A STUDY OF THE EFFECT OF THE INTEGRATION OF CHILDREN'S LITERATURE INTO THE SCIENCE CURRICULUM ON STUDENT UNDERSTANDING OF SCIENTIFIC CONCEPTS

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ABSTRACT

A STUDY OF THE EFFECT OF THE INTEGRATION OF CHILDREN'S LITERATURE INTO THE SIENCE CURRICULUM ON STUDENT UNDERSTANDING OF SCIENTIFIC CONCEPTS

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The effect of integrating children's literature into the science curriculum on student understanding of science concepts was investigated. The study involved 354 third-grade students from 14 classrooms. Students in the traditional textbook group read and discussed the textbook on a certain science topic, performed a hands-on science activity or experiment on the topic, and were tested for understanding of that topic. Students in the literature group followed the same procedure but the textbook was substituted with science trade books. Student understanding was determined by collecting scores on district Performance Objective Assessments. Results were analyzed with a multivariate analysis using the participants' 2nd grade scores on the science Terra-Nova tests and classroom science teacher as covariates for all statistical comparisons of individual tests and overall results. Results show that students in the literature group scored significantly higher ($p < 0.10$) than the traditional textbook group on three of the five P.O. tests. Overall results showed that students in the literature group scored significantly higher ($p < 0.03$) than the traditional textbook group by 3 percent of the mean normalized score for all five tests (79.6 vs. 76.6). A teacher-made survey revealed that students prefer the literature-based science instruction to the textbook-based science instruction. These results imply that the integration of children's literature can increase student understanding and enjoyment in science class.

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CHAPTER I

INTRODUCTION

There exists much concern in America about science education. In a report titled "Before It's Too Late" released recently by the Glenn Commission (2000), a committee of experts reports that "the preparation our students receive in mathematics and science is, in a word, unacceptable" (p.12). Experts suggest many reasons for the problematic status of science education in the United States. Greg Stefanich (1992), professor of science education at the University of Iowa, suggests that the problems begin in the elementary grades. He writes, "our efforts must begin when students first start their educational experiences, for it is early patterns of behavior which so often dictate future goals and aspirations" (p.13).

Research offers several reasons why elementary science programs are often perceived to be ineffective. The first problem is that elementary teachers often feel unprepared to teach science. A 1990 article reports that studies surveying teachers in 12 states found "nearly all the teachers responding felt they had inadequate undergraduate preparation in science" (Tilgner, p. 422). This feeling of inadequacy often results in negative attitudes toward science as well as avoidance of the subject. According to a 1992 study of science teaching self-efficacy "many teachers report that inadequate background in science and methods is the primary reason for their avoidance of science teaching" (Ramey-Gassert & Shroyer, p. 29). In fact, researchers express concern that "science is not considered basic to the education of American schoolchildren and thus is not given the time or attention allotted to subjects such as reading, writing, and mathematics" (Baker & Saul, 1994, p. 1023).

Another reason why elementary science programs are often perceived as ineffective is teachers' reliance on textbooks. Studies indicate flaws in elementary science textbooks, including reading beyond the reasoning capacity of students (Staver & Bay, 1989).

There is no doubt that there are problems in elementary science teaching. The two main causes of the problems seem to be teachers' feelings of inadequacy which can lead to the avoidance of teaching science and the ineffectiveness of science textbooks. This study focuses on one possible solution that involves the integration of children's literature into the science curriculum. This solution could result in making elementary teachers feel more comfortable and effective with their science instruction, allow more time for science teaching by integrating with language arts instruction, and practice less reliance on science textbooks.

Unlike their perceptions about science teaching, elementary teachers generally perceive to have strong backgrounds in language arts as a result of their mission to teach students to effectively read and write (Dickinson & Young, 1998). Therefore, integrating science into this already familiar and comfortable domain of language arts may make teachers more effective in teaching science. In addition, this integration of science and literature fits in with the main goal of the elementary classroom which is to produce literate readers and writers.

Connecting other subject areas, such as science, to language arts instruction will help pursue the goal of literacy. A 1997 study investigating the effect of a literature-based program integrated into science instruction states, "results show that literacy gains come not at the cost of science gains, but coupled with them" (Morrow, Pressley, Smith, & Smith, p.72). This study provides an example of student success in both science and language arts as a result of the integration of the two subjects. A similar study offered findings that support the integration of children's literature and science. Researchers reported that students in a group which combined instructional time for reading and science scored significantly better in science achievement than the traditional textbook group in which the subjects were taught separately (Romance & Vitale, 1992). The positive results reported in these studies solicit further investigation on the integration of children's literature into the science curriculum in an effort to increase student understanding of science concepts.

The understanding of scientific concepts is essential in being a well-informed, contributing citizen of the United States. The Glenn Commission (2000) states that children must command the disciplines of mathematics and science in order for them to "meet the challenge with the longest-range implications of all—securing their own and America's place in the world" (p. 17). This study is important in that it will contribute to a larger body of knowledge of possible solutions to improve student understanding in the area of science. The research question addressed by this study is: "How does the integration of children's literature into the science curriculum affect student understanding of scientific concepts?"

CHAPTER II

REVIEW OF LITERATURE

In the following section, recent literature related to the proposed study is summarized. This literature review is divided into three sections: teacher self-efficacy, use of textbooks, and science and language arts integration.

Teacher Self-Efficacy

In order to be effective, teachers need to feel comfortable with the subject they are teaching. Science seems to be a subject with which elementary teachers currently feel uncomfortable. In fact, in an article titled, "Reflections on Elementary Science," Greg Stefanich (1992) reports that "science educators continue to receive indications that many elementary teachers feel uncomfortable with scientific subjects and are reluctant to teach them" (p. 18). This feeling of inadequacy toward teaching science often results in the avoidance of science instruction by elementary teachers.

In an article summarizing the interrelatedness of science anxiety, attitude toward science, and low science teaching self-efficacy, Ramey-Gassert and Shroyer (1992) state that " many teachers report that inadequate background in science and methods is the primary reason for their avoidance of science teaching" (p. 29). This feeling of inadequacy is most likely due to the lack of science requirements in preservice programs.

A study was conducted among 45 universities that have a large number of education graduates each year regarding the science requirements necessary for elementary educators. Only eight of the 45 universities required courses in all three areas of life, physical, and earth science. Forty two of the 45 programs required students to take a methods course which focused on process and methods rather than content (Tilgner, 1990). With these data in mind, it is no surprise that many elementary teachers do not feel comfortable with science content.

Use of Textbooks

Because of low teacher self-efficacy in the area of science, many teachers rely on a textbook as the center of their science instruction. However, research has reported flaws in textbook-based science programs. Researchers Staver and Bay (1989) conducted an analysis of 11 science textbook series commonly adopted throughout the nation, which comprise about 90% of the market. Part of this study was to determine what reasoning skills are necessary to comprehend the concepts as presented in the text and whether those reasoning skills are consistent with the reasoning skills of students who use the texts. After reviewing one primary level (K-3) unit in each textbook series, the researchers concluded that the textbooks required the kinds of reasoning associated with Piaget's concrete operations, which, within the Piagetian perspective, is beyond the reasoning capacity of many primary-level students.

In addition, many teachers report that they are not satisfied with their science textbooks. In a survey conducted where 90 classroom teachers were asked what they like about their science textbooks, both elementary and secondary teachers reported little overall satisfaction with their textbooks. Thirty-three percent of the elementary teachers surveyed reported that they disliked "everything" about their textbooks, with readability as the largest factor (Davey, 1988).

Researchers Penick and Yager (1993) present a series of outstanding examples of excellence in science teaching in their article titled "Learning from Excellence." When the exemplary science teachers were asked what would cause their programs to fail, the most common answer was "adopting a textbook for science" (p. 4). Likewise, Tilgner (1990) suggests that "elementary teachers should be encouraged to do away with the textbook" (p. 429). Stefanich (1992) recommends the use of trade books, activity books, and resource books while the textbook should only to be used as a resource or guide.

In a 1994 analysis of research on reading and writing to learn science, Glynn and Muth conclude that textbooks put constraints on science teachers. "Teachers are empowered when they are not straightjacketed by textbook programs, instructional methods, and assessment approaches imposed on them from a top-down fashion" (p. 1069). Traditional textbook driven science teaching leaves room for improvement, so we must evaluate new approaches to teaching science. One of the approaches to be considered is integrating science with language arts.

Integration of Science and Literature

Finding time to fit science into the school day is a challenge many elementary teachers face (Monhardt & Monhardt, 2000). A popular trend in solving the problem of time constraints is the integration of subject areas. With the main goal of the elementary classroom being to produce literate readers and writers (Dickenson & Young, 1998), connecting science with language arts will help teachers reach that goal and fit science instruction into the school day.

In addition, reading and writing are an important part of all of the other subject areas, including science. Researchers Glynn and Muth (1994) conclude that reading and writing play a vital role in the learning of science. "The importance of being able to understand and explain—in clear language—the meaning of fundamental scientific concepts is central to science literacy" (p. 1058). Therefore, the integration of reading and writing into the science curriculum is a natural and necessary process in order for students to become scientifically literate. The ability to use reading and writing as tools to learn about science will be skills students will need throughout their lives.

Much of the recent research regarding the integration of science and literature reports positive results. For example, a study performed by Morrow et al. (1997) produced support for integrating a literature-based program into literacy and science instruction for third graders.

The researchers put students into three groups, two literature groups and one control. The first literature group, literature/science group, received a literature-based intervention in both their literacy and science programs. The second literature group, literature-only group, received the literature-based intervention only in their literacy program. The traditional textbook group continued in their regular basal reading texts and received traditional science textbook instruction (Morrow et al., 1997).

While the researchers expected gains in literacy for the literature/science group, they found that these gains were coupled with gains in science as well. "Classrooms using the literature/science program scored significantly higher statistically on all literacy measures used in the study. They also produced higher scores on two of the three science measures." (Morrow et al. 1997, p. 72).

Another study performed by Anderson, West, Beck, MacDonell, and Frisbie (1997) evaluated a program titled WEE (Wondering Exploring, and Explaining) which integrated reading and science education. In this program, students chose a science trade book, formed groups based on the topics of the books, and asked questions about the content (Wondering). After choosing one of the wonderments to pursue further, students formed a plan for investigating it and followed through with the plan (Exploring). Finally, the students explained (Explaining) to a group of their peers what they wondered about and how they explored (Anderson et al., 1997).

The researchers concluded that the WEE Science students were able to move from an abstract concept in a trade book to real life experiences. The program encouraged students to "take a critical stance, to ask questions, to analyze answers, to promote minds-on science" (Anderson, et al., p. 732). The researchers were impressed with the excitement that students showed in choosing a book, the students' success in generating and explaining wonderments, the enthusiasm and creativity shown in directing their own experiments, as well as the thoughtfulness that went in to their presentations. However, the observations made in this study give rise to the need for a more quantitative research study on the WEE Science program where the researchers provide statistics that support the idea that the program leads to greater student success in literacy and science.

Similarly, Gaskins et al. (1994) conducted a study on integrating the instruction of science, reading and writing. The study involved fifty middle school students who were taught reading and writing strategies while attempting to solve real-life problem scenarios involving simple machines. The investigators found that "students' cognitive and metacognitive processes for reading, understanding, and writing about science information increased" (p. 1048) after participating in the program. Although interviews with teachers and supervisors of the program revealed that the professional collaboration and explicit instruction required by such a program proved to be hard work and sometimes stressful, many of them felt the positive results were worth the effort.

Positive results were also reported in a year-long study where teachers of an literature group combined the time allotted for reading and science instruction each day into a single, expanded, two-hour teaching session while traditional textbook group teachers spent 1 ½ hours per day on reading and ½ hour on science instruction (Romance & Vitale, 1992). The researchers reported that, "literature group students performed significantly better than the controls in both reading and science" (p. 550).

One reason why the integration of literature and science was successful in the studies mentioned in this review is the observation that students seemed to enjoy participating in the literature/science programs. Morrow et al. (1997) write, "One of the most interesting outcomes was that a majority of students in the literature/science group reported that they liked science, and the majority of the literature-only and control students reported that they did not like science" (p. 72). The students who were not in the literature/science group were receiving traditional text-based science instruction which students often find boring and frustrating (Morrow et al., 1997). In addition, Barclay, Benelli, & Schoon (1999) claim that linking science and literature is not confined to the classroom. It is "a natural way for parents to extend and support scientific investigations in the home" (p. 148).

Although the programs mentioned in this section experienced success in integrating literature and science, there are some cautions that should be considered when setting up such a program. It has been determined that an important component of an effective science curriculum is a classroom library that contains a wide variety of science-related children's literature so that children can seek out books that provide them with information and help them develop scientific processes (Barclay et al., 1999). Educators must thoughtfully select the literature making sure that the scientific concepts represented in the book are correct because "accuracy of science content sometimes suffers in a trade book's attempt to represent complicated information" (Royce & Wiley, 1996, p. 19).

In addition to scientific accuracy, it is important that the trade books avoid stereotypes, have accurate and labeled illustrations, and encourage scientific ways of thinking (Royce & Wiley, 1996). James Barton (1999) claims that using multicultural literature as a part of science instruction can help overcome stereotypes. He concluded that multicultural children's literature has many roles to play in the curriculum and "becoming a catalyst for a science lesson is one of its most productive uses" (p. 4).

Selecting the literature is probably one of the most challenging tasks involved in integrating literature and science. "Good literature does not necessarily contain the best science; good science does not necessarily inspire the best literary art. The best books, obviously, are those that manage to strike a balance" (Westcott & Spell, 1999, p.70). The difficult task of selecting appropriate literature could be simplified by the collaboration of experts in both areas. The teacher who is not strong in science knowledge could consult a high school science teacher or the teacher who is not a good judge of literary art may want to consult a language arts teacher. It seems that integrating science and literature can be an effective way to increase student performance in both subject areas as long as the books thoughtfully chosen.

In conclusion, some of the problems in elementary science education include low teacher self-efficacy in the area of science and the ineffectiveness of elementary science textbooks. One possible solution that could make teachers more comfortable in the area of science and reduce reliance on science textbooks is to integrate children's literature into the science curriculum. Elementary teachers are comfortable in the literature domain and the use of children's literature could take the place of traditional textbook learning. The research cited in this review reports positive results of programs where children's literature was integrated into the science curriculum. However, the cautions and concerns in using children's literature to teach science must be taken into account.

CHAPTER III

METHODOLOGY

The purpose of this study is to determine the effect of the integration of children's literature into the science curriculum on student understanding of scientific concepts.

Setting

This study took place in a suburban Ohio elementary school containing 1130 children in grades three and four. The most distinguishing characteristic of the school is its growth. Student enrollment has gone from 787 students in 1997 to 1130 students in 2001. In addition, students come from various cultural backgrounds and socioeconomic levels.

Population and Sample

Fourteen classes of third grade students ages eight and nine were selected to participate in the study. These classes were chosen based on willingness of the homeroom teacher to participate in the study and the fact that each class has a partner class that shares the same science teacher. For every class in the literature group, there was a class in the traditional textbook group with the same classroom science teacher. All classes come to science lab for 40 minutes two times every seven days. All treatments and assessments were administered in the science lab by the science lab teacher.

Design

The design of this study is a quasi-experimental, non-randomized control group, posttest only. The independent variable in this study is the integration of children's literature into the science curriculum. This nominal variable was operationalized through the use of children's books covering a certain topic in addition to a regularly scheduled lab activity covering the same topic.

Lessons for both groups followed the same basic format. (See Appendix A for a sample lesson plan.) This format begins with the teacher presenting the reading material, class discussion of the material, a hands-on activity or experiment, returning to the reading material, and administration of the assessment. Each lesson took place over two 40-minute lab periods on consecutive days for each group. Subjects in the literature group used a trade book in the lesson whereas subjects in the traditional textbook group read the textbook. The literature group then discussed the trade book(s) and related the literature to a hands-on activity. The traditional textbook group read the section in the textbook corresponding to the topic and received traditional lecture type instruction and discussion related to the hands-on activity. Both groups participated in the same hands-on science activity or experiment during their lab time and were given the assessment immediately following the activity.

Science trade books were selected based on their relationship to the district science performance objectives. (See Appendix B for a list of trade books used in this study.) Non-fiction books were chosen based on whether the science concept was recognizable, the content and illustrations were accurate, and the book promoted a positive attitude toward science. The fiction books were chosen based on their ability to capture student interest as well as whether the science concept was identifiable and sound. Fiction books that contained scientific inaccuracies were revisited at the end of the lesson for students to point out the misconceptions based on what they learned in the lesson.

The science textbook used for the Sun, Moon, and nutrition lessons was the district-adopted science text (see Appendix B). A physical science textbook (see Appendix B) was used for the forces and friction lessons because the district-adopted science textbook did not contain a section on motion.

The dependent variable is student understanding of scientific concepts, which is an interval scale variable. This variable was operationalized through student scores on district performance objective (P.O.) assessments given after the treatment. This process was repeated with five science P.O. assessments (see Appendix C) based on the following objectives:

1. Sun P.O. - The learner will analyze the location of the Sun in the sky during a day and predict the location at an earlier or later time of day.
2. Moon P.O. - The learner will analyze the phases of the Moon and predict the next phase.
3. Forces P.O. - Given a description of a force acting on an object, the learner will predict the resulting motion of the object.
4. Friction P.O. - The learner will describe the effects of friction on motion.
5. Nutrition P.O. - The learner will classify food items from a meal according to the food pyramid, and will evaluate the healthfulness of a meal.

In order to minimize the differences between the experimental and traditional textbook groups, student's individual scores on the Terra-Nova science test they took in second grade were collected for inclusion in the analysis.

Students were also given a survey (see Appendix D) to assess their opinions about the lessons presented in this study. The teacher-made survey was given at the conclusion of the study.

The directional hypothesis of this study is that the integration of children's literature into the science curriculum will result in an increase in student understanding of the scientific concepts for the literature group. The null hypothesis is that the integration of children's literature into the science curriculum will have no effect on student understanding of the scientific concepts being taught in the study.

Instrumentation

The district science P.O. assessments will be used to assess student understanding. These assessments coincide strongly with the variable being tested. Student understanding will be evaluated on each individual scientific concept. These tests are designed to test understanding of one scientific concept at a time. There is an individual test for each of the scientific concepts being taught in this study. Assessments were given immediately following the lessons with both the literature and traditional textbook groups.

Data Analysis

A multivariate analysis of covariance was used to determine the relationship of the independent and dependent variables. Results were analyzed using participants' identity, teacher pairing, and 2nd grade Terra-Nova scores as covariates for statistical comparisons of individual tests and overall results. The significance of the difference between variables was determined using an alpha level of .10 ($p < .10$). Data were assumed to fit a normal distribution.

CHAPTER IV

RESULTS

Performance Objective Assessments

A total of 354 students from 14 classes participated in the study. There were 1319 unique test scores collected for the five P.O. assessments. Class assignment into the traditional textbook and literature groups for each performance objective is shown in Table 1. The total number of students completing all five assessments was 108 out of 354 students. On average, students completed 3.73 tests out of the possible five performance assessments. Reasons for some students not completing all five tests include absences, administration of a test by the homeroom teacher without the lessons being taught first in the science lab, and scheduling problems.

Table 1

Class Assignment

P.O.	Teaching Pair Group	Literature group	Traditional textbook group
Sun	Pair 1	Class 1a	Class 1b
	Pair 2	Class 2a	Class 2b
	Pair 3	Class 3a	Class 3b
	Pair 4	Class 4a	Class 4b
	Pair 5	Class 5a	Class 5b
Moon	Pair 1	Class 1a	Class 1b
	Pair 2	Class 2a	Class 2b
	Pair 3	Class 3a	Class 3b
	Pair 4	Class 4b	Class 4a
	Pair 5	Class 5a	Class 5b
	Pair 6	Class 6a	Class 6b
Forces	Pair 2	Class 2a	Class 2b
	Pair 3	Class 3b	Class 3a
	Pair 4	Class 4b	Class 4a
	Pair 5	Class 5a	Class 5b
	Pair 6	Class 6a	Class 6b
	Pair 7	Class 7a	Class 7b
Friction	Pair 2	Class 2a	Class 2b
	Pair 3	Class 3b	Class 3a
	Pair 4	Class 4b	Class 4a
	Pair 5	Class 5b	Class 5a
	Pair 6	Class 6b	Class 6a
	Pair 7	Class 7a	Class 7b
Nutrition	Pair 2	Class 2a	Class 2b
	Pair 3	Class 3b	Class 3a
	Pair 5	Class 5a	Class 5b
	Pair 6	Class 6a	Class 6b
	Pair 7	Class 7a	Class 7b

Descriptive statistics for the complete data set for all five P.O. assessments are shown in Table 2. Scores were higher for the literature group on all five tests. Test scores were normalized as a percent of maximum test score achievable. Overall results were determined by averaging the normalized means of the individual test scores weighted by the number of students taking each test. There were 658 total test scores in the literature group and 661 total test scores in the traditional textbook group. A summary of results is shown in Table 2.

Table 2

Descriptive Statistics of All P.O. Test Scores

P.O.	Traditional textbook group			Literature group		
	# of Students Participating	Average Test Score	Average % of Max	# of Students Participating	Average Test Score	Average % of Max
Sun	117	3.12	78.0	119	3.36	84.1
Moon	143	5.64	80.5	141	5.77	82.4
Forces	136	5.61	70.1	136	6.02	75.3
Friction	144	4.61	76.9	143	4.73	78.9
Nutrition	118	6.08	76.0	122	6.21	77.6
Overall	658 Total Test Scores		76.6	661 Total Test Scores		79.6

Due to the reasons mentioned in the initial description of results for some students missing P.O. assessments and the fact that Terra-Nova scores were only available for students who were in the school district during the previous year, only 103 students having a complete data set of P.O. test and Terra-Nova scores could be used in the seemingly unrelated regression. The software used for the seemingly unrelated regression (SAS, Statistical Analysis Software) could not handle incomplete data sets. Variables taken into account in the analysis were teacher pairings, student identity, 2^{nd} grade Terra-Nova score, treatment group, and P.O. test scores. Terra-Nova scores had the greatest impact on P.O. test scores and were highly significant for all five P.O. tests. Results reported in Table 3 show that students in the literature group scored significantly higher than the traditional textbook group on the forces, Sun, and Moon P.O. assessments

($p < 0.10$). Results for the friction and nutrition tests showed slight differences in P.O. test scores among the treatment groups, but results were not significantly different.

Table 3

<u>Seemingly Unrelated Regression of P.O. Test Scores</u>

						Results of Seemingly Unrelated Regression of P.O. Test Scores			
P.O.	# of Students	Textbook group		Literature group		TN Effect on Score (Score Effect = TN Effect * TN Score)		Literature Treatment Effect on Score	
		Mean TN Score	Mean P.O. Score (% of Max)	Mean TN Score	Mean Test Score (% of Max)	TN Effect	Significance of TN Effect on Score (Two tailed p-value)	Literature Treatment Effect	Significance of Treatment Effect (Two tailed p-value)
Forces	103	66.66	71.37	71.88	79.98	+ 0.28	0.0002	+ 7.63	0.0262
Sun	103	66.56	72.83	70.77	82.46	+ 0.34	0.0006	+ 7.36	0.0978
Moon	103	64.40	77.83	72.66	85.43	+ 0.29	0.0001	+ 5.42	0.0646
Friction	103	67.26	73.41	70.21	80.40	+ 0.32	0.0001	+ 1.08	0.7272
Nutrition	103	66.66	77.78	71.89	79.45	+ 0.30	0.0001	- 0.51	0.8738

Due to some students, teachers, and teacher pairings being present in the experimental group for some tests and control groups for other tests, a seemingly unrelated regression could not be done on pooled results to compare the significance of overall treatment effects. Pooled results were therefore analyzed using participants' 2nd grade scores on the science Terra-Nova tests as the only covariate for statistical comparisons of overall results. A total of 951 P.O. test scores were recorded from students having a Terra-Nova score.

For this analysis it was assumed that each test score was independent of one another and Terra-Nova scores were assumed to be complete descriptors of the students taking the test. This assumption was made so that students included in the literature group for one test and the traditional textbook group for another test could still be included in the analysis. This assumption is supported by the fact that Terra-Nova scores had the most significant impact on P.O. tests scores as measured by the multivariate analysis and are therefore the best descriptors of student ability to use as a covariate.

These results are shown in Table 4. Overall results show that the literature group scored significantly higher ($p < 0.03$) than the traditional textbook group for all test scores collected among students with a Terra-Nova score (951 total scores).

Table 4

Pooled Statistical Analysis of Literature Treatment Effect

Treatment	# of Test Scores Collected	Mean TN Score	Mean Test Score (% of Max)	Significance of Test Score Difference Using TN Score as a Covariate (two-tailed p-value)
Textbook	499	68.83	76.6	0.025
Literature	452	71.00	79.9	

Survey

A total of 252 students from 11 classrooms participating in this study completed the survey. Reasons for some students not completing the survey include absences and scheduling logistics at the end of the school year. Results are shown in Table 4. Question 1 was designed to stimulate thought about activities in science lab during the school year. Most responses centered around hands-on activities not pertaining to the literature or textbook lessons under evaluation in this study. Questions 2-5 were more specific to the lessons under evaluation in this study. Results from questions 2-5 show that most students prefer science trade books to science textbooks.

Table 5

Survey Results

Question	Answers		
1. Name your favorite science lab activity this year.	Various Answers Regarding Unrelated Activities		
2. What was your favorite thing we read in science lab this year?	68% trade book	4% textbook	28% unsure or did not answer
3. How much do you like reading the science textbook?	16% really like	50% sort of like	33% do not like
4. How much do you enjoy reading storybooks about science?	58% really like	37% sort of like	5% do not like
5. If you had to choose between reading the science textbook and a science storybook, which would you choose?	12% textbook		88% storybook

CHAPTER V

DISCUSSION

Student Understanding of Scientific Concepts

The overall results of this study show an increase in student understanding of scientific concepts taught through the integration of children's literature as compared to the use of traditional textbook based lessons. The results were statistically significant ($p < 0.10$) in three of the five tests and for the overall results ($p < 0.03$).

Survey

Survey results indicate that more students would choose to read science trade books than science textbooks. I believe that student interest and enjoyment plays an integral part in the success of the literature-based lessons. Similar to the results reported by Morrow et al. (1997) where students in a literature/science group expressed interest and enjoyment toward science learning, the third-graders involved in this study showed more enthusiasm toward science trade books than science textbooks. This enthusiasm was evident in the responses to student surveys. Eighty-eight percent of the 252 third-graders surveyed wrote that they would prefer a science trade book over a science textbook if given the choice. Even more interesting, were the comments students made when they were asked why the chose that answer. The two most common responses were "science textbooks are boring" and "stories are more exciting."

I believe that another reason the literature-based lessons presented in this study were successful is that the lessons were explicitly focused on science objectives. Rather than trying to find science concepts in a favorite children's book, the procedure for planning these lessons was to begin with the science concepts and search for trade books, fiction and non-fiction, that could assist in teaching the concepts. Consequently, teachers must have an adequate understanding of the science concepts in order to plan such lessons.

Cautions

Although this study reports positive results regarding the integration of children's literature into the science curriculum, teachers should not expect these results from merely reading a science trade book to students as a substitute for the textbook. I believe that the success of the literature-based lessons lies in carefully choosing fiction and non-fiction trade books, discussing scientific concepts in the books, relating the books to a hands-on activity, and going back to the books to review the concepts being learned, looking for misconceptions that might exist in the fiction books.

In addition, if elementary teachers do not fully understand the science concepts, selection of quality trade books can be difficult. This problem of low teacher self-efficacy in the area of science mentioned in the literature review can be addressed in several ways. Elementary teachers could be required to have more science content courses as a part of their college education, but a simpler more immediate solution would be for elementary teachers to collaborate with district science specialists, middle school science teachers, or high school science teachers when choosing trade books with quality science content.

Implications for Future Research

Although integration of children's literature into the science curriculum is a growing trend, there have been few experimental studies in this area. The benefits reported in this study give reason for expanded study. Confidence in this method of teaching science will increase if it is possible to replicate the positive results seen in this study.

One interesting aspect of this study was that after some lessons, students in the literature group returned to the trade books to identify misconceptions. I observed that this process was enjoyable for students and I wonder what impact it had on their understanding and retention of science concepts. In order to identify scientific inaccuracies, students would be required to apply what they learned as well as to analyze the text and illustrations in a trade book. This process takes students to a higher level of thinking and, I predict, a higher level of understanding. Therefore, I believe that the effect of using children's literature in this manner, to identify scientific inaccuracies, is worthy of investigation.

In addition, investigators may want to focus on other alternatives to traditional textbook science instruction. Many teachers are moving away from textbooks and creating their own materials because they are losing confidence in the effectiveness of the texts. As suggested by Glynn and Muth (1994) alternative reading material other than trade books can be integrated into the science curriculum. For example, newspaper articles about science topics, biographies, or classic science fiction stories may also be sources of science-literature integration. In addition, the effect of non-traditional use of textbooks, such as comparing explanation of topics in two or more textbooks, may merit investigation.

Finally, the results reported in this study do not take into account the effect of the use of children's literature in science instruction on student achievement in literacy. This study was explicitly focused on science objectives. I believe it would be beneficial to perform a similar, but more complex, study where researchers have a dual purpose: measuring achievement in literacy as well as science.

Appendix A

Sample Lesson Plan (Moon)

MOON PHASES

Lesson Plan

Ohio Proficiency Objectives

4th Grade #5 Analyze a series of events and/or daily or seasonal cycles and predict the next likely occurrence in the sequence.

Books

Papa, Please Get the Moon for Me by Eric Carle
The Moon Seems to Change by Franklin M. Branley

Materials

White foam balls (one per student)
Pencils (one per student)
Lamp (lampshade removed so light is given off in all directions)

Procedure

- Read ***Papa, Please Get the Moon for Me*** to the students. Ask them if they have ever noticed that the Moon seems to change size and shape throughout the month. Have they every wondered why? Tell them that today, they will learn the answer to that mystery from a nonfiction book.

- Read ***The Moon Seems to Change*** together. Explain that they are going to do an activity similar to the one on pages 20-26.

- Activity
  - Darken the room – the darker, the better.
  - Give each student a pencil and a foam ball. Explain that, in this activity, the foam ball will be a model of the Moon, the lamp is a model of the Sun, and their head represents Earth.
  - With their faces toward the lamp, students hold the ball (stuck on the end of a pencil) above their heads so that they have to look up to see it. In this position, students cannot see the lighted side of the ball. **It is a new Moon**.
  - Tell students to turn their bodies a bit while still holding the ball a bit above their heads. They should turn until they see a **crescent Moon**.
  - Instruct the students to keep turning and soon they will see more of the lighted half of the ball – a **quarter Moon**.
  - Students can keep turning until they see all the lighted half of the ball. This is a **full Moon**.
  - As students continue to turn in the same direction, they will see less and less of the lighted part of the ball. They will see one quarter of it –**quarter Moon**, then a thin **crescent Moon** and finally they will be back to the **new Moon**.
  - Let students go through the rotation several times – noticing the order of the phases they see.

Evaluation

- Questioning – Ask students the following questions to check for understanding.
  - **Does the Moon produce its own light?** No, the Moon reflects the light from the Sun.
  - **Does the Moon actually grow smaller, like in the book *Papa, Please Get the Moon for Me*?** No, the Moon goes through phases.
  - **Why does the Moon go through phases?** Because it revolves around the earth.
- Revisit *Papa, Please Get the Moon for Me* and ask students to identify any misconceptions that do not go along with what they just learned about why the Moon seems to change.
- Have students predict the next phase of the Moon after giving a series of phases.

Appendix B

Trade Books and Textbooks Used in the Study

Trade Books

Branley, F. M. (1998). *Floating in space*. New York: Harper Collins.

Branley, F. M. (1960). *The Moon seems to change*. New York: Crowell.

Carle, E. (1986). *Papa, please get the Moon for me*. New York: Simon & Schuster.

Fischer, L. E. (1992). *Galileo*. New York: Macmillan.

Haines, G. K. (1987). *Which way is up?* New York: Antheneum.

Johnson, M. D. (1999). *Wait, skates!* New York: Children's Press.

Leedy, Loreen. (1994). *The edible pyramid: Good eating every day*. New York: Holiday House.

Levete, S. (Ed.) (1997). *The fantastic book of in-line skating*. Brookfield, CT: Copper Beech Books.

Narahashi, K. (1987). *I have a friend.* New York: Margaret K. McElderry Books.

Parker, S. (1992). *Galileo and the universe*. New York: Harper Collins.

Schuett, S. (1995). *Somewhere in the world right now*. New York: Random House.

Textbooks

Bernstein, L., Schachter, M., Winkler, A., & Wolfe, S. (Eds.) (1991). *Physical science* (3rd ed.). Englewood Cliffs, NJ: Globe Book Company.

Discovery works. (1999). Parsippany, NJ: Silver Burdett Ginn.

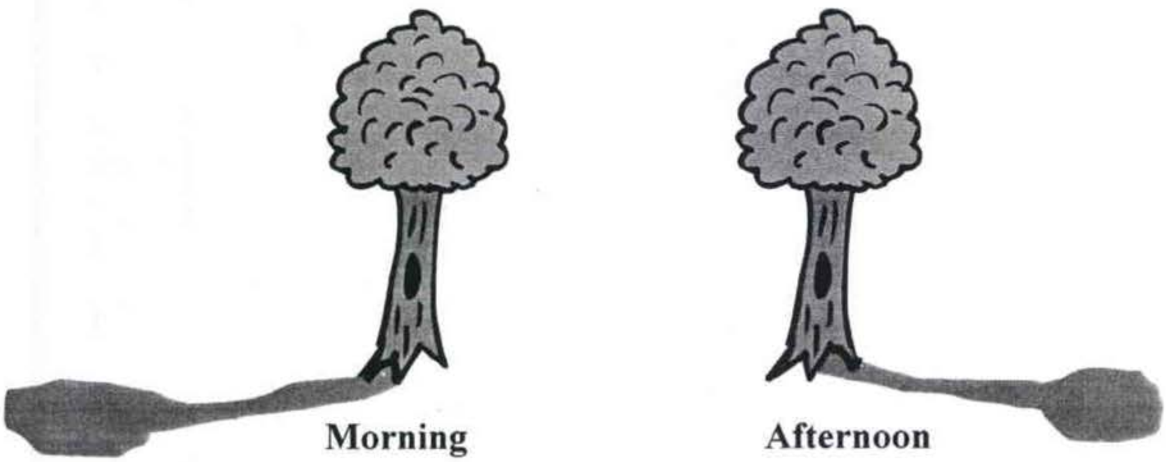
Appendix C

Third Grade Science Performance Objective (P.O.) Assessments

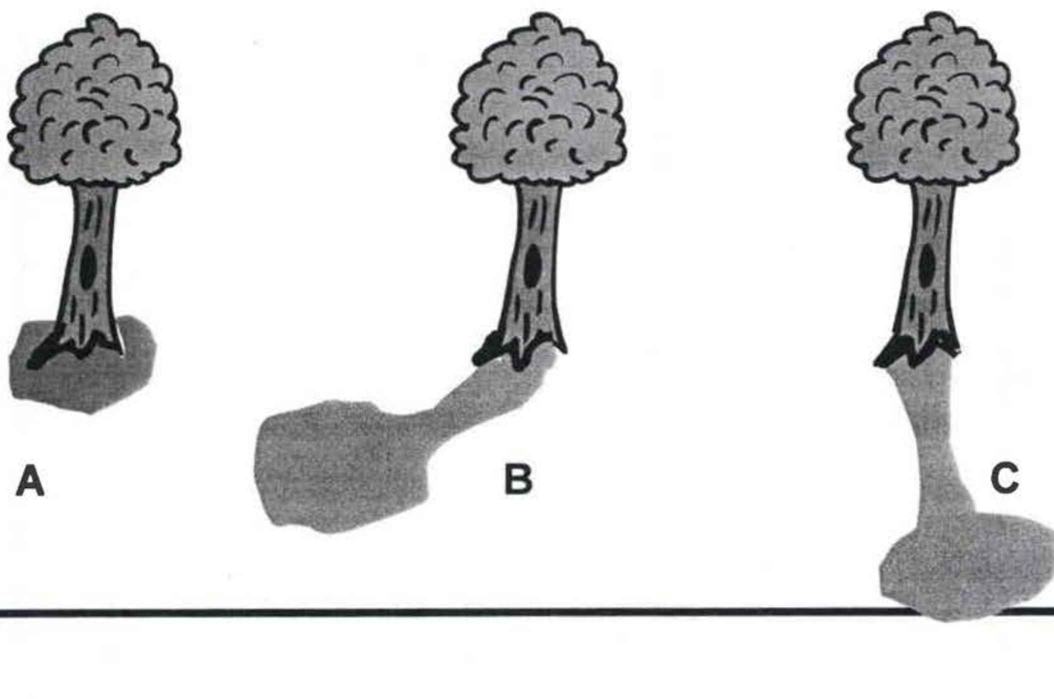
Sun P.O.

PO 3SC-7D *The learner will analyze the location of the Sun in the sky during a day and predict the location at an earlier or later time of day.*

1. The pictures below show the same tree in the morning and afternoon.



Which picture below shows when the sun was directly overhead?



2. Kenny is facing his house in the early evening. He sees the sun going down to the west of the house. Where would he see the sun if he were facing his house in the early morning?

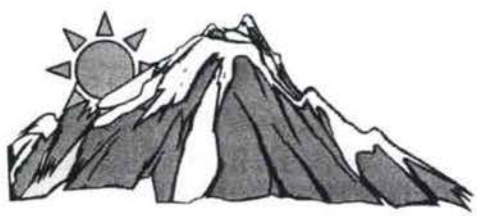
West **East**

a. He would see the sun directly above the house.

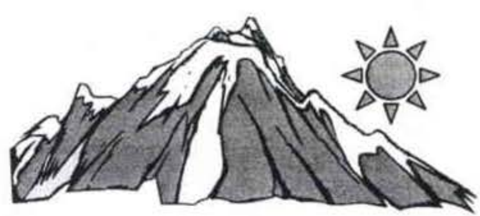
b. He would see the sun to the east of the house.

c. He would see the sun to the west of the house.

3. Which picture shows what the sun and the mountain would look like at noon?

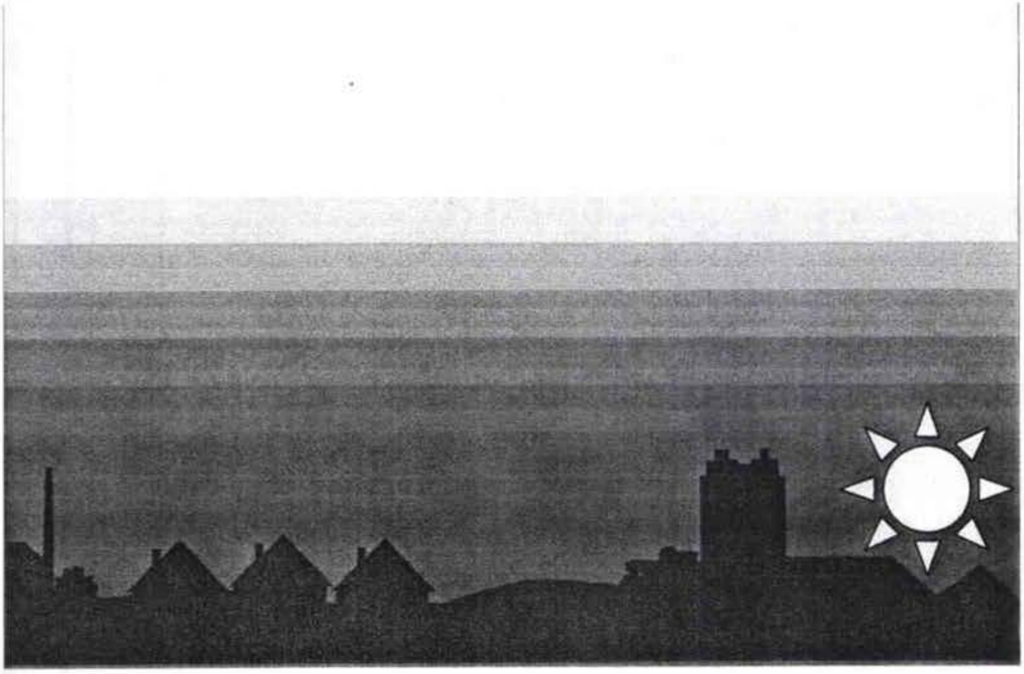


A

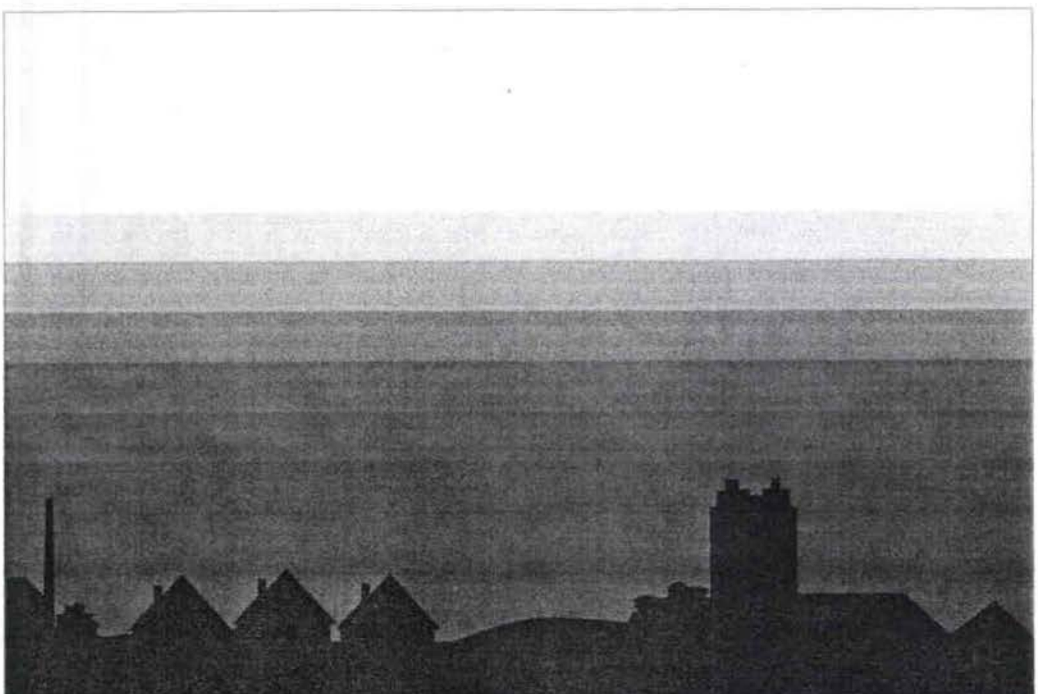


B C

4. Look at the location of the sun at **6:00 AM** in the picture below.



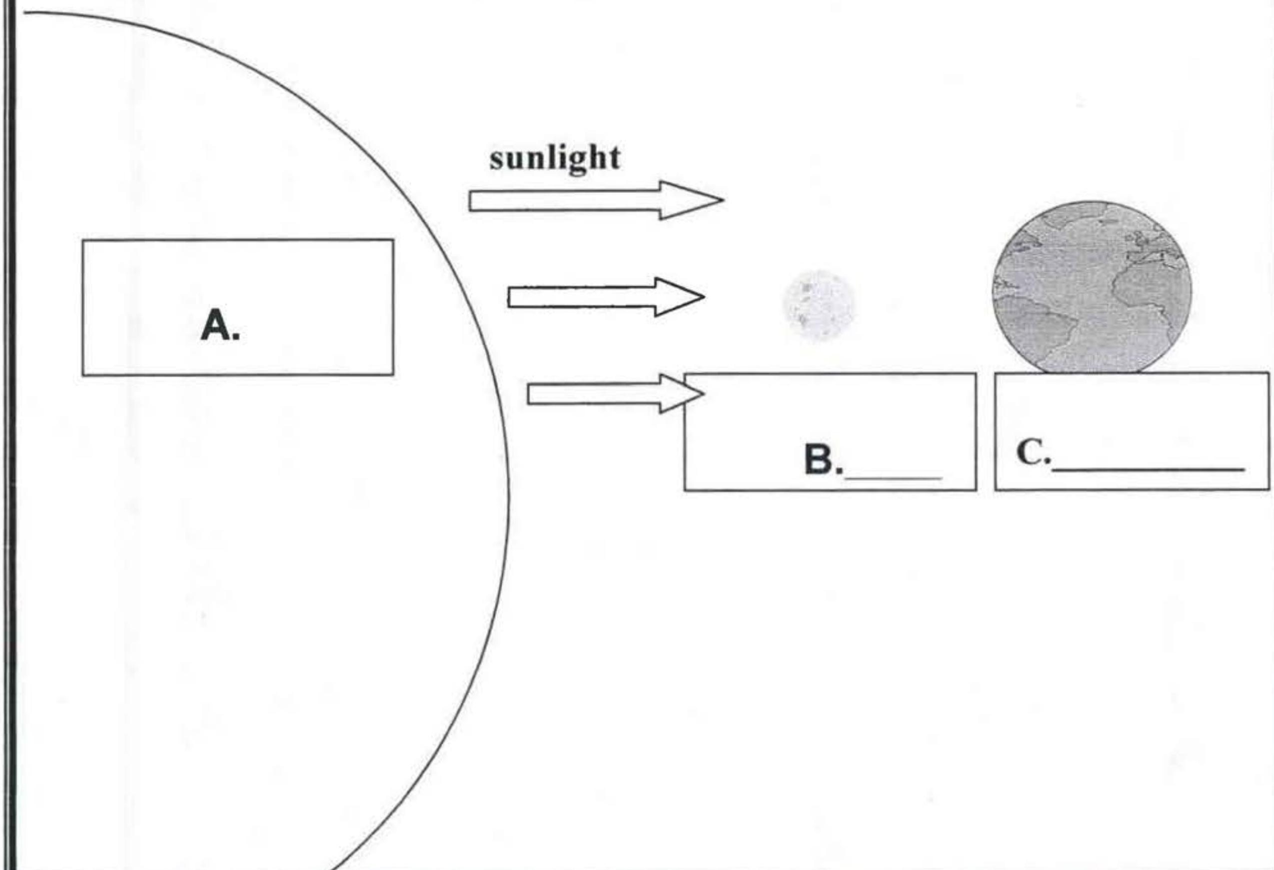
Now draw the sun at **6:00 PM** in the picture below.



Moon P.O.

PO 3SC-8D *The learner will analyze the phases of the Moon and predict the next phase.*

1. Look at the picture below. Label each object using the words Earth, Moon, or Sun.



2. The phases of the Moon occur because:

   a. The Earth revolves around the Moon.

   b. The Earth's shadow falls upon the Moon.

   c. The Moon revolves around the Earth.

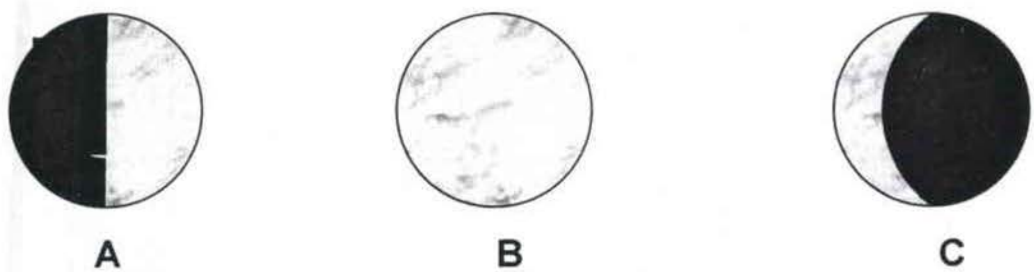
3. Heather keeps a journal of the Moon phases she sees each night. Tonight she observes a Gibbous Moon. What Moon phase can Heather expect to see in about one month?

   a. Full Moon

   b. Crescent Moon

   c. Gibbous Moon

4. The pictures above show phases of the Moon, taken four nights apart. Which of the pictures below shows the Moon four nights later?



5. Which of the following shows the correct order of the Moon phases?

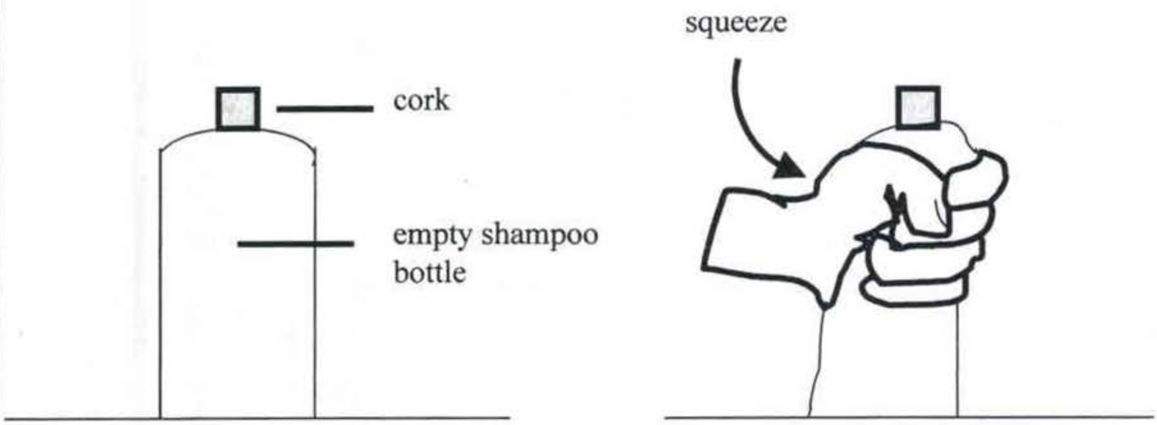
   a. New Moon, First Quarter Moon, Gibbous Moon, Crescent Moon, Full Moon

   b. New Moon, Crescent Moon, First Quarter Moon, Gibbous Moon, Full Moon

   c. New Moon, Full Moon, First Quarter Moon, Crescent Moon, Gibbous Moon

Forces P.O.

PO 3SC-9E *Given a description of a force acting on an object, the learner will predict the resulting motion of the object.*



1. A cork is stuck loosely into the neck of an empty plastic shampoo bottle. Jack squeezes the middle of the bottle very hard with one hand (see arrow). Make two predictions about what will happen to the cork and explain ***why*** those things will happen.

a) *What will happen first? Why?* ____________________

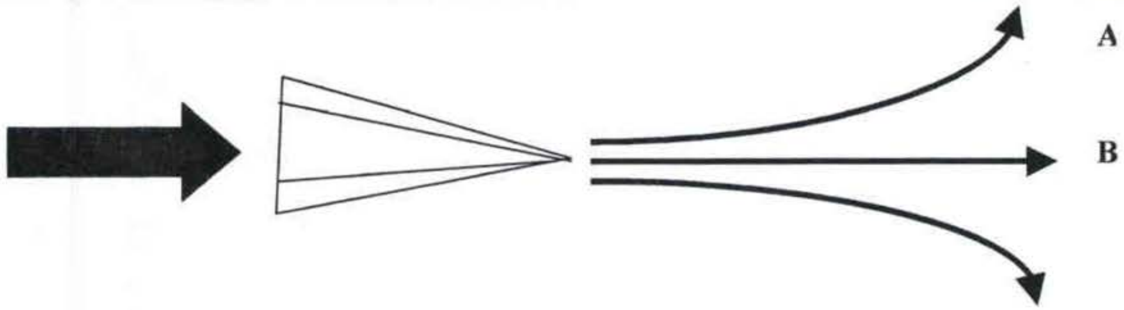
____

____

b) *What will happen next? Why?* ____________________

____

____



2. A paper airplane is thrown straight out in deep space, where there is no gravity, in the direction shown by the large arrow. Which path will the plane take into space?

   a) Path A

   b) Path B

   c) Path C

   Explain why you chose that answer:

   ____

   ____

   ____

   ____

3. A 15-pound bowling ball and a 1-pound grapefruit are dropped from a rooftop at exactly the same time. Which one will hit the ground first? Why?

   ____

   ____

   ____

   ____

   ____

Friction P.O.

PO 3SC-10E *The learner will describe the effects of friction on motion.*

1. In-line skates have smooth, narrow wheels. Why?

   a. The smooth, narrow wheels decrease gravity and help the skater do tricks on the skates.

   b. The smooth, narrow wheels increase friction with the ground and help keep the skater from falling.

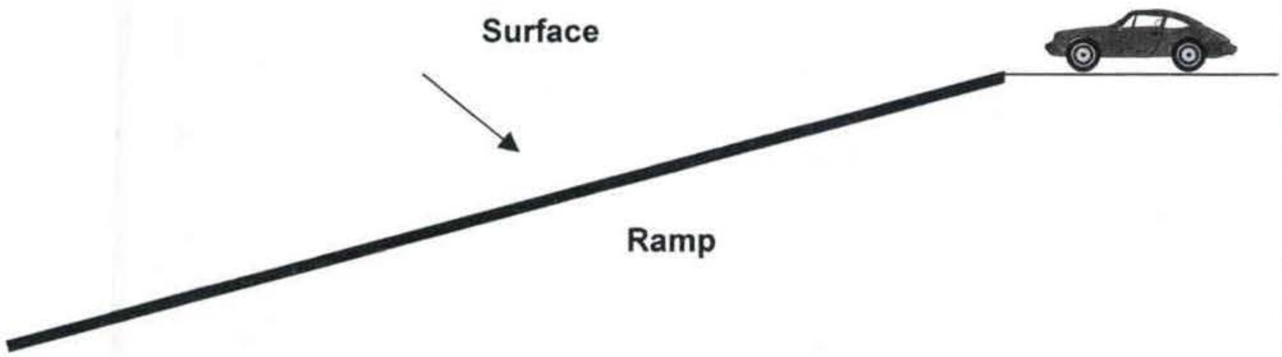
   c. The smooth, narrow wheels decrease friction with the ground and help the skater move quickly and smoothly.

2. Marla throws a paper airplane. The airplane flies for several meters, then slows down and begins to fall to the ground. What two forces cause the airplane to slow down and fall to the ground?

   a. Friction from Marla's hand makes it slow down, and a magnetic force pulls it to the earth.

   b. Friction with the air slows it down, and gravity pulls it to the earth.

   c. Gravity makes it slow down, and the pull of the moon makes it fall to the earth.



Time it takes car to travel down ramp

Ramp Surface	Trial 1	Trial 2	Trial 3	Average Time
Smooth Metal	5 seconds	4 seconds	3 seconds	4 seconds
Smooth Wood	6 seconds	5 seconds	7 seconds	6 seconds
Fine Sandpaper	10 seconds	8 seconds	12 seconds	10 seconds
Rough Sandpaper	?	?	?	?

Jamie is doing an experiment. He is testing to see which surface will allow a toy car to roll the fastest. He is using a small car with rubber-coated wheels and a long ramp. Jamie puts different surfaces on the ramp, and then lets the car roll down the ramp. He times each trial with a stopwatch.

3. On which surface did the car roll the fastest?

    a. Smooth Metal

    b. Smooth Wood

    c. Fine Sandpaper

4. In Jamie's experiment, would the car roll faster on rough or fine sandpaper?

___

5. Why? Explain your answer to #4 above.

___

___

6. What could Jamie do to the car's wheels to make it roll faster?

___

___

Nutrition P.O.

PO 3SC-11F *The learner will classify food items from a meal according to the food pyramid, and will evaluate the healthfulness of the meal.*

1. Some vitamins, like vitamin C, are not stored in the body and must be eaten every day. Which of the following foods should be included in a daily diet to provide vitamin C?

   a. Beef, fish, or eggs

   b. Bread, potatoes, or rice

   c. Oranges, grapefruits, or tomatoes

2. Which of the following main dishes contains the least amount of fat?

   a. Spaghetti with tomato sauce

   b. Cheeseburger

   c. Fried chicken nuggets

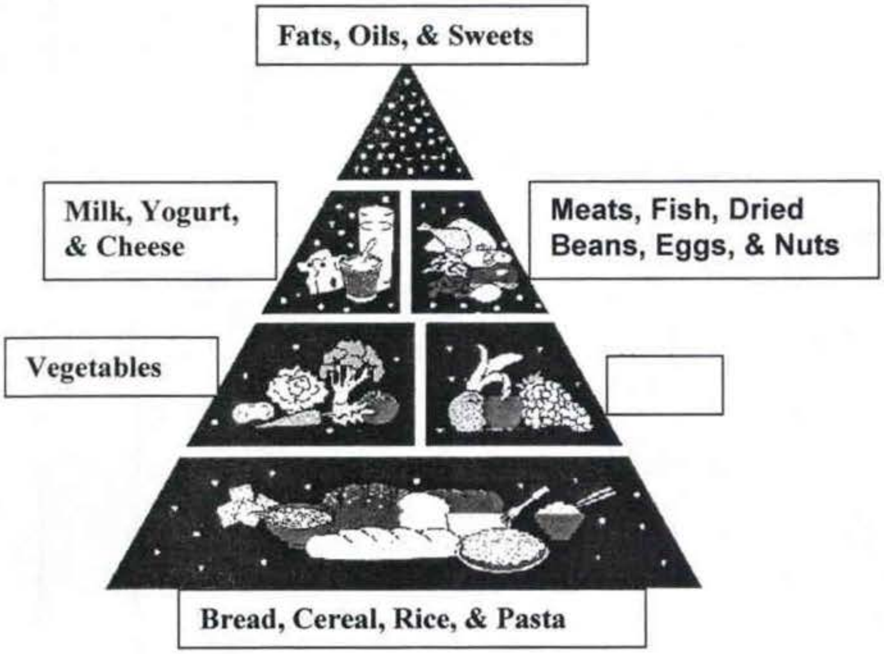
3. Calcium is an important nutrient for building strong teeth and bones. Which drink contains the most calcium?

   a. Soda Pop

   b. Milk

   c. Lemonade

Use the Food Pyramid below to answer the following questions.



4. Which of these food groups should you eat the fewest servings of?

   a. Fats, oils, and sweets
   b. Vegetables
   c. Bread, cereal, rice, and pasta

5. Which of these diets would be the most balanced?

   a. All fruits and vegetables
   b. Mostly breads and rice, no fats, oils, or sweets
   c. Some foods from each group, few meat servings

6. Which of the following menus is the most balanced?

   a. A steak, a baked potato, a glass of pop, and a piece of apple pie
   b. Salad, baked fish, rice, green beans, a glass of milk and watermelon
   c. A fish sandwich, French fries, and a glass of iced tea

7. Below are Nutrition Fact labels from three snacks. Which of these snacks is high in carbohydrates and low in total fat?
   a. A
   b. B
   c. C

A.

Nutrition Facts
Serving Size 1 Bag

Fat Cal. 130

*Percent Daily Values are based on a 2,000 calorie diet.

Amount/Serving	%DV	Amount/Serving	%DV
Total Fat 14 g	22%	**Total Carb.** 20 g	7%
Sat. Fat 7 g	35%	Dietary Fiber 1 g	5%
Cholest. 5 mg	2%	Sugars 18 g	
Sodium 35 g	2%	**Protein** 5 g	

Vitamin A 0% ⏱ Vitamin C 0% ⏱Calcium 8% ⏱ Iron

B.

Nutrition Facts
Serving Size 1 bag
Servings per container 1

Amount per serving
Calories 130
Calories from Fat 30

	% Daily Value
Total Fat 13 g	8%
Saturated Fat 1.5 g	8%
Cholesterol 0 mg	0%
Sodium 190 mg	8%
Total Carbohydrate 24 g	8%
Dietary Fiber less than 1 g	3%
Sugars less than 1 g	
Protein 2 g	

Vitamin A 0% ⏱ Vitamin C 0%
Calcium 0% ⏱ Iron 4%

C.

Nutrition Facts
Serving Size 1 bag (36 g)
Servings per Container 1

Amount per serving
Calories 150
Calories from Fat 30

	% Daily Value
Total Fat 3 g	8%
Saturated Fat 2 g	9%
Cholesterol less than 1 mg	0%
Sodium 125 mg	5%
Total Carbohydrate 28 g	10%
Dietary Fiber 1 g	3%
Sugars 20 g	
Protein 3 g	

Vitamin A 4% ⏱ Vitamin C 0%
Calcium 0% ⏱ Iron 6%

8. Charlie's dad has heart disease. His doctor told him to cut down on the amount of cholesterol he is eating. Which food label above came from a food item that Charlie's dad should **avoid** eating?
   a. A
   b. B
   c. C

<u>Third Grade Science Performance Objective Assessment Answer Keys</u>

Sun P.O.

1. A
2. B
3. B
4. Sun should be in the lower left quadrant of the picture.

Moon P.O.

1. A. Sun B. Moon C. Earth (3 points)
2. C
3. C
4. A
5. B

Forces P.O.

1. a) The cork will shoot in to the air (1 point), because squeezing the bottle makes the air inside press against the cork with a strong force (1 point).
   b) The cork will fall to the ground (1 point), because the force of gravity acts on it (1 point).

2. Path B (1 point), because there is no gravity to pull the plane "down" or off its path. It will continue going the same direction (1 point).

3. They will hit at the same time (1 point) because things fall at the same rage no matter how heavy they are (1 point).

Friction P.O.

1. C
2. B
3. A
4. Fine Sandpaper
5. Fine sandpaper would cause less friction and the car would roll faster.
6. Jamie could put oil or grease on the wheels and the car would roll faster. (Also accept, "Jamie could take the rubber off the wheels and leave the smooth metal in contact with the ramp", etc.)

Nutrition P.O.

1. C
2. A
3. B
4. A
5. C
6. B
7. C
8. A

Appendix D

Student Survey

SCIENCE LAB SURVEY

Name ______________________ Homeroom Teacher ________________

1. Name your favorite science lab activity this year.

____

Why? ______________________________________

2. Name your favorite thing we read in science lab this year.

____

Why? ______________________________________

3. How much do you enjoy reading the science textbook? (circle one)

a. I really like to read the textbook.
b. I sort of like to read the textbook.
c. I do not like to read the textbook.

4. How much do you enjoy reading storybooks about science? (circle one)

a. I really like to read storybooks about science.
b. I sort of like to read storybooks about science.
c. I do not like to read storybooks about science.

5. If you had to choose between reading the science textbook and a science storybook. Which would you choose? (circle one)

a. a science textbook
b. a science storybook

Why did you choose that answer? ____________________

____

Appendix E

Letter to Inform Administration of the Proposed Study

February 5, 2001

Will Becker
Western Row Elementary
755 Western Row Road
Mason, OH 45040

Dear Mr. Becker,

In order to complete my Master's Degree at the University of Dayton, I am required to conduct a research study and write a thesis. I am writing to inform you of the study I plan to conduct in my classroom.

My study will address the question, "How does the integration of children's literature into the science curriculum affect student understanding of scientific concepts?" This study will involve 14 classes of third graders. Subjects in the literature group will read a trade book along with a lab activity whereas subjects in the traditional textbook group will do the lab activity only, without reading the trade book. This procedure will be repeated for five different scientific concepts. The results will be analyzed to determine any significant changes in student understanding of scientific concepts between the experimental and traditional textbook groups.

I will begin the study in February, and the research will be complete by the end of May. The results will be reported in a thesis no later than August 2nd. Please contact me if you have any questions. I have attached a copy of my proposal for you to review.

Sincerely,

Emily R. Morgan

Appendix F

Request for Permission to Use Terra-Nova Scores

May 21, 2001

Will Becker
Western Row Elementary
755 Western Row Road
Mason, OH 45040

Dear Mr. Becker,

I am finishing my research for my Master's Thesis at the University of Dayton. As I described in my letter earlier this year, I am addressing the question, "How does the integration of children's literature into the science curriculum affect student understanding of scientific concepts?" I have been integrating children's literature into my lab activities with the literature groups, while I have been using the textbook with the traditional textbook groups. All of the groups are tested for understanding of scientific concepts with the district Science Performance Objective Assessments. The results will be analyzed this summer.

I am writing to request permission to use the students' second grade Terra Nova Science Test scores as a variable against which to compare my data. Be assured that **no student names will be used** when reporting the findings of this study. Please let me know if I have permission to use these scores.

Thank you,

Emily Morgan

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