	Treatment		
Grade	No Lesson	Lesson	M
4	5.39	6.52	5.96
	N = 54	N = 56	N = 110
6	6.60	8.04	7.31
	N = 55	N = 54	N = 109
M	6.00	7.26	6.63
	N = 109	N = 110	N = 219

null hypotheses held so that the lesson effect was removed next, followed by the pretest effect and interactions. An examination of correlations of the estimated effects in the full model suggests that adjustments resulting from reordering would be minimal unless the lesson by pretest interaction is non-zero.

The results of the analysis are shown in Table 4. A significant difference was noted between students who received lessons and those who did not. Mean posttest scores as a function of lesson and grade are presented in Table 5. The mean score for students who received no lesson was 6.00, while the mean score for those who received a lesson was 7.26. A 95 percent confidence interval estimate of the difference in posttest scores indicates that studying the lesson increased the mean score by at least 0.69 points.

The effect of grade on posttest scores was also significant. The means shown in Table 5 reveal that fourth graders attained a mean score of only 5.96, while sixth graders had a mean score of 7.31. A 95 percent confidence interval estimate shows that sixth graders scores were at least .81 points higher than those of fourth graders.

Retention

The means and standard deviations of retention scores are presented in Table 6, and the analysis of variance of these scores is shown in Table 7. The pattern of results is similar to that for posttest scores, with significant differences due to lesson and grade level. Mean retention scores by lesson and grade appear in Table 8. The mean score for students who did not study the biodegradable lesson was 5.55; for students who studied the lesson, the mean was 6.25. Thus, even after a three-month retention interval, performance was significantly higher as a result of the lesson. The mean retention score for fourth graders was 5.31, while that for sixth graders was 6.50, indicating a maintenance of the advantage shown by sixth graders on the posttest.

Comparison of Tables 5 and 8 gives some indication of the amount of forgetting over the three-month interval. The mean posttest score for students who received the lesson was 7.26, and the mean retention score was 6.25—a loss of 1.01. An analysis of variance of "loss" (posttest minus retention) scores confirmed that there was a statistically significant ($p < .0001$)

Table 6
Means and Standard Deviations of Retention Scores as Functions of Lesson, Pretest, Grade, and Sex

		Treatment			
		No Lesson		Lesson	
Grade	Sex	No Pretest	Pretest	No Pretest	Pretest
4	Male	4.69 (2.41) $N = 16$	5.30 (2.71) $N = 10$	5.77 (1.88) $N = 13$	6.00 (2.57) $N = 11$
	Female	4.83 (1.95) $N = 12$	5.25 (2.38) $N = 16$	5.94 (2.64) $N = 16$	4.88 (2.13) $N = 16$
6	Male	5.59 (2.69) $N = 17$	7.23 (2.62) $N = 13$	6.87 (2.07) $N = 15$	6.77 (3.03) $N = 13$
	Female	6.08 (1.88) $N = 12$	5.62 (1.89) $N = 13$	6.58 (2.68) $N = 12$	7.43 (1.99) $N = 14$

Note.—Standard deviations are given in parentheses.

Table 7
Analysis of Variance of Retention Scores

Source	df	MS	F	p <
Sex (S)	1	2.36	< 1	.52
Grade (G)	1	76.62	13.62	.0003*
Lesson (L)	1	28.83	5.13	.02*
Pretest (P)	1	3.66	< 1	.42
S X G	1	.04	< 1	.93
S X L	1	.01	< 1	.96
G X L	1	.65	< 1	.73
S X G X L	1	5.39	< 1	.33
L X P	1	6.23	1.11	.29
S X P	1	6.90	1.23	.27
G X P	1	2.92	< 1	.47
S X G X P	1	.12	< 1	.88
S X P X L	1	2.91	< 1	.47
G X P X L	1	1.93	< 1	.56
S X G X P X L	1	14.41	2.56	.11
Within Cells (Error)	203	5.63		

*Significant at or beyond the .05 level.

Table 8
Mean Retention Scores as a Function of Lesson and Grade

Grade	Treatment: No Lesson	Treatment: Lesson	M
4	5.00	5.61	5.31
	N = 54	N = 56	N = 110
6	6.09	6.93	6.50
	N = 55	N = 54	N = 109
M	5.55	6.25	5.90
	N = 109	N = 110	N = 219

Table 9
Means and Standard Deviations of Pretest Scores as Functions of Grade, Sex, and Lesson

Grade	Sex	Treatment: No Lesson	Treatment: Lesson	M
4	Male	5.00 (2.54) N = 10	5.09 (1.81) N = 11	
	Female	5.63 (1.45) N = 16	4.88 (2.45) N = 16	
	M			5.17 N = 53
6	Male	6.31 (2.10) N = 13	5.92 (3.04) N = 13	
	Female	5.77 (2.45) N = 13	6.71 (2.23) N = 14	
	M			6.19 N = 53
	M	5.71 N = 52	5.65 N = 54	5.68 N = 106

Note.—Standard deviations are given in parentheses.

Table 10
Analysis of Variance of Pretest Scores

Source	df	MS	F	p <
Sex (S)	1	.14	< 1	.87
Grade (G)	1	28.14	5.37	.02*
Lesson (L)	1	.11	< 1	.89
S X G	1	.02	< 1	.95
S X L	1	.26	< 1	.83
G X L	1	3.54	< 1	.41
S X G X L	1	7.62	1.46	.23
Within Cells (Error)	98	6.39		

*Significant at or beyond the .05 level.

Table 11
Means and Standard Deviations of Gain Scores as Functions of Grade, Sex, and Lesson

		Treatment		
Grade	Sex	No Lesson	Lesson	M
4	Male	-.20 (2.82) N = 10	1.91 (2.77) N = 11	
	Female	.19 (2.07) N = 16	1.25 (2.86) N = 16	
	M	.04	1.52	.79 N = 53
6	Male	.15 (1.77) N = 13	2.00 (2.65) N = 13	
	Female	1.15 (2.44) N = 13	1.64 (2.73) N = 14	
	M	.65	1.81	1.25 N = 53
	M	.35 N = 52	1.67 N = 54	N = 106

Note.—Standard deviations are given in parentheses.

Table 12
Analysis of Covariance of Gain Scores Using Pretest Score as a Covariate

Source	df	MS	F	p <
Sex (S)	1	.12	< 1	.88
Grade (G)	1	21.52	4.01	.05*
Lesson (L)	1	44.22	8.23	.005*
S X G	1	1.23	< 1	.63
S X L	1	7.53	1.40	.24
G X L	1	.07	< 1	.91
S X G X L	1	.72	< 1	.71
Within Cells (Error)	97	5.37		

*Significant at or beyond the .05 level.

loss for all groups between the posttest and retention test. The amount of loss, however, did not differ as a function of grade.

Pretest

To confirm the initial equivalence of the no-lesson and lesson groups and to determine whether the basal knowledge levels of the fourth and sixth graders were the same, comparisons of pretest scores were made. The means and standard deviations of pretest scores as a function of grade, sex, and lesson are presented in Table 9. The analysis of variance of these scores is presented in Table 10. The only significant effect was that due to grade. Referring to Table 9, it can be seen that the pretest mean was 5.17 for fourth graders and 6.19 for sixth graders. The sixth graders, therefore, had more knowledge concerning the concepts prior to studying the lessons than did the fourth graders.

The lack of a significant lesson effect confirms that the no-lesson and lesson groups were initially equivalent.

Gain

The analyses of the posttest and retention scores indicated that sixth graders attained significantly higher scores than fourth graders. Pretest scores, however, were also significantly higher for sixth graders. An important question is whether the higher posttest and retention scores of sixth graders were due solely to initial differences between the grades or whether the sixth graders also learned more from the lessons. This question can be answered by analysis of "gain" (posttest minus pretest) scores.

Means and standard deviations of gain scores are given in Table 11. An analysis of covariance was carried out on the gain scores, using pretest scores as the covariates. Results of the analysis of covariance appear in Table 12. There was a significant difference between grade levels in the amount learned from the lessons. Examination of the mean gain scores in Table 11 shows that fourth graders gained .79 points; sixth graders gained 1.25 points. Thus, sixth graders not only knew more than fourth graders about the concepts prior to the lessons, but also learned more from the lessons. The significant lesson effect simply confirms that the students learned from the lessons.

IV
Discussion and Conclusions

The primary purpose of this study was to determine whether children in the middle elementary grades would be able to learn abstract environmental concepts from a short written lesson. Secondary purposes were to examine the degree to which a pretest, grade level, and sex of the student influenced the amount learned.

Students who studied the lesson achieved significantly higher scores on an immediate posttest and on a three-month retention test than students who did not study the lesson. Thus, there is evidence that students were able to learn from the lessons, and remembered what they learned three months later.

On the other hand, the absolute level of performance on the test was not very high. The mean score on the posttest for children who had studied the lesson was only 7.26, which certainly does not reflect mastery of the concepts. The mean score on the retention test was 6.25, only slightly above 50 percent correct. It is clear that while children learned from the lesson, modifications of the lesson or the instructional approach itself should be tested in an attempt to enable more children to attain mastery.

One way to strengthen the lesson might be to include instruction on the prerequisite concepts living thing, nonliving thing, and product of a living thing. It was noted in the study that sixth graders made larger gains as a result of studying the lesson. It is plausible that these gains were a function of greater previous knowledge of the prerequisite concepts.

A second approach to strengthening the lesson would be to determine whether there was a consistent pattern in the errors made on the test with regard to the concept being tested or the type of question asked. At the fourth-grade level, there were three questions, numbers 1, 4, and 7, on which children who did not study the lesson made greater gains from pretest to posttest than children who studied the lesson. These questions dealt with recognition of an example of biodegradable material (No. 1), recognition of an irrelevant attribute of the biodegradable process (No. 4), and recognition of an example of the biodegradable process (No. 7).

At the sixth-grade level, questions 2, 3, and 5 showed smaller gains for students receiving the lesson than for students not receiving the lesson. These questions dealt with recognition of a relevant attribute of the biodegradable process (No. 2), recognition of a nonexample of biodegradable agent (No. 3), and recognition of an example of biodegradable agent (No. 5). Given that there is no pattern of item types missed either within or between grade levels, no specific deficiency in the lesson can be identified. The strengthening of the lesson, therefore, should probably be in its general approach.

First, as mentioned earlier, instruction in prerequisite concepts should be given. Second, the lesson should probably be expanded to a series of lessons which provide more examples and nonexamples and allow for review of the concepts learned in earlier lessons. The lesson used in this experiment was completed by the children in approximately ten minutes—an extremely brief period of time to learn three difficult concepts. Third, instruction should incorporate demonstration and discussion as well as printed text. This would clarify the concepts for children whose reading skills are not yet well-established, would provide feedback to correct misconceptions, and probably would increase motivation as well. Finally, application of the concepts should be stressed. What happens if a material is not biodegradable? What would happen if there were no bacteria in garbage? Application of the concepts serves as a basis for making decisions concerning the environment.

The fact that pretesting did not have a significant effect suggests that pretesting can be used to individualize instruction without fear that the amount of learning will be altered by its use. Further, a pretest-posttest design might be used with greater confidence in further experimentation comparing various lessons. This would be desirable, since a pretest-posttest design requires fewer subjects than the Solomon Four-Group Design or a posttest-only design with a control group.

Both fourth and sixth graders learned from the lesson, although sixth graders learned significantly more. The results suggest, however, that fourth graders are capable of learning abstract environmental concepts. In all probability, a different instructional approach employing demonstration and discussion would prove even more effective with children of this age who have less reading expertise.

Finally, no differences were observed between boys and girls in the amount of previous knowledge concerning the concepts or the amount learned from the lesson. This supported the hypothesis that the sex of the student would not be a significant factor in learning. The implication is that boys and girls have roughly the same amount of incidental or background knowledge about these concepts and that the same instructional approach can be used for both boys and girls.

Conclusions

To summarize, both fourth- and sixth-grade students gained information concerning the concepts biodegradable agent, biodegradable material, and biodegradable process by studying a short written lesson, and retained a significant amount of that information for a three-month period. Sixth graders had greater prior knowledge concerning the concepts than fourth graders, and also learned more from the lesson. Administration of a pretest prior to studying the lesson did not affect the amount learned. Finally, boys did not differ from girls either in background knowledge or amount learned.

References

Bruner, J. S., Olver, R. R., & Greenfield, P. M., et al. Studies in cognitive growth. New York: John Wiley, 1966.

Campbell, D. T., & Stanley, J. C. Experimental and quasi-experimental designs for research. Chicago: Rand McNally, 1963.

Flavell, J. H. The developmental psychology of Jean Piaget. Princeton, N. J.: Van Nostrand, 1963.

Frayer, D. A., Fredrick, W. C., & Klausmeier, H. J. A schema for testing the level of concept mastery. Wisconsin Research & Development Center for Cognitive Learning, Working Paper No. 16, 1969.

Gagné, R. M. The conditions of learning. (2nd ed.) New York: Holt, Rinehart, & Winston, 1970.

Golub, L. S., Fredrick, W., Nelson, N., & Frayer, D. A. Selection and analysis of language arts concepts for inclusion in tests of concept attainment. Wisconsin Research & Development Center for Cognitive Learning, Working Paper No. 59, 1971.

Klausmeier, H. J., Quilling, M. R., Sorenson, J. S., Way, R. S., & Glasrud, G. R. Individually guided education and the multiunit elementary school: Guidelines for implementation. Madison: Wisconsin Research & Development Center for Cognitive Learning, 1971.

Romberg, T. A., Steitz, J., & Frayer, D. A. Selection and analysis of mathematics concepts for inclusion in tests of concept attainment. Wisconsin Research & Development Center for Cognitive Learning, Working Paper No. 55, 1971.

Solomon, R. L., & Lessac, M. S. A control group design for experimental study of developmental processes. Psychological Bulletin, 1968, 70, 145-150.

Tabachnick, B. R., Weible, E., & Frayer, D. A. Selection and analysis of social studies concepts for inclusion in tests of concept attainment. Wisconsin Research & Development Center for Cognitive Learning, Working Paper No. 53, 1970.

Voelker, A. M., Sorenson, J. S., & Frayer, D. A. Selection and analysis of classificatory science concepts by intermediate grade children. Wisconsin Research & Development Center for Cognitive Learning, Working Paper No. 58, 1971.

Young, G., & Blair, J. P. Pollution, threat to man's only home. National Geographic, 1970, 138, 738-781.

Appendix A
Analyses of the Concepts
Biodegradable Agent, Biodegradable Material,
and Biodegradable Process

BIODEGRADABLE AGENT

Relevant Attributes
1. living thing

Irrelevant Attributes
1. type of living thing—human being, animal, or plant

Examples
1. animal
   a. insect
   b. bird
   c. bacteria
   d. squirrel
   e. caterpillar
   f. moth
   g. human being—boy
2. plant
   a. mold

Nonexamples
1. weather
2. breeze
3. scissors
4. warm water

BIODEGRADABLE MATERIAL

Relevant Attributes
1. can be separated into simpler parts by a living thing

Irrelevant Attributes
1. status of material—living or nonliving
2. source of material—plant or animal

Examples
1. living things and products of living things
2. food
   a. cream cheese
   b. orange peel
   c. hot dog
   d. baked pork chop
3. plants and plant products
   a. pine cone
   b. leaf (e.g., maple leaf)
   c. book
   d. newspaper
   e. rosebush

BIODEGRADABLE MATERIAL (cont.)

Nonexamples
1. rubber materials
   a. car tire
2. plastic materials
   a. plastic spoon
   b. telephone
3. metal materials
   a. tin can
   b. razor blade
4. glass materials
   a. pop bottle
   b. window pane
   c. light bulb
   d. peanut butter jar
5. sand pile

BIODEGRADABLE PROCESS

Relevant Attributes
1. living thing separates a material into simpler parts
2. the simpler parts of the material are used by the living thing for energy and growth

Irrelevant Attributes
1. type of living thing—animal or plant
2. status of material—living or nonliving
3. source of material—plant or animal
4. amount of time needed to separate the material

Examples
1. human beings eating food
   a. boy chewing a hamburger
   b. girl eating lunch
2. bacteria making garbage rot
3. log rotting in the woods
4. mold growing on a piece of bread
5. moth eating a woolen coat

Nonexamples
1. grandma cutting bread with a knife
2. baking soda dissolving in hot water
3. car running over an ice cream cone
4. mother slicing a birthday cake
5. ice cube melting in a glass
6. sugar dissolving in warm water

Appendix B
Lesson on the Concepts
<u>Biodegradable Agent</u>, <u>Biodegradable Material</u>,
and <u>Biodegradable Process</u>

WORD LIST

Let's look at the word list for this lesson. Listen while I say each word and then repeat each word with me.

1. biodegradable
2. koala
3. agent
4. oyster
5. eucalyptus
6. simpler
7. material
8. process
9. bacteria
10. separate
11. sloth
12. screech
13. nonbiodegradable
14. stucco
15. energy
16. coyote
17. growth
18. digest

DAD'S NEW WORD

One day Dad said, "Children, I have a new word for you. It is biodegradable."

"It's what?" asked Steve.

"Biodegradable," Dad said. "This is what the word looks like." Dad showed them this card

biodegradable

"Perhaps if you write the word down it will help you remember it. Write it down now."

____

"Look again, children," said Dad. "Make sure you spelled biodegradable correctly. Have you any idea what biodegradable means?"

Steve said, "I think I've heard the word before but I don't know what it means."

"It means separated into simpler parts by living things," Dad explained. "The living thing that does the separating is called the biodegradable agent."

"Susan," asked Dad, "can you think of some biodegradable agents?"

"How about a man or just any animal?" asked Susan.

"Yes," said Dad. "All men and other animals are agents when they are alive because they can separate materials into simpler parts. Steve, can you name some agents?"

"Insects and birds," answered Steve.

"Good," said Dad. "All insects and birds are agents that separate materials into simpler parts. In fact, all animals can be agents. Even all the little germs you can't see, like bacteria, are biodegradable agents."

Dad went on, "Let's have a contest and see which one of you can name two biodegradable agents. Write them down now."

____

____

"Did you each think of two agents?" asked Dad. "Are you sure that each one is a living thing that can separate materials into simpler parts? These materials that the agents separate are called biodegradable materials. The agents use the simpler parts for energy and growth."

Dad went on, "Can you think of some examples of biodegradable materials?"

"I know," said Steve. "Aren't cream cheese, orange peels, and hot dogs examples of biodegradable materials?"

"Yes," said Dad. "They are because each one can be separated into simpler parts by living agents and the agent uses the parts for energy and growth. In fact, all foods are made out of biodegradable materials. Susan, can you think of some other examples of biodegradable materials?"

"Are pine cones, leaves, and my book examples of biodegradable materials?" asked Susan.

"Yes, they are," answered Dad. "All plants and things made from plants are. In fact, all living things and products made from living things are biodegradable materials. Now, let's continue with our contest. See if you can name two examples of biodegradable materials. Write them down now."

____

____

"Did you think of two?" asked Dad. "Look at your list again. Can each one be used by an agent for energy and growth? If materials cannot be used for energy and growth, they are not biodegradable materials," Dad went on. "Can you think of some examples of nonbiodegradable materials?"

"I know," answered Susan. "Car tires, plastic spoons, and pop bottles cannot be used by an agent for energy and growth."

"Right," said Dad. "Things made out of

rubber, plastic, and glass materials cannot be used for energy or growth. Therefore, they are called nonbiodegradable materials. Steve, can you think of some other examples of nonbiodegradable materials?"

"I don't think that tin cans and razor blades can be used for energy and growth, can they?" asked Steve.

"No, they can't," answered Dad. "Therefore, they are not examples of biodegradable materials. All metals are nonbiodegradable materials because they cannot be separated into simpler parts and used by living things for energy and growth."

Then Dad went on, "We have talked about examples of biodegradable agents and biodegradable materials. Together they are the biodegradable process. The agent separating the material into simpler parts for energy and growth is the biodegradable process."

"I think I understand," said Susan. "Eating my lunch is a biodegradable process. I am a biodegradable agent. My lunch is made out of biodegradable materials, and when I separate it into simpler parts or digest it, I get energy and help for growing. That is the biodegradable process."

"That's a good example, Susan," said Dad. "Eating food is an example of the biodegradable process. Now, Steve, can you think of another example of the biodegradable process?"

"Well," answered Steve, "you said that bacteria are biodegradable agents. Therefore, I think bacteria making the garbage rot is an example of the biodegradable process. The bacteria separate the garbage into simpler parts that give them energy and help them to grow."

"Great!" exclaimed Dad. "You seem to understand what the biodegradable process is. Let's finish our contest. This time you write down an example of the biodegradable process. Write it down now."

____

____

"Look at your answer again," said Dad. "I hope you remember that the two important things about the biodegradable process are:

1. that the biodegradable material is separated into simpler parts by a living thing called an agent, and

2. that the agent uses the simpler parts for energy and growth.

"Now let's think about a nonbiodegradable process. Is it a nonbiodegradable process when Grandma cuts bread with a knife?"

"That's easy," answered Steve. "The knife cuts the bread and it is not a living thing. The knife sure can't use the bread for energy or growth!"

"Right," said Dad. "Grandma cutting bread with a knife is a nonbiodegradable process. But what if Grandma breaks a glass into pieces? Grandma is the agent because she is a living thing."

"But Grandma cannot use the pieces of glass for food or growth," explained Susan.

"Good work," said Dad. "I think you understand the word biodegradable. Remember these three things:

1. The biodegradable agent must be a living thing.

2. The biodegradable material must be able to be separated into simpler parts by the agent and used for its energy and growth.

3. The biodegradable process is when an agent separates these materials into simpler parts and uses these parts for energy and growth.

"Now, let's go be biodegradable agents while we eat our biodegradable hamburgers for lunch. Let's start the biodegradable process and get some energy to help us grow.

"After lunch, I will see who won the contest," said Dad as they walked into the kitchen.

Appendix C
Test on the Concepts
<u>Biodegradable Agent</u>, <u>Biodegradable Material</u>,
and <u>Biodegradable Process</u>

GPO 829-077-3

MY UNDERSTANDING OF BIODEGRADABLE

1. An example of a biodegradable material is

   a. a window pane
   b. a newspaper
   c. a telephone

2. In the biodegradable process the parts are

   a. toasted in an oven
   b. pasted back together
   c. used for energy and growth

3. Which is <u>not</u> a biodegradable agent?

   a. weather
   b. boy
   c. squirrel

4. The biodegradable process does <u>not</u>

   a. use living things
   b. always take the same amount of time
   c. happen in nature

5. Bacteria are

   a. not biodegradable
   b. not living things
   c. biodegradable agents

6. Which is <u>not</u> an example of the biodegradable process?

   a. some baking soda dissolving in hot water
   b. a log rotting in the woods
   c. a boy chewing a hamburger

7. An example of the biodegradable process is

   a. a car running over an ice cream cone
   b. your mother slicing a birthday cake
   c. some mold growing on a piece of bread

8. One biodegradable agent is

   a. a caterpillar
   b. a breeze
   c. a pair of scissors

9. In the biodegradable process, the material is

   a. broken down into simpler parts
   b. blown away by the wind
   c. smashed by a rock

10. An example of the biodegradable process is

    a. an ice cube melting in a glass
    b. a moth eating a woolen coat
    c. a teaspoon of sugar dissolving in warm water

11. Which material is biodegradable?

    a. rosebush
    b. sand pile
    c. light bulb

12. Which material is <u>not</u> biodegradable?

    a. maple leaf
    b. baked pork chop
    c. peanut butter jar

Appendix D
Instructions to Students

General Instructions for the Pretest

Good morning.

I am not sure just what you have been told about why I am here today, so I will try to explain it to you. I am taking a college course at the University of Wisconsin on how boys and girls learn new ideas and acquire information. I am trying to find new ways for making it easier for students to learn science.

This morning I will be giving you a test, but first, I need to tell you some very special information.

1. Each person in this room is very important in my study.

2. You will not receive a grade on this work. This will be used only to help other teachers to learn what boys and girls in the fourth and sixth grades know about my science lesson.

3. Your classroom teacher will not see your paper. I will be the only person looking at your work.

Now I would like you to take out a pencil. When you receive your first test, fill in the front page, but do not open your booklet.

Now turn to the first page and listen while I read the directions.

When you finish, place your pencil on your desk and turn your booklet over.

Ready? Turn the page and you may begin.

General Instructions for the Lesson

This afternoon, I will be giving you a lesson on science to study by yourself. At the end of this lesson, you will again be given another test to see how much you have learned.

Since I am trying out different ideas, the lessons are not the same.

When you are reading my lesson you may see either a single line or a series of lines on the paper. That means you are to fill in the line or lines with your answer.

Once you begin reading the lesson, I will only be able to answer questions about words you do not know.

After you have received the lesson, fill in the front cover, but do not turn the page.

If you finish before your classmates, you may wish to tell me what you liked about the story you have read, or else draw a picture of something you have read about in the lesson.

Now turn the page and listen while I read the directions.

Turn the page and you may begin.

General Instructions for the Posttest

This is the last part of my project.

Remember, when I give you this last test, you will not receive a grade, and I will be the only person to see your paper.

After you have received your test booklet, fill in the front cover, but do not turn the page.

Now turn the page and listen carefully while I read the directions.

Turn the page and begin.

[Collect booklets]

I would like to thank you for your cooperation. I hope to see all of you again sometime.