A CASE STUDY APPROACH TO FOOD AND FIBER SYSTEMS LITERACY ASSESSMENT

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> Brothers, I do not consider myself yet to have taken hold of it. But one thing I do: Forgetting what is behind and straining toward what is ahead, I press on toward the goal to win the prize for which God has called me heavenward in Christ Jesus. Philippians 3: 13-14, NIV.

What a wonderful adventure this has been. My highest praise goes to my Lord Jesus Christ for His constant blessings, His never-ending support and for His perfect timing. He knew just when I needed to feel His presence and He drew me near. He knew when I needed help, and He brought the right people into my life. I press onward toward the goal with His constant guidance, leadership and encouragement. I praise Him for allowing me to bring this particular adventure to a close and I look forward to the next adventure that He has in store for me.

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> Finally, brethren, whatever is true, whatever is honorable, whatever is right, whatever is pure, whatever is lovely, whatever is of good repute, if there is any excellence and if anything worthy of praise, ponder these things. Philippians 4:8, NASB.

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CHAPTER I

INTRODUCTION

A long-standing tradition of excellent education in agriculture exists through secondary school agricultural education programs. These programs are vitally important in preparing individuals for employment in the food and fiber system. However, there is also a need to educate individuals about agriculture. In 1988 the National Research Council's Committee on Agricultural Education in Secondary Schools identified the need for education about agriculture or agricultural literacy. In this report, the committee proposed that an agriculturally literate person would understand the food and fiber system in relation to its history, economic, social and environmental significance (National Research Council, [NRC] 1988). The committee also recommended that "all students should receive at least some systematic instruction about agriculture beginning in kindergarten or first grade and continuing through twelfth grade" (NRC, 1988, p.10).

Desmond, Leising, King, Rilla and Coppock (1990) concluded that education about agriculture:

> ...focuses on agriculture in the context of the environment, society, and the economy. It deals with agriculture as an industry and with the relationship between agriculture and resources—natural and human. It analyzes local, national and international policy issues involving

> agriculture. It can be viewed as a lifelong process, beginning in the primary grades and continuing through public information mechanisms into adulthood. In short, it provides a cognitive context that permits more rational public decisions about agriculture and the food supply (p. 153).

Since the report Understanding Agriculture: New Directions for Education was issued in 1988, many different groups and organizations have developed what have come to be known as agricultural literacy or elementary agriculture instructional materials. From the United States Department of Agriculture's Ag in the Classroom effort, to many national and state commodity groups, the lessons and activities to educate students about agriculture have been developed. Many of the various groups can provide statistics showing that their materials have reached large numbers of students. However, there has been limited work based upon the systematic, sequential approach called for by the National Research Council report.

Leising and Zilbert (1994) approached agricultural literacy from a different angle. They developed a systematic curriculum framework that identified what students should know or be able to do by grade groupings.

The Food and Fiber Systems Framework explained in narrative fashion what an agriculturally literate adult should comprehend (Leising and Zilbert, 1994). Using five thematic areas with a series of standards addressing each area, the framework delineated the necessary components for understanding the food and fiber system and the way that it relates to the individual's daily life.

The second part of the framework broke the theme areas and standards into developmentally significant grade-grouped benchmarks, including K-1, 2-3, 4-5 and 6-8.

Leising and Zilbert's (1994) work, however, did not include a secondary (grades 9-12) component. It was noted from the framework document that both the framework narrative and the standards and benchmarks went through significant review and content validation. However, the field testing of standards and benchmarks in classrooms was not accomplished.

The Framework put forth by Leising and Zilbert (1994) provided a more systematic means of addressing the lack of agricultural literacy among the nation's populace. Such a comprehensive approach was more likely to gain the attention of state and national educators who were being driven to look for ways to add relevance to education while also addressing core academic standards.

The next logical step in the effort to develop consensus for an agricultural literacy model was to determine if the standards and benchmarks set forth in the Framework actually supported the necessary instruction to increase the learners' knowledge of food and fiber systems, or agriculture. That step was necessary to provide the additional validation of the Framework to move it forth into the national education arena as a means of addressing the agricultural literacy issue while also meeting core academic requirements for students.

Statement of the Problem

According to Desmond, Leising, King, Rilla and Coppock (1990) and the NRC (1988) the need exists to educate all students from kindergarten through twelfth grade <u>about</u> agriculture. The problem to be addressed was whether education <u>about</u> agriculture can effectively be infused into core academic learning using the Food and Fiber Systems Literacy Framework as the guide for instruction.

Purpose of the Study

The purpose of this study was to assess food and fiber knowledge of selected students in kindergarten through eighth grade before and after receiving instruction based upon the Food and Fiber Systems Literacy Framework standards and benchmarks.

Objectives of the Study

For the two case studies of this research, the specific objectives included:

1. Develop a profile of the test site schools included in this study.
2. Assess students' knowledge of food and fiber systems prior to and after receiving instruction based upon the Food and Fiber Systems Literacy Framework.
3. Determine differences by grade grouping (K-1, 2-3, 4-5, 6-8) in student knowledge about agriculture before and after instruction based upon the Food and Fiber Systems Literacy Framework.
4. Determine grade-grouping differences in student knowledge about agriculture before and after instruction based upon the five thematic areas of the Food and Fiber Systems Literacy Framework.
5. Determine if a relationship existed between the differences in student knowledge about agriculture before and after instruction based upon the Food and Fiber Systems

Literacy Framework and the number of teacher reported instructional connections to the Framework.

Scope of the Study

The scope of this study included a case study of a Montana school and a case study of an Oklahoma school. In both cases, the schools were involved in the Food and Fiber Systems Literacy project during the 1997-98 academic year.

Assumptions

The following assumptions were made regarding this study:

1. The instruments used elicited accurate responses.
2. The respondents fully understood the questions that were asked.
3. The respondents provided honest expressions of their knowledge.
4. Teachers of the selected students provided instruction based upon the Food and Fiber Systems Literacy Framework.

Definition of Terms

Agricultural Literacy—possessing knowledge and understanding of food and fiber systems. An individual possessing such knowledge would be able to synthesize, analyze, and communicate basic information about agriculture.

Benchmark—statement identifying expected or anticipated skill or understanding relating to food and fiber systems at various developmental levels. May be declarative, procedural, or contextual in the type of knowledge it describes.

Food and Fiber Systems—term used synonymously with the term agriculture.

Food and Fiber Systems Literacy—term used synonymously with the term agricultural literacy.

Food and Fiber Systems Literacy Framework—a curriculum model delineating what a person should know to be agriculturally literate. The Framework was divided into five thematic areas relating to agriculture: Food and Fiber Systems – Understanding Agriculture; History, Culture and Geography; Science – Agricultural and Environmental Interdependence; Business and Economics; and Food, Nutrition and Health. It included a narrative explanation of the concepts and information that an agriculturally literate person would understand. The Framework also included grade-grouped standards with accompanying benchmarks.

Instructional Connection—infusion of food and fiber concepts into classroom discussions and learning through lessons or activities.

Standard—describes what a student should know or be able to do relating to food and fiber systems knowledge or understanding.

CHAPTER II

REVIEW OF LITERATURE

The purpose of this chapter was to present a review of the relevant literature for this research study. This review of literature was divided into the following sections: (1) Introduction; (2) Agricultural Literacy Programs in the United States; (3) Agricultural Literacy Research; (4) The Food and Fiber Systems Literacy Framework; (5) The Food and Fiber Systems Literacy Project, and (6) Summary.

Introduction

Hillison (1997) documented the use of agriculture as a means of delivering core academic competencies to elementary school students in the early part of this century. He noted, however, that most of the elementary agriculture instruction of that time was focused toward the production aspect of agriculture. In one instance, it was suggested that school gardens be established in order that classroom learning could be practiced. Hillison also reported that the nature study movement of the early 1900's was agriculturally based, with the purposed end result as "sympathy for nature and outdoors" (p. 53).

The study of agriculture includes such subjects as biology, economics, environment, international relations and international trade, politics, sociology and technology (Moore, 1987). While that is expansive in scope, the scope of agricultural literacy, or education about agriculture is just as broad:

> …an agriculturally literate person's understanding of the food and fiber system would include its history and its current economic, social, and environmental significance to all Americans. This definition is purposely broad, and encompasses some knowledge of food and fiber production, processing, and domestic and international marketing. As a complement to instruction in other academic subjects, it also includes enough knowledge of nutrition to make informed personal choices about diet and health. Agriculturally literate people would have the practical knowledge needed to care for their outdoor environments, which include lawns, gardens, recreational areas, and parks (National Research Council, [NRC] 1988, p. 8-9).

With such a broad scope, agricultural literacy should be seen as cross-curricular. The NRC (1988) even went so far as to say, "Much of the material could be incorporated into existing courses and would not have to be taught separately" (p.10).

The report by the National Research Council's Committee on Agriculture Education in Secondary Schools recommending the integration of agricultural literacy in K-12 schools was not immediately met with praise or even much respect. The Associate Director of the National Center for Research in Vocational Education at the University of California Berkeley had this to say about the National Research Council's effort:

> In 1988, the National Research Council's Board on Agriculture completed a 3-year study and issued a report entitled Understanding Agriculture:

> New Directions for the Future [sic] (National Research Council, 1988). The report offered 12 recommendations. Most are not actionable by the sponsors of the study and the report contains no new directions for education [italics added] to be taken by colleges of agriculture. The report is clearly indicative of how the Board on Agriculture of the NCR [sic] is, in its membership and its actions, among the most tradition-bound organizations in existence. There is almost no likelihood that the Report will have even the slightest effect on the agenda or mission of colleges of agriculture in the United States (Swanson 1991, p. 6-7).

That view was borne out through a review of the research priorities of the time. In research completed by Silva-Guerrero and Sutphin (1990) on the priorities for research in agricultural education, out of 13 research categories and 109 identified research topics, there was no reference to agricultural literacy, food and fiber systems literacy or elementary agriculture. In a similar study by Williams (1991), agricultural literacy was still not identified as a research priority.

Agricultural Literacy Programs in the United States

One might assume that agricultural literacy programming and research efforts would have been quickly adopted soon after the release of the report by the NRC (1988). However, a review of the literature did not provide evidence of such. There were however, several agricultural literacy programs that existed prior to 1988. The National FFA Food for America program was implemented in 1975. According to Tenney (1977) it was initially a program to involve high school agriculture students in sharing agriculture with elementary students in an effort to help those younger children understand how food gets from the producer to the consumer. The program was "an expansion of the work previously done by FFA chapters, such as operating children's barnyards and providing information on agriculture to children in the elementary schools" (Tenney 1977, p. 73).

Another agricultural literacy effort, the Ag in the Classroom initiative of the United States Department of Agriculture, began in 1981. The goal of Ag in the Classroom was to help students in grades preK-12 become agriculturally literate (United States Department of Agriculture [USDA], 1998). According to Traxler, (1992) implementation of the program was accomplished primarily through state departments of agriculture and state Farm Bureau organizations. The program encouraged educators to teach more about the food and fiber system and the role of agriculture in our economy and society. A group composed of educators, government officials, and representatives from agricultural organizations and agri-businesses carried out the program in each state. Traxler (1990) reported that the Ag in the Classroom task force "wisely decided that the program maintain its grass roots approach since education decisions are made at the state and local levels" (p.9). Traxler, then Director of the National Ag in the Classroom program, also wrote:

> During the 60's and 70's, as experienced agriculture, conservation and forestry organizations realized the need for quality materials, many excellent films, filmstrips, literature and classroom aids were financed and produced by businesses, foundations, nonprofit groups and associations, as

well as state and federal agencies. However, there was no coordination, hence there was little exchange of ideas among the groups (p. 9).

The U.S. Department of Agriculture provided leadership, counsel, and educational materials, and maintained a nationwide network of individuals and organizations who actively support the Ag in the Classroom mission (USDA, 1998).

Many state Ag in the Classroom efforts began with the development of instructional activities for fourth grade. That decision was based upon the reasoning that the study of state history and geography, subjects complemented well by agricultural information, began in the fourth grade (Traxler, 1990). As other agricultural literacy efforts began to develop, more emphasis was placed upon the secondary learner; specifically those already enrolled in agricultural education courses. Frick and Spotanski (1990) discussed the importance of agricultural literacy within secondary agriculture programs. They wrote of three major areas of emphasis:

1. An understanding of the applied processes or methods of agriculture
2. The basic vocabulary of agricultural terms, and
3. The impact of agriculture on society (p. 6).

Those three emphasis areas have been much the same for all agricultural literacy efforts, from elementary through secondary to adult. However, consensus as to what an agriculturally literate person should know and understand has been more elusive.

Frick, in 1990, reported one of the first widely published agricultural literacy definitions. His doctoral research focused on the definition and concepts of agricultural literacy. Frick delineated three objectives for his research:

To refine a group definition of agricultural literacy.

To identify those subject areas falling within the framework of agricultural literacy.

To identify those agricultural concepts that every U.S. citizen should know (p.4).

Using a Delphi technique, the study incorporated two questionnaires and 98 participating panelists to reach a consensus definition of agricultural literacy:

> Agricultural literacy can be defined as possessing knowledge and understanding of our food and fiber system. An individual possessing such knowledge would be able to synthesize, analyze, and communicate basic information about agriculture. Basic agricultural information includes: the production of plant and animal products, the economic impact of agriculture, its societal significance, agriculture's important relationship with natural resources and the environment, the marketing of agricultural products, the processing of agricultural products, public agricultural policies, the global significance of agriculture, and the distribution of agricultural products (Frick 1991, p. 52).

Additionally, Frick identified eleven broad agriculture subject areas that were encompassed by agricultural literacy. Those included:

> 1) agriculture's important relationship with the environment, 2) processing of agricultural products, 3) public agricultural policies, 4) agriculture's important relationship with natural resources, 5) production of animal products, 6) societal significance of agriculture, 7) production of plant

> products, 8) economic impact of agriculture, 9) marketing of agricultural products, 10) distribution of agricultural products, and 11) global significance of agriculture (p. 54).

The definition and the 11 subject areas of agricultural literacy reported by Frick were the basis for many of the succeeding research studies in this area. Law (1990) put a similar definition forth:

> ...agricultural literacy may be defined as the development of the individual in the principles and concepts underlying modern agriculture technology. As defined here, it applies to producing, processing, distribution, marketing, and consuming the products of the food and fiber system. It also includes an awareness of the impact agriculture has on the environment, on society, and on everyday living of the individual (p.5).

Present agriculture literacy efforts in the United States are numerous and the approaches are varied. The United States Department of Agriculture's Ag in the Classroom program has continued to expand. More than 300 organizations and publishers contributed to the 1996 Agriculture in the Classroom Resource Guide (United States Department of Agriculture, 1996). Individual states have also become involved through Ag in the Classroom. For example, Oklahoma's Ag in the Classroom personnel have developed lesson plans and instructional activities for kindergarten through sixth grade and have provided training to approximately 40 teachers per year since 1995 (Wilhelm, Cox, and Terry, 1997). Commodity groups have also undertaken the creation and dissemination of educational materials promoting their individual product. Colleges and universities offer generalized courses about agriculture for the non-agriculture major.

By 1990, thirty-two states reported agricultural literacy programs were being conducted in at least one grade level (Hall, 1991). However, among all these efforts, what still seemed to be lacking was a general consensus on the scope of agricultural literacy, or the determination of what an agriculturally literate person should know. Without such a defining scope, it has been difficult to ascribe standards for educational accountability to the various efforts. Brown and Stewart (1992) reported:

> There has been a national move to implement programs to improve the agricultural knowledge and attitude of individuals from kindergarten through the adult level. These programs have been primarily delivered through the public school system and can range from merely incorporating agricultural information into the current curriculum to complete courses in education about agriculture (p. 230).

Much of the focus on agriculture literacy has been on the development of instructional materials. Again looking to the NRC (1988) report, it was found that:

> Few systematic educational efforts are made to teach or otherwise develop agricultural literacy in students of any age. Although children are taught something about agriculture, the material tends to be fragmented, frequently outdated, usually only farm oriented, and often negative or condescending in tone (p. 9).

Creators of agricultural literacy instructional materials have begun to evaluate the usefulness of the materials in elementary classrooms. Pals (1998a), reporting on an assessment of Idaho Ag in the Classroom program, noted that teachers were most often incorporating agriculturally related instruction into the science core subject area. Pals also reported that respondents were interested in taking workshops for science credit and were interested in receiving lists of resource materials and people available to assist in providing agricultural instruction. Pals went on to recommend a renewed emphasis on science when revising or developing new Ag in the Classroom curriculum. In a related study, Pals (1998b) reported on the evaluation of the Idaho Ag in the Classroom curriculum guide. The 128 teachers using the curriculum guide yielded a mean of nearly 11 units taught per year. Science, health and nutrition, and social studies were the most frequently incorporated topics. Teachers also indicated that effective use of the materials was not contingent upon prior agriculture knowledge by the teacher.

Agricultural Literacy Research

It has been well documented that many adults lack an understanding of ways agriculture impacts their personal and professional lives. Elliot and Frick (1995) discovered that College of Education faculties at two land grant institutions had basic knowledge about agriculture and agriculture issues, but lacked the understanding of where to gain additional agricultural information. Harris and Birkenholz (1993) reported that a study of secondary school teachers regarding knowledge and attitude about agriculture indicated language arts teachers and mathematics teachers produced significantly lower scores in both areas than did any other teacher group. They recommended that "preservice courses to assist students in identifying strategies for applying agricultural examples to academic disciplines should be offered to students preparing to become academic teachers" (p. 353). Terry, Herring and Larke (1992) surveyed fourth grade teachers in Texas to determine, in part, that group's knowledge and attitudes about agriculture and to determine the teachers' usage of agricultural materials and concepts in their classrooms. Those researchers concluded that to enhance the teaching of agricultural concepts among the population, efforts must be undertaken to increase both the teachers' technical knowledge and their attitudes about agriculture.

Cox (1994) reported a study of Oklahoma fourth grade teachers. The respondents' perceptions of agriculture were assessed through an open-ended definition of agriculture. Cox reported that the respondents used terms based upon livestock and crop production most often, followed by agri-business terms. Only seven percent of the respondents used agri-science terminology. In assessing teachers' knowledge of agriculture, Cox used a 25-item multiple choice instrument. It was reported that a majority of teachers selected correct responses for fifteen items:

> Over 80 percent of the teachers knew bedrock is the hard bottom layer that underlies the earth's crust... Likewise, over 80 percent of the teachers knew a heifer had not yet borne a calf, a spider was not an insect, wheat is Oklahoma's number one agricultural crop, and the item with the greatest volume is listed first on the manufacturer's label of ingredients (p. 63).

Cox also reported that a majority of teachers incorrectly answered ten of the items:

> ...between 40 and 45 percent of the teachers knew...Americans eat about 65 pounds of beef annually, and underground aquifers are the major source of irrigation water in western Oklahoma. Also related to beef consumption, only 32.2 percent of the teachers knew the caloric value of beef sirloin...Only 26.4 percent of the teachers knew Oklahoma ranks second among hard red winter wheat producing states (p. 63).

An Arizona study by Flood and Elliot (1994) sought to assess agricultural knowledge of urban community college students in the state. The results indicated that over 30 percent of the respondents answered the basic knowledge questions incorrectly. The majority of the attitude responses fell between agree and disagree on a four-point scale. Interestingly, it was reported that over eighty percent of the respondents believed they needed facts about agriculture to make informed decisions.

There have also been a number of projects undertaken to assess the agricultural literacy level of secondary students. Frick and Wilson (1996) studied the agricultural literacy level of Native American high school students in Montana in an effort to provide baseline data on the knowledge and perceptions of that subgroup regarding the food and fiber system. Using the instrument developed by Frick (1990), the researchers sought to assess the overall knowledge and perceptions of agriculture and also knowledge and perception in seven concept areas. The findings indicated that the overall knowledge level was moderate to high, although the concept area means yielded wide variation. Concept areas included: significance, policy, natural resources, plants, animals, processing and marketing. Frick and Wilson also found that the overall perception toward agriculture by the Native American high school students was positive. However, they reported wide variances of perception within the seven concept areas.

A study of rural and urban-inner-city high school students by Frick, Birkenholz, Gardner and Machtmes (1994) also used the 1990 Frick study as its basis. The researchers reported that rural high school students were most knowledgeable about natural resource concepts and least knowledgeable about plants in agriculture. Their urban-inner-city counterparts were most knowledgeable about natural resources but least knowledgeable of agriculture policy. It was also reported that the urban-inner-city students had lower mean knowledge scores and less positive perceptions overall than the rural students.

Frick, Birkenholz and Machtmes (1994) reported a study with 4-H members attending a state 4-H conference as the population and using Frick's 1990 work as the basis for instrument development. The demographic results indicated that the respondents were primarily junior high and high school students. With this population, the researchers concluded that the overall mean knowledge level was high, but had wide variation. Likewise, the overall mean perception toward agriculture was positive, but also varied.

While much research was found on adults and secondary school students' agricultural literacy, there has been limited research in regards to instruction about agriculture with elementary and middle school students. Horn and Vining (as cited in Frick, Kahler and Miller, 1991) completed a study of 2000 Kansas students in 1986. It was reported that less than 30 percent provided correct answers to basic agriculture questions. In 1992, Brown and Stewart reported a study of agricultural instruction in Missouri middle schools. They concluded that, with the study population, a change in agricultural knowledge and attitude occurred after the students received instruction about agriculture. Their study involved students participating in instruction about agriculture for lengths of time between six and eighteen weeks. Brown and Stewart concluded that the length of instruction time between six and eighteen weeks did not affect the change in agricultural knowledge or attitude.

In an evaluation of the Georgia Agriculture in the Classroom program, Herren and Oakley (1995) used an experimental posttest only design with almost 600 students in second and fourth grades. The researchers reported some interesting findings. There were significant differences in knowledge of students, except for the students with teachers who had agricultural backgrounds. From that finding, Herren and Oakley concluded that the agricultural literacy level of the teacher was important to any gains in agricultural literacy of the students. They also found that the program was effective with both urban and rural students, implying that rural students did not necessarily know more about agriculture than their urban counterparts. This would lend credence to the necessity of agricultural literacy instruction for all students.

Another study of elementary students yielded somewhat different results between rural and urban students. Swortzel, in 1996, reported a study to assess Ohio fourth-graders knowledge of animal agriculture before and after receiving instruction about agriculture. The instruction was integrated into the core curriculum over a period of four weeks. A pretest/posttest design was used and a statistically significant difference was shown between the two test scores. The students scored an average of 9.6 points higher on the posttest and the gains were greater for students living in urban areas.

Trexlar (1997) also reported findings contradictory to the Herren and Oakley (1995) study. In a three-year pretest/posttest methodology employed in Michigan, Trexlar concluded that no significantly different gains in science knowledge or agriculture knowledge occurred between the control and treatment groups of fifth grade students. In the instance reported, the treatment involved providing inservice to fifth grade teachers regarding the incorporation of agricultural concepts into science instruction. The treatment also involved those teachers using an agri-science curriculum. Trexlar concluded that the introduction of an agriculturally based science curriculum "did not alter or negatively effect student perceptions of science, agriculture or their agri-science knowledge level" (p. 19). In a related study, Trexlar and Suvedi (1997) reported that teachers, after three years of interventions, possessed more favorable perceptions of agri-science than prior to the treatment. Trexlar added that those more favorable perceptions were not transferred to the teachers' students.

Much of the agricultural literacy research sought to document what individuals do not know about agriculture. Perhaps a more important objective for future research should be to document what individuals should know to be agriculturally literate. Nunnery (1996) noted the necessity for building an agricultural literacy framework for understanding agriculture's many different perspectives and viewpoints.

The Food and Fiber Systems Literacy Framework

Martin (1996) posed several pertinent questions for agricultural literacy researchers in his remarks as a discussant of the research presented by Frick and Wilson (1996). Martin questioned:

1. What constitutes literacy?
2. How 'much' does one need to know to have an understanding and an appreciation for agriculture? Who says so? Who sets the limits?
3. Why should American citizens have a basic understanding of agriculture? Whose understanding and to fill what need? (p. 66).

Those questions were similar to the ones put forth by Leising and Zilbert (1994) in the process of creating the Food and Fiber Systems Literacy Framework. One of the justifications for developing such a framework was that through all the definitions of agricultural literacy, through the many agricultural literacy programs and agricultural literacy research, little emphasis had been placed on determining the actual knowledge a person needed to be agriculturally literate. The authors asserted that measurable standards and benchmarks were necessary to bring focus to not only agricultural literacy instructional material development, but to agricultural literacy research as well.

The Framework was initially developed using a modified Delphi technique with elementary teachers, school administrators, science teachers, 4-H leaders, food scientists, agricultural economists and business people. According to Leising and Zilbert (1994):

> The developmental process was iterative using the nominal group technique to refine the contents of framework sections. Each theme in the framework went through at least four iterative reviews. The process began with a national review of curricula for general education about agriculture and a review of the literature on agricultural literacy. Six themes were identified to serve as the foundation for the framework: Food and Fiber Systems: Understanding Agriculture; Historical, Cultural, and Geographic Significance; Science: Agricultural-Environmental Interdependence; Business and Economics; Food, Nutrition, and Health; and Career Pathways in Agriculture.
>
> The task force then proceeded to develop a set of key questions for each theme. Key questions were used to guide the learner through significant

> concepts related to each question. The Framework was also reviewed by California State Department of Education staff in agricultural education, and by the State Advisory Committee on Agricultural Education. To further refine the Framework, a survey was undertaken to solicit review of the Framework by representatives of agricultural business and industry, agricultural producers, government agencies responsible for regulating agriculture, California farm advisors and 4-H and youth specialists, and agriculture educators at the elementary, secondary and post secondary levels (p. 113).

From the validation process, Leising and Zilbert (1994) concluded that the reviewers believed agriculture was an important subject and should be included in school curriculums. Further, all the key questions in the thematic areas were important for general education about agriculture. Finally, the Framework as an area of study presented a balanced treatment of the various viewpoints regarding agriculture.

In subsequent review, the task force recommended the infusion of the Career Pathways theme into the other five thematic areas. According to Leising (personal communication, May 5, 1998) that was done in order to remove the likelihood that the Framework could be denoted as promoting the vocational aspects of agriculture and, as such, could be considered a precursor to secondary level agricultural education.

Upon completion of the Framework, Leising (1994) set about the creation of benchmarks to support each standard. The development of the benchmarks was accomplished through the efforts of the Food and Fiber Systems Literacy Framework Task Force, the California Department of Education staff in agricultural education, researchers at the University of California, Davis, staff of the Agricultural and Environmental Education department at the Milton Hershey School and a writing team consisting of elementary teachers, science teachers, school administrators and other stakeholders. Using a sequential approach, developmentally appropriate benchmarks were developed for the following grade level groupings: K-1, 2-3, 4-5 and 6-8. Appendix A contains a copy of the Food and Fiber Systems Literacy Framework with accompanying standards and benchmarks.

The Food and Fiber Systems Literacy Project

In early 1996, Oklahoma State University was awarded funding by the W. K. Kellogg Foundation for the Food and Fiber Systems Literacy Project. The goal of the project was to "motivate students to achieve higher levels of core academic competencies and the agricultural knowledge needed to become informed and literate citizens and responsible resource managers" (Leising and Igo, 1997, p.2). The project was based upon the Leising and Zilbert (1994) Food and Fiber Systems Literacy Framework.

Additionally, eight specific objectives were set forth for the Kellogg funded project:

1. Align the food and fiber systems framework and learner outcomes with national education standards, instructional activities and resource materials.
2. Develop food and fiber systems learner outcomes for grades 9-12.
3. Establish field test sites in four geographic regions of the United States.

4. Establish a comprehensive food and fiber systems teacher training model.
5. Establish a working relationship between science and teaching professionals for the dissemination of the food and fiber systems framework, standards, benchmarks and instructional materials.
6. Develop assessment instruments and conduct project evaluation.
7. Develop an electronic clearinghouse and data base support system.
8. Provide an annual project evaluation that clearly describes the achievement of each objective. (Leising and Igo, 1997, p.2).

Those project goals were to be accomplished through a variety of means. Prior to project staffing, an advisory committee was formed. That 12-member committee was instrumental in developing the project implementation plan and in providing oversight and direction to project efforts. Test site selection was based upon size, location and diversity of the schools, as well as the willingness of site personnel to participate in the project. Instructional material development began with a review of existing materials by project staff and teachers. The determination was made that quality ideas and activities existed, therefore it was not necessary to duplicate efforts of others in developing new materials. However, selected instructional activities were significantly revised to better meet the Framework's standards and benchmarks, and to reflect the format desired by the teacher review panel (Leising and Igo, 1997).

The Kellogg Foundation outlined four specific evaluation questions to be addressed by the project:

1. How did the diverse partnership of scientists, educators, and food systems industry professionals impact the quality of literacy curriculum materials?
2. What was the impact on achievement in core academic subjects when food and fiber systems information was used as a medium for learning?
3. What was the impact on achievement in food and fiber systems learning when delivered through an infusion within core academic subjects?
4. What attitudinal shifts in students, teachers, and collaborators regarding food and fiber literacy achievement resulted from this project? (Leising and Igo, 1997, Appendix D).

Project staff and the advisory committee developed an evaluation plan to address those questions. It was to be the first known effort utilizing a curriculum framework model as a means of guiding instruction and assessing learning in agricultural literacy.

Summary

This chapter has provided background information concerning the development of the agricultural literacy movement, agricultural literacy programs, agricultural literacy research, the Food and Fiber Systems Literacy Framework and the Food and Fiber Systems Literacy Project.

Agricultural literacy has received increasingly more attention since the release of Understanding Agriculture: New Directions for Education in 1988. Agricultural literacy programs and research have proliferated since that time. Programs have targeted learners from the primary grades to adulthood. Research has been conducted with those same populations. Many have written of the importance of having an agriculturally literate populace. Law (1990) wrote:

> As special interest groups revolving around issues such as animal rights, pesticide usage, soil and water conservation, and other environmental concerns gain more media and public attention, it becomes even more important that the general public have some background and understanding of not only what agriculture is all about, but of how it affects each person's life on a daily basis (p.5).

One of the points of contention regarding agricultural literacy has been the most appropriate and least intrusive way to incorporate the instruction into an already overloaded curriculum. The consensus was that additional courses were not feasible or necessary, but that a more realistic approach would be to infuse agricultural concepts into existing courses (Law, 1990). The Food and Fiber Systems Literacy Framework was built upon that concept.

The Framework also addressed another challenge in bringing the American public to an acceptable level of agricultural literacy. What was lacking in most of the current programs was a uniformly measurable standard for assessing a person's agricultural knowledge. Instead of building a program upon instructional activities, the Framework was designed to make connections to agricultural concepts through the existing curriculum and academic standards that were mandated by local school districts and by states.

The concept of using a framework as a means of bringing about and assessing literacy continued to develop. In 1996, Nunnery wrote:

> Agriculture literacy must...build a framework for understanding agriculture from a variety of perspectives and viewpoints. It must sensitize the generations to the living history of agriculture and its impact on the land, the environment, and its people. Agriculture literacy should promote trust and responsibility. And rather than create passive learners, it should inspire and empower independent thinking, a positive activism toward food and agriculture issues, and support of education initiatives (p. 13).

The Framework, with its standards and benchmarks, was designed to address active learning through use of the cognitive, affective and psychomotor learning domains. It was also designed, through its sequential approach, to promote the development of critical thinking skills.

The W. K. Kellogg Foundation funded project at Oklahoma State University provided the means for moving the Food and Fiber Systems Literacy Framework to the next level of adoption and accessibility. The infusion of education about agriculture has been a clarion call in agricultural literacy for over a decade. The pilot testing of the Framework's standards and benchmarks was a means of adding credibility towards adoption of that systematic approach.

An understanding of the food and fiber system is truly important for the United States citizenry to make informed decisions from the supermarket to the voting booth. Agricultural literacy programs need to be comprehensive and systematic. The programs must present accurate information regarding the food and fiber system and be based upon what individuals must know to make those informed consumer decisions. Above all, agricultural literacy programs should be based upon measurable outcomes in order that agricultural literacy levels may be evaluated and progress measured.

CHAPTER III

METHODOLOGY

This chapter was to describe the methods and procedures used in developing and conducting this research study. The purpose of the study was to assess food and fiber knowledge of selected students in kindergarten through eighth grade before and after receiving instruction based upon the Food and Fiber Systems Literacy Framework curriculum model. The research methodology for this study consisted of individual case studies at the two test sites. Qualitative analyses of the characteristics of each site and quantitative analyses for assessing student knowledge were included in these case studies. According to Yin (1994), case study research involves numerous variables, relies on multiple sources of evidence and benefits from previously developed theory to guide the data collection and analysis. The purpose and objectives of this study fell within those design parameters.

Objectives of the Study

In order to accomplish the purpose of the study, the following objectives were established.

1. Develop a profile of the test site schools included in this study.

2. Assess students' knowledge of food and fiber systems prior to and after receiving instruction based upon the Food and Fiber Systems Literacy Framework.
3. Determine differences by grade grouping (K-1, 2-3, 4-5, 6-8) in student knowledge about agriculture before and after instruction based upon the Food and Fiber Systems Literacy Framework.
4. Determine grade grouping differences in student knowledge about agriculture before and after instruction based upon the five thematic areas of the Food and Fiber Systems Literacy Framework.
5. Determine if a relationship existed between the differences in student knowledge about agriculture before and after instruction based upon the Food and Fiber Systems Literacy Framework and the number of teacher reported instructional connections to the Framework.

Institutional Review Board (IRB)

Federal regulations and Oklahoma State University policy require review and approval of all research studies that involve human subjects before investigators can begin their research. The Oklahoma State University Office of University Research Services, through the Institutional Review Board, (IRB) conducts this review to protect the rights and welfare of human subjects involved in biomedical and behavioral research. In compliance with the aforementioned policy, this study received proper review and was granted permission to proceed. The Institutional Review Board assigned the number AG-98-007 to the Food and Fiber Systems Literacy Project. Appendix B presented a copy of the IRB approval form.

Case Study

The study included two cases, one in a Montana school and the other in an Oklahoma school. In both cases, the schools were participants in the Food and Fiber Systems Literacy Project during the 1997-98 academic year. The cases primarily involved the kindergarten through eighth grade students and teachers at the sites. The sites were selected based upon the objectives of the Project requiring geographically, socio-economically, and agriculturally diverse settings for the test site schools.

Instructional Materials Development

As a means of providing incentive for teachers to implement the Project at each test site, the Project staff developed a series of lesson plans and instructional activities that supported the Framework. The initial step in that process was to review existing instructional materials to identify the quality and quantity of materials currently available. The staff found a wide range of lessons and activities were available from a variety of sources. Upon review of those materials, the decision was made to adapt existing lessons to better support the Framework. It was also determined that some Framework standards did not have existing lessons that applied, and in those instances, lessons were developed. The goal was to provide adequate instructional materials to the participating teachers to address each benchmark in the Framework at least once. It was not the goal nor intention of the Project staff to provide all the necessary lessons and activities for teachers to use the Framework and instruction as a stand-alone program. Rather, the purpose was to provide to teachers enough example lessons that the teachers could begin infusing agricultural concepts into their core academic subject matter and encourage teachers to make connections to the Framework from existing instruction.

The Project staff brought together two participating teachers from each site in January 1997. The purpose of the two and one-half day conference was to gain teacher input on lesson applicability and to gather consensus on lesson plan format. The teachers used a keep/cull process with the lessons in determining applicability of content and grade-level appropriateness.

Teacher Training

Preparing teachers to utilize the Food and Fiber Systems Literacy Framework was completed in two phases. Phase I training at the two sites was accomplished in May 1997. Phase II was completed in August and September 1997. The agendas for all training sessions were based upon eleven identified outcomes for teacher training, and incorporated the use of lessons by the teachers being trained. Sample agendas with the accompanying outcomes were attached as Appendix C.

The first segment of Phase I training at each site involved introductions and an overview of individual expectations for participating teachers. A hands-on activity immediately followed to get teachers directly and actively involved. The second segment was centered upon an explanation of the Project, orientation to the Framework, standards and benchmarks and the introduction of the supporting lessons and activities. Segment three featured a demonstration of the Project web site with time for the teachers to explore the web site and related links. The final segment of Phase I training was utilized to assist teachers in organizing instructional materials and creating a rough outline plan for implementing food and fiber systems instruction.

Phase II training was designed using the participant evaluations from Phase I training. It included additional time for teachers to become familiar with the Project web site, including instruction on submitting feedback electronically to the Project staff. The majority of Phase II was spent in helping teachers focus on planning instructional time throughout the academic year to address food and fiber systems concepts.

Additional teacher preparation was accomplished through visits to each site during the academic year. The researcher coordinated with the building principals to visit each teacher two additional times during the fall semester and two times during the spring semester. Those visits were one-on-one interactions to address any questions or concerns that teachers had encountered. The teachers were also encouraged to interact with the researcher and the rest of the Project staff through e-mail, telephone or fax.

Instrumentation

The design and development of instruments for this study involved the review and evaluation of instruments used in previous agricultural literacy research. It was necessary to develop instruments specifically linked to the Food and Fiber Systems Literacy Framework.

Four different instruments were developed based upon the grade level groupings in the Framework: K-1, 2-3, 4-5 and 6-8. The items for each instrument were developed from the standards and benchmarks within each grade level grouping. The instruments were developed in collaboration with the Project advisory committee, researchers and curriculum specialists at Montana State University and at Oklahoma State University, and elementary teachers at the Project test sites. Appendix D contains the four instruments.

The items for each instrument went through a series of developmental stages from the formation of the specific question based upon the appropriate grade-level benchmark, to the final selection of questions and illustrations to be included with each item. The K-1 and 2-3 instruments included 16 and 21 items respectively. Both primarily utilized a format consisting of questions to be read by the teacher followed by a series or group of illustrations from which the students were to pick the correct answer or answers. The K-1 instrument responses were entirely pictures, while the 2-3 instrument utilized ten items with picture responses and eleven items with simple text responses. At the suggestion of the curriculum specialists and the elementary teachers, both instruments instructed students to draw a line connecting the correct responses or to use crayons to circle or box appropriate responses. Instructions with the K-1 and the 2-3 test asked the teacher to read each question and then read the word or phrase accompanying each picture.

The 4-5 and 6-8 grade level instruments were made up entirely of text responses and contained 35 and 30 items respectively. Items included true/false, matching, and multiple choice responses. The curriculum specialists and the elementary teachers reviewed these instruments for age-level, reading-level and vocabulary-level appropriateness. Instructions provided with each instrument explained that the student should read the questions carefully and to then choose the correct answer or answers to each question. Instructions went on to add that the student should ask the teacher for help with any questions or terms that were not understood.

The initial instruments were reviewed by the curriculum specialists and the elementary teachers. Based upon that review, the instruments were revised to be more grade-level appropriate. The instruments were again reviewed by researchers at Oklahoma State University and at Montana State University to ensure that the included items on each instrument were based upon the appropriate grade-level benchmark.

Following this double review, a pilot test was undertaken with thirty-five Montana State University elementary education majors. Those respondents added an extra measure of validity for the context of the instruments. Finally, a pilot test was conducted with a K-8 student population in a Montana school. The instrument was administered by the grade-level teachers over the period of one day. Following administration of the instruments, teachers were asked to provide input for the improvement of the instruments based upon their expertise and the observed responses of their students. A Guttman Split-Halves reliability coefficient was computed on the instruments using the Statistical Package for Social Sciences (SPSS) software.

The teachers of the pilot-tested kindergarten and first grade students recommended that the instrument be administered over a period of two or more days. They reported observing students loosing interest and concentration after completing the second page of the instrument. The Guttman Split-Halves reliability coefficient for the K-1 instrument was computed at 0.7763, a level deemed to be acceptable for a pretest.

The second and third grade teachers of pilot-tested students also recommended allowing additional time for the administration of the instrument at those grade levels. They reported that the reading of each question by the teacher and the effort to keep each student on the same item took additional time and more concentration. With the relatively short attention spans of students in these grades, it was believed that more accurate responses would be obtained by breaking up the testing time into two or more segments. The Guttman Split-Halves reliability coefficient for the 2-3 instrument was computed at 0.9469.

The reliability coefficient for the 4-5 instrument was much lower at 0.4709 Teachers of those pilot-tested students noted that the students seemed to understand the questions and have little difficulty with the vocabulary. Four of the questions on the instrument were deleted with the intent of maintaining the Framework based content of the instrument and increasing the reliability. The 31 remaining questions yielded a Guttman Split-Halves reliability coefficient of 0.7892.

The 6-8 instrument yielded a computed Guttman Split-Halves reliability coefficient of 0.7879. Teachers commented that the pilot-tested students seemed to have a little difficulty comprehending the items in the instrument. However, the major complaint of the students, as reported by the teachers, was being asked to take a test over content which they had never received instruction. The instrument was minimally revised and some items were reworded based upon the input from the teachers.

Data Collection

The researcher began meeting with the teachers at each test site during the summer of 1997. Input was gleaned from the teachers regarding the most appropriate time during the initial part of the school year to administer the pretest. Due to the varied school starting dates, the agreement was reached that teachers would administer the pretest during the first week of October. During the training phases of Project implementation, the teachers were instructed not to incorporate instruction from the Food and Fiber Systems Framework until after the students had completed the pretest.

It should be noted that no demographic data were gathered on individual students. That decision was based upon several factors. One primary consideration was the gathering of parental consent forms that would have been required on each participating student if demographic information was to be used. Without the demographic information, and because each school test site had completed a subcontract agreement, the Institutional Review Board deemed the parental consent form unnecessary. Additionally, since no individual data were to be reported, the need for demographic information was determined to be unnecessary.

The pre-test was given at the two test sites during the first week of October 1997. Teachers at each site administered the pre-tests in their own classrooms. The teachers were instructed to monitor the students and provide basic assistance. The instruments were collected by building principals and returned to the researcher by mail.

The post-test was administered at the two sites during the week of May 5, 1998. Once again, the classroom teacher was responsible for administering the instrument in his/her classroom. The researcher arranged to be at each site soon after the completion of testing to retrieve the completed instruments.

Feedback regarding the connections made to the Framework was solicited from the teachers throughout the Project year. The Project staff created a form to gain the necessary information about the number of lessons taught, the standards and benchmarks addressed and the related activities teachers used in making connections to the Framework. Teachers were expected to teach a minimum of two food and fiber related lessons per month and to submit reports of those lessons to the Project staff. The form was incorporated into the Food and Fiber Systems Literacy web page to allow teachers to submit the form electronically. Teachers were also given the option of submitting forms by facsimile or by mail. A copy of the feedback form is exhibited as Appendix E.

Analysis of Data

Profile data on the two schools used in the research study were gained through the assistance of school administrators. The data consisted of the number of students and teachers participating at each grade level. Additionally, the researcher was provided demographic information for the school based upon copies of documents the schools submitted for state and federal funding. Information was also gleaned from the Chambers of Commerce in each community. The researcher made qualitative observations during site visits throughout the Project year.

After administration of the pretest, the tests were scored and coded into a Microsoft™ Excel spreadsheet for analysis. Means, and percentiles were computed by grade-level grouping for the pretest scores from both test sites. Test site teachers were instructed to posttest only those students who had been pretested. Test mortality accounted for 14 fewer students tested at the Montana site and 11 fewer students tested at the Oklahoma site. The posttest data were handled in the same manner following the administration and retrieval of those instruments. The same descriptive statistics were computed on the posttest scores, again by grade-level grouping.

Analysis of variance procedures were performed using SAS version 6.11 to determine differences in pretest and posttest knowledge scores. The analyses included the General Linear Models procedure and computation of Least Squares Means to delineate differences by theme area of the Food and Fiber Systems Literacy Framework. A Pearson's Product Moment Correlation was computed using SAS version 6.11 to assess relationships between pre- and posttest differences and the number of teacher reported instructional connections to the Framework.

The SAS data analysis was a split plot arrangement in a completely randomized design. The mark plot treatment was the state and the mark plot experimental unit was the class. The difference in pretest and posttest scores was the split plot treatment. The individual student scores were considered to be subsamples. Mark effects of pre- and posttest differences and the differences by state interactions were examined. Simple effects of the pre- and posttest differences by state were also calculated using the SLICE option in an LSMEANS statement in SAS.

CHAPTER IV

DATA ANALYSIS AND FINDINGS

The objective of this chapter was to present the research data succinctly in graphic and narrative format. Following analysis, the researcher organized the data to address the purpose and objectives of the research study.

Introduction

The purpose of this study was to assess food and fiber knowledge of selected students in kindergarten through eighth grade before and after receiving instruction based upon the Food and Fiber Systems Literacy Framework standards and benchmarks.

Case Study

Data were collected during the 1997-98 academic year. A total of 15 classrooms in the Oklahoma site elementary and junior high and 9 classrooms in the Montana site elementary and junior high were included in the study. The Montana case study included 177 students and the Oklahoma case study included 257 students. Upon initial analysis of the posttest data, one Oklahoma classroom was eliminated due to the appearance of contaminated data. The researcher visited the Oklahoma site eight times and the

Montana site seven times during the project test year to collect the qualitative and quantitative data used for this research.

Site Description

Profile of Montana Site

Community and school.

The Montana school was in a community with a population of 1635. The community was also the county seat. The county population was near 3500. The community was situated in the Missouri River valley between the Elkhorn Mountains to the west and the Big Belts to the east. The first town on the Missouri River, the community sat at an elevation of 3800 feet and was approximately 35 miles from the state capitol. The county had several industries, including timber and mining. Near a large reservoir, the community also supported several recreational enterprises. The main agricultural crops of the county included wheat and beef cattle.

The Montana school consisted of an elementary, junior high and high school. There were 550 students enrolled in grades K-8 for the 1997-1998 academic year. Of those, two were Native American, two were Black, three were Asian, and seven were Hispanic. Approximately 30 percent of the students were enrolled in special services such as Title I or Special Education. The school had 51 percent student free and reduced lunch eligibility. There was also a 19 percent transient rate for the 1997-1998 academic year.

The elementary school included kindergarten through sixth grade. The school utilized half-day kindergarten programs with two teachers. Each of the other grades had two classrooms per grade level as well. One teacher at each grade level participated in the Food and Fiber Systems Literacy Project. The junior high utilized a departmental approach with the students traveling to teachers in different classrooms for the various subjects. The two science teachers at the junior high were primarily responsible for delivering course content related to the Food and Fiber Systems Project. The eighth grade science teacher also served as the junior high principal. The elementary principal was site coordinator for the Food and Fiber Systems Literacy Project.

The initial process of site selection for the Project culminated with a visit to the school in November 1996. In preparation for that visit by the project director and the researcher, the elementary principal called together a group of individuals from the school and community. Included in the group were three teachers, a member of the local board of education, a farmer and an agribusiness person. That group attended the meeting to listen to the Project overview and objectives and to determine the school and community's interest in participating. That group became the nucleus of an advisory committee for the Montana site.

Teacher training.

During Phase I training at the Montana site during May 1997, the teachers, who were selected by the principal for Project participation, were personable and enthusiastic. They welcomed the researcher and other Project staff to the school and into their homes during the evenings. The researcher noticed that same enthusiasm on all visits to the site.

Other Project staff also commented on the personable nature of the principal and teachers during visits to the site.

Phase I training at the site was coordinated by the researcher and the principal at the elementary school. The principal organized a field trip to a local wheat production, processing and marketing operation that helped set the tone for the rest of the training at the site. That trip allowed the teachers to connect food and fiber systems to their local setting and to the state of Montana. Following the trip, the teachers made bread. During the exercise, teachers commented that the bread-making activity was a great way to help the students make the connection between the local wheat farmers and the bread in the grocery stores.

The researcher gained insight into the culture of the site during Phase I training as well. The school was in the process of fund-raising for new playground equipment. The principal related that the community had held several events to raise money, including a community-wide rummage sale and an auction of work by local artisans. At the time the Project staff was in the community for Phase I training, one of the local restaurants was donating all proceeds from coffee sales to the playground fund. According to the principal, in just over one year, the $40,000 necessary to purchase the equipment was raised. During the October visit to the Montana site, the researcher participated in the playground dedication ceremony.

Instructional connections observed.

The teachers at the Montana site made many informal connections to food and fiber systems in addition to the formal instruction for which reports were presented. The

Montana kindergarten and first grade teachers' rooms were decorated with seasonal decorations as well as examples of student work relating to food and fiber systems. On one visit, the researcher observed the pumpkins and apples from a fall harvest unit the teachers were completing. On another visit, the researcher observed the results of a kindergarten wool processing lesson, including shorn wool, washed wool, carded wool, spun wool, the spinning wheel, wool yarn, a hand loom, and woven wool. On yet another occasion, the kindergarten children, at the request of the teacher, explained the ingredients of a pizza snack, where those ingredients came from, and the processes the ingredients went through to become pizza. During one visit, the researcher observed first graders dramatizing Eric Carle's The Very Hungry Caterpillar. On the researcher's final visit in May 1998, the kindergarten students showed off the chicks they had hatched and explained how the incubator worked. They also were proud of the trees they had rooted for Mother's Day gifts. During that same visit, the first graders exhibited their bird feeder projects, also Mother's Day gifts.

The second through sixth grade teachers at the Montana site also had interesting food and fiber related bulletin boards and decorations around their rooms. During an early spring visit, the researcher noted second graders studying birds. Besides making bird nests, they also had displayed reports on the different kinds of birds in Montana and ways those birds helped or harmed humans, including agriculture producers and processors. On another visit, the third grade had activities displayed around the classroom from a unit they had completed on all the products that came from cattle. During that same visit, the fourth graders showed off the insect models they had created while completing an insect unit. The fifth grade teacher reported that the fifth graders had really enjoyed making ice cream in plastic bags and applying what they had learned to principles of science. When the researcher asked the sixth graders in May what their favorite memory of sixth grade was, the consensus agreement was getting to make bread in the classroom. Their teacher stated that the activity had been presented as a science laboratory lesson and the students had completed lab reports on what they observed.

The researcher observed fewer food and fiber activities in the seventh and eighth grades. During the researcher's winter visit, the eighth grade teacher related a lesson about testing foods for fat content, and determining caloric content of various foods that had been completed as a laboratory assignment. During the May 1998 visit, the researcher observed seventh graders drawing correlation between the diets of the family described in The Diary of Anne Frank to the current daily recommendations in the USDA Food Guide Pyramid.

Showcase/outreach.

The Montana site hosted a Food and Fiber Systems Literacy Showcase on May 15, 1998. The researcher attended the event where teachers displayed activities their students had completed throughout the year. Also attending were representatives from the Montana Department of Public Instruction. The Deans from Montana State University's College of Agriculture and College of Education were also present. Additionally, there were community members, parents and representatives from agricultural commodity groups. The showcase was the idea of the elementary principal and the teachers, and they organized and orchestrated the entire event.

Profile of Oklahoma Site

Community and school.

The Oklahoma community had a population of almost 1400. The community was located in a county in the north central part of the state. The county population was near 62,000. The city was one of seven incorporated communities in the county. At an elevation of 984 feet, the community was located approximately 25 miles from the state's land grant university. It was also within 65 miles of the state's two largest metropolitan areas. Near one of the oil and natural gas producing centers of Oklahoma, petroleum and agriculture have traditionally been the basis of the area's economy. Several light industries also added to the community's tax-base. Many of the residents of the community traveled to nearby towns or cities for employment.

The schools of the Oklahoma site consisted of two separate campuses. The elementary school contained kindergarten through sixth grade. The junior high and high school were combined on one campus. Elementary enrollment was 246, while enrollment in grades 7-12 was 248. The Native American student population at the school was 38, the Hispanic student population was 9 and the school had 1 Asian student. There were no Blacks during the 1997-98 school year. Just over 50 percent of the student population qualified for the free and reduced lunch program. The Title I program was school-wide and had no targeted assistance for particular students. The transient rate for the 1997-1998 school year was 13 percent and 22 percent of the students received services such as speech or special education.

The elementary school used a half-day kindergarten approach, with two sections taught by the same teacher. At first through sixth grades, there were two classes per grade. All of the regular education classroom teachers at the elementary school participated in the Food and Fiber Systems Literacy Project. In the departmentalized junior high, two teachers were primarily responsible for accountability to the Project, the math teacher and the science teacher. The elementary principal served as the site coordinator for the Food and Fiber Systems Literacy Project.

Teacher training.

Phase I training at the Oklahoma site was scheduled by the elementary principal on the two days in May 1997 immediately following the last day of school for students. Project staff observed that teachers did not seem enthusiastic about training. More than one teacher commented to the researcher that they were tired and would have preferred having a few days break before beginning training for the project. Eighteen teachers participated in Phase I training, including the Title I reading teacher, the computer teacher and the physical education teacher. Those teachers, especially, seemed to have trouble with the concept of infusing food and fiber systems instruction into their teaching. One teacher who was to have participated did not show up on either day of Phase I training and another was present on the first day only.

The superintendent at the Oklahoma site resigned during the 1997 summer and a new superintendent was hired shortly before school started in August. Amid budget reduction efforts, the new superintendent eliminated some programs and reassigned some teachers. Those changes took some teachers who had been prepared in Phase I training out of classrooms and put other teachers who had not been trained into classrooms. Thus, to accommodate those changes, the Phase II training was reorganized.

The elementary principal at the Oklahoma site held a meeting for teachers during the summer to brainstorm and discuss food and fiber resources and activities that could be accomplished during the 1997-1998 school year. The principal reported that several teachers met with individuals or organizations near the site to gain information about potential resources available to teachers. From those contacts, the teachers were able to secure the use of an aquarium for an aquaculture study that was utilized by many of the elementary teachers. Contacts were also made for field trips to a farm, a dairy, and a greenhouse.

Instructional connections observed.

The kindergarten teacher and one of the first grade teachers at the site decorated their rooms for the beginning of the school year around an agricultural theme. They reported teaching units on agriculture soon after the administration of the pretest. One of the second grade teachers also started an agriculture unit in October. During an October visit to the site by the researcher, a third grade teacher asked for help in finding a peanut plant with the peanuts intact. The plant was located and delivered to the school and several teachers used the plant for a discussion of peanuts, tying it to a lesson on George Washington Carver.

One of the projects undertaken by the school in conjunction with the Food and Fiber Systems Literacy Project was the creation of a raised-bed garden. The principal secured the donation of surplus railroad ties and the fifth and sixth grades took on the project. The students planned and measured the materials needed to create the beds and designed the layout of the plants. One fifth grade teacher reported that her students really enjoyed the application of math, science, language arts and visual arts in the process of planning the garden.

A complaint of teachers in the Oklahoma site was the lack of available computers for accessing the Food and Fiber Systems Literacy Project web page. The elementary school had only one computer with internet connection until near the end of April 1998. One fourth grade teacher and one second grade teacher, however, reported using the web page extensively to access instructional and resource materials for supporting food and fiber related instruction. The fourth grade teacher, in particular, was not a computer user prior to the beginning of the Project, but learned during Phase I training to use the computer to access the internet and to send electronic mail. That teacher used the computer to submit all 28 of the feedback forms she completed.

Three junior high teachers initially committed to the Project, but the language arts teacher never submitted any documentation during the year. During site visits, the teacher was always unavailable to meet with the researcher. In late winter, the site coordinator reported to the researcher that the language arts teacher had asked to be relieved of any commitment to the Project. During visits with the science and mathematics teachers at the junior high, the researcher observed that more agricultural connections were being made than were being reported. Both teachers were using agricultural examples in relating subject matter to students, but when questioned about those connections, the teachers seemed surprised to learn that connections could have been made. For example, the science teacher reported teaching a botany unit, but did not relate botany to agriculture. The mathematics lesson on mapping, which included section layouts for the county, was not seen as a food and fiber systems connection by the math teacher.

Many of the teachers in the Oklahoma case study seemed to struggle with the concept of infusing food and fiber concepts into existing instruction. Lower grade-level teachers seemed to have less difficulty, perhaps because they used a thematic approach to instruction, whereas the upper grade-level teachers in the case study used textbooks more. Several teachers related to the researcher that it was difficult to work in a food and fiber lesson that was relevant to other instruction. Some teachers reported they thought the only way to make the connection was by teaching one of the lessons provided by the Project. In discussing the possible connections, the researcher challenged the teachers to think of any lesson they taught that could not be connected in some way to food and fiber systems.

Pretest and Posttest Grade Grouping Analysis

The pretest and posttest food and fiber knowledge scores for students in Montana are represented in Table I. Numbers of respondents, the mean test scores and the number of groups or classrooms were provided for each grade grouping. The table also indicates levels of significance for differences between pretest and posttest knowledge scores, as determined by Analysis of Variance procedures run using SAS version 6.11. The mean score for the K-1 grade group rose almost 17 points, showing statistical significance. At grade grouping 2-3, the mean score rose almost 14 points. At the 4-5-grade group, the mean score rose four points. The mean knowledge score between the pretest and the posttest actually dropped 1.3 points in the 6-8 grade grouping. Neither the 2-3, 4-5, nor 6-8 groups had pre- and posttest score differences that were statistically significant.

TABLE I

MONTANA STUDENTS' FOOD AND FIBER KNOWLEDGE LEVELS AS MEASURED BY PRETEST AND POSTTEST SCORES

	Pretest		Posttest				
Grade	n	Mean	n	Mean	Groups	F-value	p
K-1	54	72.1	50	88.8	2	22.84	0.0411*
2-3	38	75.6	35	89.4	2	3.87	0.1203
4-5	49	67.2	47	71.2	2	0.62	0.4748
6-8	50	63.7	45	62.4	2	3.42	0.1616

Note. df for all calculations was 1.

*$p<0.05$

Similar pretest and posttest data for the Oklahoma site were presented in Table II. Numbers of respondents, the mean pre- and posttest scores and the number of groups or classrooms were provided for each grade grouping. Levels of significance for differences between pretest and posttest knowledge scores were determined by Analysis of Variance. The K-1 mean score rose almost nine points from the pretest to the posttest. In the 2-3 grouping the mean score rose just over nine points. At grade grouping 4-5, the mean score on the posttest rose over six points. The 6-8-grade group posttest score dropped almost three points. The 6-8 group was the only one within the Oklahoma site showing a statistically significant difference in pre- and posttest knowledge scores, and that difference was negative.

TABLE II

OKLAHOMA STUDENTS' FOOD AND FIBER KNOWLEDGE LEVELS AS MEASURED BY PRETEST AND POSTTEST SCORES

	Pretest		Posttest				
Grade	n	Mean	n	Mean	Groups	F-value	p
K-1	53	77.3	53	86.1	2	5.67	0.1401
2-3	73	79.3	72	88.4	4	3.72	0.1261
4-5	75	66.1	74	72.7	4	1.58	0.2769
6-8	67	57.9	58	55.0	3	10.23	0.0494*

Note. df for all calculations was 1.

*$p < 0.05$

Thematic Area Analysis

The Food and Fiber Systems Literacy Framework was organized around five thematic areas: Food and Fiber Systems—Understanding Agriculture; Science—Agricultural and Environmental Interdependence; Business and Economics; and Food, Nutrition and Health. A Composite General Linear Models Procedure was generated to analyze pretest and posttest score differences by grade groupings within the theme areas.

Table III provides the F-value comparison of those differences for the Montana site. The Science and Environment theme showed the most statistically significant differences, with each grade grouping returning those differences. Within the History, Culture and Geography area, statistical significance appeared within the K-1 and the 6-8 grade groupings. Two themes, Understanding Agriculture and Business and Economics, showed statistically significant differences only within the K-1 grade group. The 6-8

TABLE III

F-VALUE COMPARISON OF MONTANA PRETEST AND POSTTEST DIFFERENCES BY GRADE GROUPS WITHIN THEME AREAS

Theme and group	*F*-value	*p*
Understanding Agriculture		
K-1	46.58	0.0208*
2-3	0.66	0.4624
4-5	2.20	0.2119
6-8	0.02	0.9045
History, Culture and Geography		
K-1	392.20	0.0025*
2-3	4.73	0.0954
4-5	4.22	0.1091
6-8	253.00	0.0005*
Science and Environment		
K-1	83.97	0.0117*
2-3	79.43	0.0009*
4-5	12.49	0.0241*
6-8	11.71	0.0418*
Business and Economics		
K-1	37.70	0.0255*
2-3	3.03	0.1566
4-5	6.50	0.0634
6-8	0.23	0.6660
Food, Nutrition & Health		
K-1	1.43	0.3546
2-3	2.98	0.1593
4-5	3.93	0.1186
6-8	25.71	0.0148*

Note. *df* for all calculations was 1.
$^{*}p < 0.05$

group within the Food, Nutrition and Health theme returned the only statistically significant difference for that theme at the Montana site.

It must also be noted that for the Montana site, the K-1 grade group yielded significance at the 0.05 level within four theme areas, while the 6-8 group yielded 0.05 level significance within three theme areas. The 2-3 group and the 4-5 group returned statistical significance only within the Science and Environment theme.

Table IV outlines similar data for the Oklahoma site. Again, a Composite General Linear Models Procedure was generated to analyze pretest and posttest score differences by grade groupings within the theme areas. The table provides the F-value comparison of those differences for Oklahoma.

No grade grouping returned statistically significant differences for the Understanding Agriculture theme. The Business and Economics theme showed 0.05 level significance only at the 4-5-grade grouping. The other three themes each yielded statistical significance within two grade groups, although not the same groups for all themes. The History, Culture and Geography theme showed significant differences at the 0.05 level for grade groups 2-3 and 6-8. The Science and Environment theme showed statistically significant differences for grade groups 2-3 and 4-5. The Food, Nutrition and Health theme yielded 0.05 levels of significance within the 4-5 and 6-8 grade groups. The 4-5-grade group returned statistically significant differences in three theme areas. Grade groups 2-3 and 6-8 both yielded significance at the 0.05 level within two theme areas. Interestingly, the Oklahoma K-1 grade group did not return any significant differences for any theme.

TABLE IV

F-VALUE COMPARISON OF OKLAHOMA PRETEST AND POSTTEST DIFFERENCES BY GRADE GROUPS WITHIN THEME AREAS

Theme and group	F-value	p
Understanding Agriculture		
K-1	4.63	0.1643
2-3	0.29	0.6204
4-5	3.52	0.1339
6-8	0.46	0.5467
History, Culture and Geography		
K-1	0.54	0.5384
2-3	8.07	0.0469*
4-5	4.23	0.1088
6-8	382.1	0.0003*
Science and Environment		
K-1	1.99	0.2938
2-3	18.80	0.0123*
4-5	32.66	0.0046*
6-8	8.84	0.0589
Business and Economics		
K-1	8.48	0.1005
2-3	4.95	0.0901
4-5	23.78	0.0082*
6-8	0.002	0.9602
Food, Nutrition & Health		
K-1	4.87	0.1580
2-3	1.31	0.3157
4-5	7.94	0.0480*
6-8	33.56	0.0102*

Note. df for all calculations was 1.
*$p < 0.05$

The Montana data and Oklahoma data were pooled to create a composite for further analysis of theme related differences between the pretest and the posttest. Table V provides the F-value comparisons for those composite differences. The Composite General Linear Models Procedure was again generated through SAS for the analysis.

With the pooled data, the Understanding Agriculture yielded no statistically significant differences across any of the grade groupings. However, the History, Culture and Geography theme, as well as the Science and Environment theme, produced statistical significance at all grade groups. Within the Business and Economics theme, both the 2-3 and the 4-5 grade groups yielded significant differences at the 0.05 level. Two statistically significant differences were also returned within the Food, Nutrition and Health theme. Those occurred in grade group 4-5 and grade group 6-8.

Looking for significance within grade groupings across the theme areas, the 4-5-grade group yielded significance at the 0.05 level in four of the five themes: History, Culture and Geography; Science and Environment; Business and Economics; and Food, Nutrition and Health. Similarly, the 2-3 showed statistically significant differences in three theme areas, including History, Culture and Geography, Science and Environment; and Business and Economics. There were also three statistically significant themes for the 6-8 group: History, Culture and Geography; Science and Environment; and Food, Nutrition and Health. The K-1 group showed 0.05 level of significance in the themes History, Culture and Geography and Science and Environment.

TABLE V

F-VALUE COMPARISON OF COMPOSITE PRETEST AND POSTTEST DIFFERENCES BY GRADE GROUPS WITHIN THEME AREAS

Theme and group	F-value	p
Understanding Agriculture		
K-1	10.40	0.0841
2-3	0.93	0.3885
4-5	5.41	0.0816
6-8	0.33	0.6038
History, Culture and Geography		
K-1	206.13	0.0048*
2-3	12.29	0.0247*
4-5	8.11	0.0475*
6-8	604.04	0.0001*
Science and Environment		
K-1	54.91	0.0177*
2-3	90.77	0.0006*
4-5	41.92	0.0036*
6-8	20.28	0.0194*
Business and Economics		
K-1	4.85	0.1584
2-3	7.70	0.0500*
4-5	28.81	0.0097*
6-8	0.09	0.7881
Food, Nutrition & Health		
K-1	5.83	0.1370
2-3	4.24	0.1085
4-5	11.26	0.0309*
6-8	56.87	0.0035*

Note. df for all calculations was 1.
*$p < 0.05$

Correlation Analysis

As a measure of the instructional connections to the Framework, the teachers involved with the Food and Fiber Systems Literacy Project submitted feedback forms for food and fiber related lessons. One of the project expectations was that teachers would make those connections through at least two lessons per month from October through May of the 1997-1998 school year. Table VI summarizes connections reported by classroom. It should be reiterated that only one classroom per grade level in Montana participated in the study, while two classrooms at grades two through six participated in Oklahoma. The Kindergarten teachers at both sites had two half-day sections of students

TABLE VI

TEACHER REPORTED INSTRUCTIONAL CONNECTIONS TO THE FOOD AND FIBER SYSTEMS LITERACY FRAMEWORK

	Reported Connections		
Classroom	MT	OK-A	OK-B
Kindergarten	28	20	
First Grade	22	15	
Second Grade	24	19	18
Third Grade	15	5	16
Fourth Grade	14	27	16
Fifth Grade	18	9	9
Sixth Grade	17	15	15
Seventh-Eighth Grades	18	10	

and both sections at each site received the treatment. Additionally, due to the departmentalization of students in grades seven and eight at both sites, that data were pooled for analysis. In general, the lower grade-level teachers reported more connections than the upper grade-level teachers did. The range of reported connections was between 5 and 28.

Pearson's Product Moment Correlation Coefficients were computed using SAS to assess whether a relationship existed between the difference in pretest and posttest knowledge scores and the number of instructional connections that teachers made to food and fiber systems. Those instructional connections were based upon feedback provided by the teachers within the site as a part of the Food and Fiber Systems Literacy Project. Table VII indicates the result of the analysis. Both the Montana site and the Oklahoma site showed a strong correlation, 0.621 and 0.586, respectively between the test score differences and the number of instructional connections made by teachers. However, a significant statistical difference occurred only for the Oklahoma site. With the data from

TABLE VII

CORRELATION OF DIFFERENCES IN PRETEST AND POSTTEST SCORES TO INSTRUCTIONAL CONNECTIONS BY SITE

Site	n	Pearson r	p
Montana	8	0.621	0.1003
Oklahoma	13	0.586	0.0353*
Composite	21	0.603	0.0038*

*$p < 0.05$

both sites pooled to create a composite, the correlation coefficient was 0.603 and the computed difference was statistically significant as well.

The information from Table VII was presented graphically in figures 1, 2 and 3. The figures represent the correlation between teacher-reported connections to the Food and Fiber Systems Literacy Framework and the percentage differences in student pre- and posttest scores. The score differences were converted to percentages to allow comparisons across grade groupings. Figure 1 graphs the correlation for the Montana site. The graph shows that the classroom with the highest number of teacher reported connections (28) also had the largest percent score difference (20%).

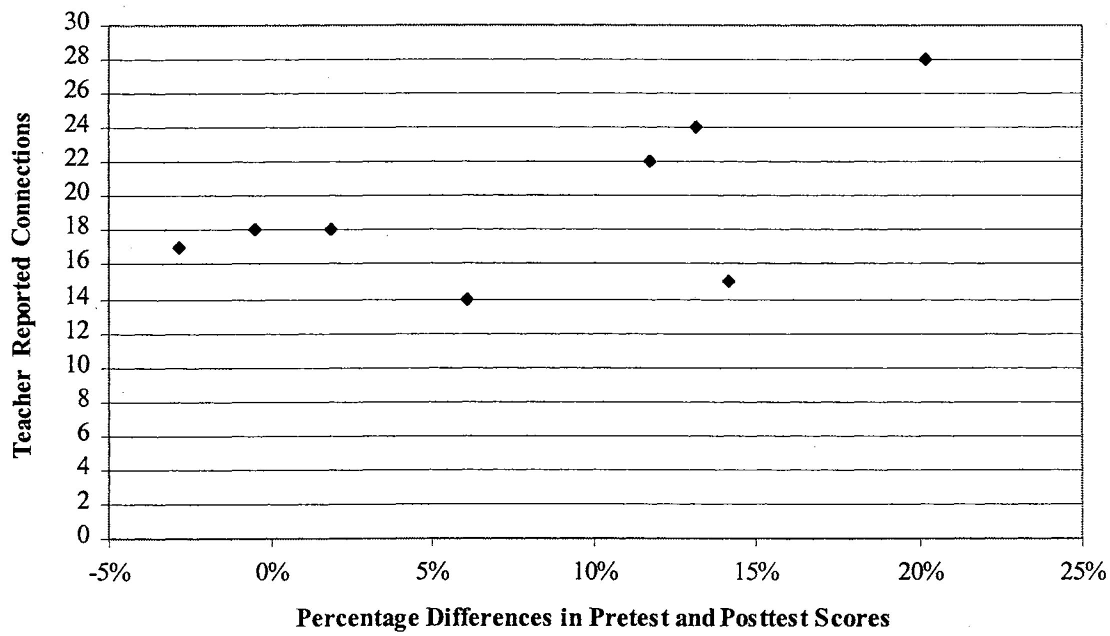

Figure 1. Correlation of differences in Montana student pretest and posttest scores to Montana teacher connections to the Food and Fiber Systems Literacy Framework

Figure 2 represents the correlation of teacher reported connections to percentage differences in pre- and posttest scores for the Oklahoma site. The graph shows that five classrooms yielded a negative percentage difference and that four classrooms yielded an increase of 10 percent or more. A 17 percent increase in scores occurred with students in the classroom where 27 connections were reported.

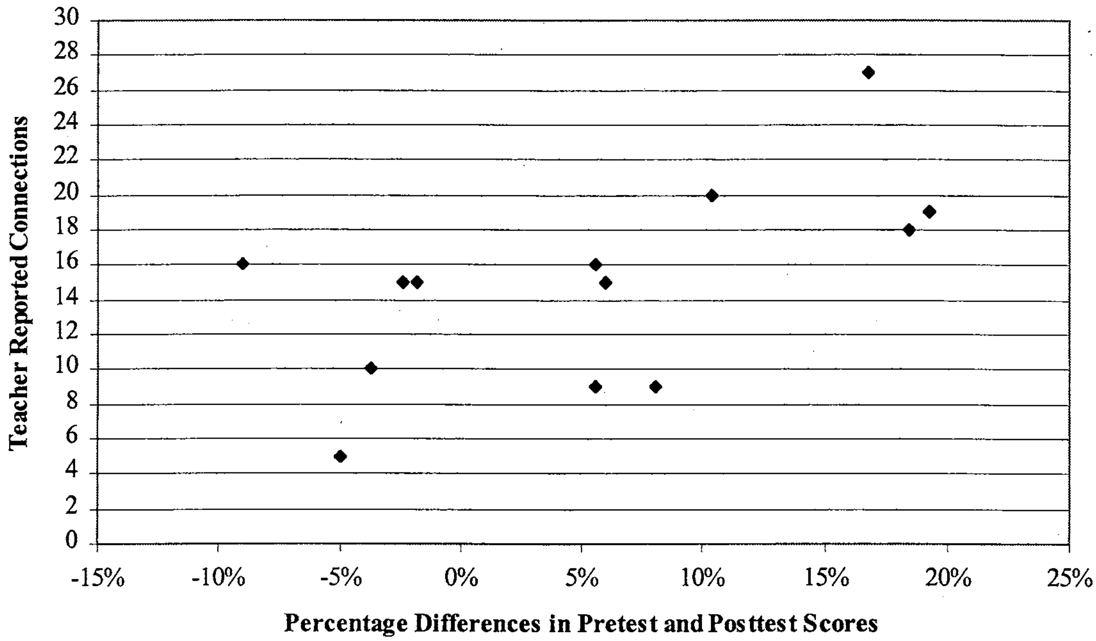

Figure 2. Correlation of differences in Oklahoma student pretest and posttest scores to Oklahoma teacher connections to the Food and Fiber Systems Literacy Framework

Figure 3 similarly illustrates the composite data for both sites. With the data pooled, the graph indicated that seven classrooms yielded decreases in percentage score differences from pre- to posttest while 14 classrooms showed increases in knowledge scores . Thirteen classes knowledge difference scores increased by 5 percent or more. Knowledge score increases of 10 percent or better were seen when the number of reported connections rose to 20 or above.

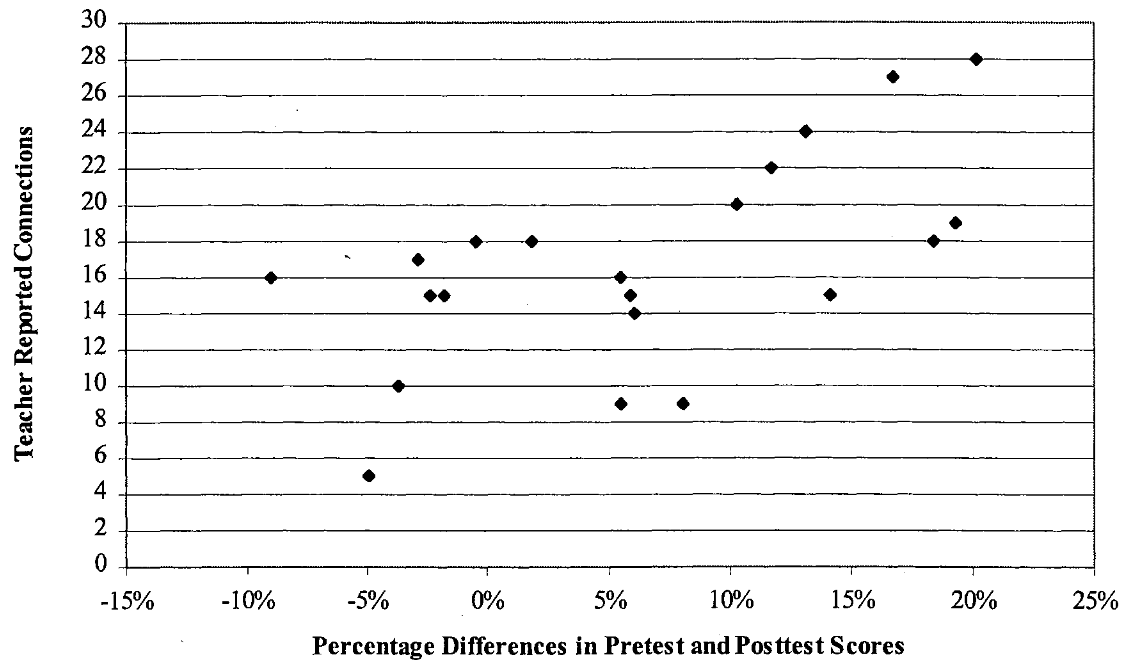

Figure 3. Correlation of differences in composite student pretest and posttest scores to composite teacher connections to the Food and Fiber Systems Literacy Framework

Summary of Findings

1. The profiles of the Montana and Oklahoma sites revealed that the schools shared many similarities (students qualifying for free/reduced lunches, transient rates, number of students enrolled) although the communities were quite different.
2. The Montana students posttest scores were higher than pretest scores for grades K-5 although only the K-1 grade group were significantly higher statistically.
3. The Oklahoma students posttest scores were higher than pretest scores for grades K-5, although no grade grouping differences showed statistical significance.
4. The posttest scores for students in grades 6-8 in both case studies were lower than the pretest scores.

5. The Science and Environment theme showed the most statistical significance across grade groupings at the Montana site.
6. The Understanding Agriculture, Business and Economics and Food, Nutrition and Health themes showed statistical significance at only one grade grouping for the Montana site.
7. The Montana K-1 grade group showed statistically significant change in four theme areas: Understanding Agriculture; History, Culture and Geography; Science and Environment; and Business and Economics.
8. The Understanding Agriculture theme was not significant at the 0.05 level for any grade group at the Oklahoma site.
9. Three themes, History, Culture and Geography; Science and Environment; and Food, Nutrition and Health each showed statistical significance at two grade groupings in Oklahoma.
10. The test score difference for the Oklahoma 6-8-grade group showed a negative significance at the 0.05 level in pre- and posttest knowledge difference scores for the History, Culture and Geography theme and the Food, Nutrition and Health theme.
11. The composite History, Culture and Geography theme and the Science and Environment theme both showed 0.05 level significance in pretest and posttest knowledge scores across all grade groups.
12. No statistically significant changes between composite pre- and posttest knowledge scores were indicated at any grade group for the theme Understanding Agriculture.
13. The composite 4-5-grade group showed pretest and posttest knowledge score significance at the 0.05 level in four of the five theme areas.

14. Teacher reported connections to the Food and Fiber Systems Literacy Framework ranged from 5 to 28.
15. There was a statistically significant correlation between pre- and posttest scores and the number of teacher reported instructional connections in Oklahoma.
16. There was a statistically significant correlation between pre- and posttest scores and the number of composite teacher reported instructional connections.

Researcher Reflections

The levels of statistical significance shown through the analysis of the study seemed to indicate that the use of curriculum framework to guide instruction was a viable means of delivering agricultural literacy instruction. To gauge the generalizable applicability of any such framework model, a longer period for assessment would be necessary. Although the knowledge assessment instruments used in the study were tested for reliability and validity, use by a larger sample of students from diverse settings would add to the overall validity of the instruments. Instrumentation was also difficult because of the inclusion of non-readers in the testing sample. The revision of the instruments should include the incorporation of highest quality line art to help ensure the likelihood that duplicated instruments would continue to have clear and understandable images.

Due to the distance between sites, it was impractical for the researcher to personally oversee the administration of the pre- and posttests at each site. It would have been helpful for the researcher to be at each site to answer teacher and student questions during the pre- and posttesting process. Having the researcher on site during test administration would also have guarded against potential contamination of data.

CHAPTER V

CONCLUSIONS, RECOMMENDATIONS AND IMPLICATIONS

Summary

Purpose

The purpose of the study was to assess food and fiber knowledge of selected students in kindergarten through eighth grade before and after receiving instruction based upon the Food and Fiber Systems Literacy Framework standards and benchmarks.

Objectives

To accomplish the purpose of the study, the investigation was directed toward achieving specific research objectives:

1. Develop a profile of the test site schools included in this study.
2. Assess students' knowledge of food and fiber systems prior to and after receiving instruction based upon the Food and Fiber Systems Literacy Framework.
3. Determine differences by grade grouping (K-1, 2-3, 4-5, 6-8) in student knowledge about agriculture before and after instruction based upon the Food and Fiber Systems Literacy Framework.

4. Determine grade-grouping differences in student knowledge about agriculture before and after instruction based upon the five thematic areas of the Food and Fiber Systems Literacy Framework.
5. Determine if a relationship existed between the differences in student knowledge about agriculture before and after instruction based upon the Food and Fiber Systems Literacy Framework and the number of teacher reported instructional connections to the Framework.

Study Design and Conduct

Case studies were conducted of the two school sites used in the research. The use of pretests/posttests allowed a measurable assessment of agricultural literacy knowledge levels over the course of the academic year. The administration of those instruments by the classroom teachers instead of the researcher was an attempt to reduce the anxiety level of students. It was believed that the students' familiarity with their teacher would yield more reliable results than could have been gleaned by an outsider going into a classroom and administering evaluation instruments.

Instruments that had been previously used in other research studies were reviewed for applicability to this effort. However, the study was based upon the Framework, therefore it was essential that the instruments be based upon that same Framework, Instruments were developed for each of the four grade groupings: K-1, 2-3, 4-5, and 6-8.

The case study in Montana included 177 students in kindergarten to eighth grade. That included one intact classroom at each grade, kindergarten through sixth. The junior high in the Montana case study used a departmental approach, therefore students were reached primarily through the two science teachers, although other junior high teachers were involved in the presentation and application of food and fiber related instruction.

The Oklahoma case study included 257 students in thirteen classrooms. That population included one classroom in kindergarten and first grade and two intact classrooms from second through sixth grade. The departmentalized junior high setting utilized the science and mathematics teachers for the Food and Fiber Systems Literacy project. It was through those teachers that primary instruction occurred. Those two teachers were also responsible for administering the evaluation instruments to the junior high students.

Teachers provided feedback regarding connections made to the Framework. The forms were submitted by electronic mail, by facsimile and by mail. Teachers were expected to teach a minimum of two lessons per month relating to food and fiber systems.

The pretest was administered to students in early October 1997 and the posttest was administered in May 1998. The researcher visited the Montana site seven times and the Oklahoma site eight times between May 1997 and May 1998. The quantitative data were coded and entered into a Microsoft Excel spreadsheet then analyzed using the Statistical Analysis System (SAS). In addition to simple descriptive statistics, analysis of variance and Pearson's Product Moment Correlation were used to analyze and describe the data.

Major Findings

Objective 1.

A profile of the Montana test site and the Oklahoma test site revealed several similarities between the two schools. Both utilized half day kindergarten programs and intact classrooms from kindergarten through sixth grade. The junior highs at both sites were departmentalized. Both schools reported a free and reduced lunch percentage of just over 50 percent.

There were also several unique qualities associated with each site. The Montana case study had a smaller range of student ethnicity than the Oklahoma case study. As the county seat, the Montana site had a somewhat larger population than the Oklahoma site. The Montana site was the only incorporated community in the county. Oklahoma's case study, on the other hand, was one of the smaller communities in the county. In addition, the Oklahoma county had almost 18 times as many people as the Montana county. Many of the residents of the Oklahoma site were employed outside of the community, while the Montana case study residents were employed within the community or nearby surrounding area.

Objective 2.

Prior to receiving instruction based upon food and fiber systems, students in Montana had some knowledge of agriculture, with pretest grade-grouped mean scores ranging from 64 percent to 76 percent for the four grade groupings. Grade-grouped mean scores were generally higher after receiving instruction. The posttest mean scores in Montana ranged from 62 percent to 89 percent.

Oklahoma students also had some knowledge of food and fiber systems, based upon the pretest scores. Means for the pretest ranged from 58 percent to 79 percent for the four grade groupings. Posttest means were higher in all but the 6-8 grade group. The Oklahoma posttest means ranged from 55 to 88 percent.

Objective 3.

The Montana students posttest scores were higher than pretest scores for grades K-5, although only the K-1 grade group was significantly higher statistically. The Oklahoma students posttest scores were higher than pretest scores for grades K-5, although no grade grouping differences were statistically significant. The posttest scores for 6-8 students in both Montana and Oklahoma were lower than pretest scores.

Objective 4.

The Science and Environment theme showed the most statistical significance across grade groupings at the Montana site. The Understanding Agriculture, Business and Economics and Food, Nutrition and Health themes showed significance at the 0.05 level for only one grade grouping for the Montana case study. The Montana K-1 grade group showed statistically significant change in four theme areas: Understanding Agriculture; History, Culture and Geography; Science and Environment; and Business and Economics.

The Understanding Agriculture theme was not statistically significant at any grade group for the Oklahoma site. Three themes, History, Culture and Geography; Science and Environment; and Food, Nutrition and Health each showed significance at the 0.05 level for two grade groupings in Oklahoma. The Oklahoma 6-8 grade group showed a negative statistically significant difference in knowledge of the History, Culture and Geography theme and the Food, Nutrition and Health theme.

The composite difference scores for the History, Culture and Geography theme and the Science and Environment theme were both statistically significant across all grade groups. No significance at the 0.05 level was found in pre- and posttest knowledge differences at any grade group for the theme Understanding Agriculture. The composite difference score for the 4-5 grade group was statistically significant in four of the five theme areas.

Objective 5.

Teacher reported connections to the Food and Fiber Systems Literacy Framework ranged from 5 to 28. There was a statistically significant correlation between pre- and posttest score differences and the number of teacher reported instructional connections in Oklahoma. There was also a statistically significant correlation between pre- and posttest scores differences and the number of composite teacher reported instructional connections.

Conclusions

The conclusions were not to be generalized beyond the case studies within this research. Examination and analysis of the major findings for each objective led to the following conclusions:

1. Students at both sites had some knowledge of food and fiber systems prior to the study.
2. In both case studies, it was possible to increase student knowledge about agriculture by infusing instruction based upon the Food and Fiber Systems Literacy Framework standards and benchmarks.
3. In both case studies, greatest increases in student food and fiber knowledge occurred within the History, Culture and Geography and the Science and Environment themes.
4. In both case studies, a positive relationship existed between the number of connections teachers made to the Food and Fiber Systems Literacy Framework and increases in student knowledge.

Recommendations

Based upon the conclusions and major findings of the research, the following recommendations were made:

1. This study included the testing of standards and benchmarks for grades K-8. In order to adequately address agricultural literacy, there is a need to develop Food and Fiber Systems Literacy benchmarks for grades 9-12 and to link instruction to those benchmarks.

2. As a means of assessing changes in student knowledge about food and fiber systems, existing agricultural literacy instructional materials should be linked to the Food and Fiber Systems Literacy standards and benchmarks. Additionally, those standards and benchmarks should be used as a guide for new instructional material development.
3. There is a need for inservice training of teachers at all grade levels to assist them in making relevant connections between core academic instruction and food and fiber systems.
4. Further investigation is needed to better understand how food and fiber systems standards and benchmarks can be effectively infused into departmentalized instruction often found in middle schools and junior and senior high schools.
5. Further research is needed to understand why no significant increase in pre- and posttest knowledge score differences for the Understanding Agriculture theme occurred in this study.
6. Subsequent studies should incorporate an experimental or quasi-experimental design with larger student populations to better understand the relationship between teaching and learning and the Food and Fiber Systems Literacy Framework.

Implications

The conclusions from this study showed that the Food and Fiber Systems Literacy Framework can be used effectively to guide instruction about agriculture. The opportunity exists for further dialogue about agricultural literacy and the use of standards and benchmarks to assess agricultural literacy levels. Discussions among agricultural literacy professionals, agriculture educators, curriculum specialists, state education leaders, and local educators must focus on agricultural literacy as the common goal. To accomplish that goal, consensus agreement must be reached on the definition and scope of agricultural literacy. The use of the Food and Fiber Systems Literacy Framework with its standards and benchmarks provides an opportunity to engage the stakeholders in a dialogue toward attaining that goal.

The whole-school setting for implementing food and fiber systems literacy instruction works to create a synergy among teachers, administrators, students and parents. That synergy may lead to greater overall student accomplishment as well as increased sustainability of the agricultural literacy program.

Agricultural stakeholders helping educators to increase their own agricultural knowledge through both formal and informal means may lead to increased connections to food and fiber systems by those educators. In turn, those increased connections to existing instruction may lead to greater infusion of agricultural concepts in core academic instruction.

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APPENDIXES

APPENDIX A

FOOD AND FIBER SYSTEMS LITERACY FRAMEWORK WITH STANDARDS AND BENCHMARKS

The
Food and Fiber Systems Literacy Framework

with Standards and Benchmarks for Grades K-8 Literacy

The University of California, Davis
and
The Milton Hershey School

Table of Contents

Preface

Beginning in kindergarten and continuing through twelfth grade, all students should receive some systematic instruction about agriculture.

From Understanding Agriculture: New Directions for Education
National Research Council, 1988

Understanding the relationship between environmental degradation and world hunger is of the utmost importance. Combined, they form concurrent explosions of human population and technology. Unfortunately, we are ill prepared, in many respects, as a society and as educators, to properly address our youth about such matters. Nevertheless, the need to do so is clearly not optional.

Ours is an age of decreasing resources inversely mirrored by an increasing number of consumers and their needs. Any culture that hopes to survive, much less prosper, must be literate regarding the environment and our food and fiber systems. Collective efforts are necessary to produce the knowledge required to meet the demands of the 21st century. Citizens of the next and succeeding generations must be far better prepared than traditional educational models allow currently. Current models seem to simply reinforce stasis and investment in a progressively myopic world view.

Solutions to this educational dilemma are elusive and multifaceted. It is essential to be better able to create a desperately needed shift in perspective and to assist in producing the concomitant development of good thinking. An interdisciplinary model for education, available to children across the spectrum of their developmental years, would be a significant step forward. Transitions from one developmental level to the next could then occur in a seamless fashion.

The relational dynamics inherent in such a program provide positive peer influences, self image and esteem building, interactive group learning opportunities and the chance to more authentically self-assess than traditional settings allow. Students of such a program would have the potential to effect genuine change in the thought processes of their time. They would find themselves sufficiently equipped to be cultural determiners instead of being culturally determined.

Within such a holistic model, food and fiber and renewable resources studies become highly viable because of their nearly universal application to other disciplines. Most sciences and mathematics are drawn neatly under their umbrella. Environmental philosophy, literature, and history are all exploding fields. Most practical and industrial arts and the fine arts are environmental by nature. The importance of these fields to numerous ethical, social, and political issues of the day combine with their nearly universal scope to present the educator with an authentically interdisciplinary framework with exceptional flexibility. This flexibility includes a curriculum that is easily developed sequentially and with specific age appropriateness. It is well suited to applied and experiential conceptual development methodologies.

The result of combining these studies is a natural academic partnership. They are not nearly compatible but synergistic when properly mated and hold astonishing potential in a variety of interdisciplinary educational models. The union of food and fiber literacy, as part of an interdisciplinary course of study, operated in partnership with private sector business, higher education, governmental agencies, and the local educational community, is an idea whose time has come. It is ideally suited to serve a generation of students who seem unfortunately destined to inherit an environmentally compromised planet as their home. Indeed, it lies within our capacity and vision to establish unique opportunities to develop a holistic educational model for young people and to help create, as Barry Lopez has so eloquently written, "some place between the extremes of nature and civilization where it is possible to live without regret."

James Leising, Project Director

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The Food and Fiber System: Understanding Agriculture

Agriculture is our oldest, largest, and most essential industry. It is the foundation of the food and fiber system. This system comprises all the activities necessary to produce, harvest, process, and transport food and fiber products. The food and fiber system provides for people's basic needs for food, clothing, shelter, and more. Most of the things we use every day are products of agriculture, including cardboard, carrots, chickens, chop sticks, cosmetics, cut flowers, dental floss, dyes, inks, latex gloves, lumber, matches, medicines, paper, ribbon, rope, soap, tires, and toothpicks.

The food and fiber system is complex and far-reaching. About 20 percent of America's labor force works in some part of the system. Globally, more people work in agriculture for their livelihood than in any other occupation. A growing world population will increase the demand for agricultural products, as well as for qualified people to work in the agriculture industry.

Understand the Meaning of Food and Fiber Systems/Agriculture

Agriculture gives us the food and fiber we need for food, clothing, and shelter. The word agriculture comes from Latin, agerr, meaning field and cultura, meaning cultivation.

Agriculture has been traditionally defined as the science and art of farming in which people make use of technology to aid them in the production and harvest of plants, trees, animals, and fish.

Agriculture also involves the management of range lands, forests, and other natural resources. In addition, people use agricultural products and knowledge to improve and beautify their homes and communities.

Agricultural production uses many kinds of inputs including human resources and natural resources. Soil, water, air, and energy are the primary resources used throughout the food and fiber system. Agricultural production exists nearly everywhere in the world, but varies according to regional factors such as climate, soil and water quality, labor supply, and land-use priorities.

Agriculture is the foundation of a nation's standard of living. In order to continue meeting the food and fiber needs of society, the food and fiber system must be sustainable and must also renew and replenish all the resources used in production.

Understand the Essential Components of Food and Fiber Systems

The essential components of the food and fiber system include production, processing, support services, marketing, distribution, research, regulation, and natural resource management.

Agribusinesses include the many enterprises associated with agriculture. These include brokers, processors, distributors, suppliers, and service providers such as consultants and financiers. The term agribusiness includes all the industries that supply agriculture with goods and services or process and distribute agricultural products.

Another essential component of the food and fiber system is natural resource management as natural resources provide the materials agricultural production and agribusiness depend on. Many government agencies help regulate the food and fiber system to ensure product safety, protect workers, and promote conservation of resources. To meet the needs of a growing world population with the diminishing natural resource base, and generally to increase the efficiency of the system, governments, private companies, and universities conduct research and development related to agriculture.

Understand Societies Relationship to Food and Fiber Systems

Agricultural systems have constantly adjusted to conform to the changing needs of society. Throughout history, trees, plants, animals, fish, birds, insects, and micro-organisms have provided people with food, medicine, clothing, and shelter. As humans evolved, we learned to work with plants and animals and to cultivate the land. Early agricultural practices facilitated the emergence of more complex societies. People began to live in permanent settlements. Eventually, abundant agricultural production allowed many people to pursue activities other than foraging or working the land for their livelihood.

Today, while the majority of people in the world still work directly with the land, in developed countries like the United States, less than two percent of the population works on farms. Instead, many people work in agricultural industries that support today's technologically intensive agriculture.

Improvements in society's ability to provide food, clothing, and shelter have been paralleled by improvements in the health and well-being of many people in the world. As a result, the world's human population has grown in proportion to our agricultural production. In the pursuit of rapid growth and short-term economic success, however, we have learned that some agricultural practices have caused the loss of valuable nutrient rich top-soil, clean ground water reserves, and species diversity.

The ability to provide for future generations concerns many people today, and many agriculturists have made improvements towards a more sustainable agriculture system. Over time, human ingenuity has solved numerous problems involved in the production, storage, and preparation of food. Throughout history agricultural practices have changed in response to society's needs and new knowledge. Improvements in practices will continue to occur as long as our society is aware of the critical nature of the food and fiber system.

Understand the Local, National, and International Importance of Food and Fiber Systems

Agriculture is an integral part of nearly every regional economy, providing employment and the raw materials for every person's basic needs. All over the world, agricultural producers share air, water, and soil resources with other industries, households, and wildlife.

Agriculture is the primary economic activity in many parts of the world, including America. Rural areas in particular can be heavily dependent on agriculture. Changes in weather, availability of supplies, market prices, and international political relationships may dramatically affect the viability of local farms and agribusinesses. Globalization of markets may stabilize the impact of such events for consumers. Those who work in the food and fiber system in this country must therefore understand the global market forces that will determine demand for their products.

In America, the success of modern agriculture has allowed the U.S. economy as a whole to diversify and develop many other industries. Agricultural products are still the largest single U.S. export, and agriculture continues to be our largest industry.

Approximately 20 million jobs exist in the food and fiber system in the United States. Of these jobs, about half are in wholesale and retail trade of agricultural products, and many are in metropolitan areas. Thirty percent of all agricultural jobs are in processing, marketing, and providing supplies to agribusiness, while the remaining 20 percent are in production.

Understand Possible Careers in Food and Fiber Systems

Today's food and fiber industry is also America's largest industry. More than 20 percent of America's workforce is employed in some phase of the agricultural industry. Seven people work in agribusiness for every farmer. In fact, there are over 8,000 job titles in agriculture.

Continued growth in the world population means a greater demand for food and fiber. It also means a growing demand for qualified people in the agricultural industry. Almost 10 percent of today's professional jobs in agriculture go unfilled because there are more jobs available than there are people who understand agriculture. Agriculture is changing rapidly, and many of tomorrow's careers have not yet been imagined. It is an exciting, challenging, and dynamic field in which to work.

Educational requirements for work in agriculture have also increased with differing amounts of education after high school required for most positions. The demand for graduates in agricultural business and management, engineering, food science, sales, marketing, education and communications has expanded dramatically in recent years.

Historical, cultural, and geographical significance

Agriculture has played a key role in every human civilization and has been the work of most of humanity throughout the ages. Agricultural themes can be found to enhance the study of any period of history, from the study of aboriginal cultures and ancient civilizations to the westward movement and contemporary social issues. The entire globe is open to scrutiny through agriculture. Cultural, physical, and political geography can be taught through the study of agriculture worldwide. Many important historical figures, inventions, and events are related to agriculture.

Understand the Role Food and Fiber Systems Played in the Evolution of Civilizations

Humans have always altered and affected the places in which they have lived. Originally, people lived as hunter/gatherers in tribes and bands. The hunter/gatherers lived simply off the land, collecting and catching what was available locally and seasonally. Hunter/gatherer cultures tended to be limited in population and technological development. As groups followed the migrations of animals, over many thousands of years they traveled across whole continents entering new territories and natural environments. The availability of food and shelter in the places they lived regulated the size of individual groups.

Many hunter/gatherer cultures developed pre-agricultural practices in which they manipulated the environment to control or increase their kills and harvests. The burning of grasslands by native Americans stimulated the germination of desired plants that attracted greater concentrations of bison and other grazing animals to hunt. Indirectly, this was the beginning of their agriculture.

While domestication of plants and animals may have been "discovered" in many places at once, the application of these discoveries resulted in distinct practices depending on the local natural environment. The first civilizations to grow rapidly with the arrival of cultivation were located in flood plains. The quality of soils found in these places, as well as available water, made such rapid growth possible. The earliest irrigation systems we know of were built about 7,000 years ago in the area called Mesopotamia, which is today the country of Iraq.

Agrarian societies like the one in Mesopotamia expanded rapidly. Technology enabled individuals to produce more food than they themselves needed, so many people could dedicate their time to other pursuits such as the arts, sciences, and other areas of culture. The study of the movement of stars, planets, the moon, and the sun helped people time their planting and harvesting. This type of information was the first to be recorded on stones and skins. Agricultural trade stimulated the development of measurement, accounting, and written communication.

Understand the Role Food and Fiber Systems Have Played in Societies Throughout World History

As early agricultural societies grew, they became more and more complex. When populations expanded, emergent city-states began to look beyond their immediate environments for resources that had become depleted locally. Throughout history, the expansion of civilization and agriculture has involved conflicts over crop and grazing lands as well as access to ports and trading routes. The permanence of civilizations has also been critically dependent upon access to and stewardship of soil and water resources.

Agricultural production throughout the Mediterranean region became dominated by the in-kind taxation exacted by the conquering Romans. Non-perishable products such as wheat, olive oil, wine, and timber were produced on a large scale and shipped long distances to support the great city of Rome. Eventually, soil erosion, deforestation, overgrazing, and conflicts between farmers and herdsmen dramatically reduced the productivity of agriculture within the Roman Empire. Hunger and social unrest in the cities and countryside resulted in the destruction of the Roman power structure and political system, in the period we now refer to as the European Dark Ages.

In many parts of the world, feudal societies emerged in which land owners or "lords" relied on slaves, serfs, or peasants to work the land. The workers relied on the lords for protection from raiding bands and robbers. Wars were fought over crop and grazing lands, as well as access to ports and trading routes. A common tactic of aggressors was and still is to destroy food supplies and crops of their victims and to prevent food from reaching conquered populations.

With the development of feudalism, merchants emerged as a class of people who made their living traveling between regions trading goods from other places. Among wealthy Europeans, demand for agricultural products from distant lands increased. Silk cloth, carried overland from Asia, was finer and more luxurious than the rough wool and linen people had been using for clothing. Other products, especially spices, helped preserve and diversify the diet of Europeans in the Middle Ages. The desire to find and grow certain crops, including sugar and spices, eventually led to the exploration and conquest of the Americas.

Understand the Role Food and Fiber Systems Have Played in the History of the United States

Before the arrival of Europeans in the Americas, agriculture was already highly developed in Central and South America, although less so in North America. Great empires such as the Incas thrived in the West Andes mountains with architecture and irrigation systems that rivaled those of ancient Rome and Egypt. The Maya, Olmec, Toltec, and Aztec people living around the Valley of Mexico are considered to be the first to cultivate maize, or corn as we know it today.

The most agriculturally advanced native people in North America included the Iroquois, who established permanent territorial associations around agricultural settlements and the Shoshone, who practiced agriculture in a very arid climate, mostly relying on maize as their staple crop.

When the very first Europeans arrived on the east coast, they tried to establish the agricultural practices they had used back home. In many cases these practices failed, and we have stories of mass starvation that occurred in the early years of colonization. In contrast, in the west, Spanish missionaries found a Mediterranean climate very similar to that of Spain, thus many of their agricultural crops including olive trees, grapevines, figs, and cattle transferred readily to the new land. On many occasions, Native Americans came to the aid of the newly arrived Europeans, teaching them about wild and cultivated plants on which they lived.

The colonies along the east coast experienced economic prosperity derived from newly plowed agricultural land worked by slaves from Africa. Large plantations grew cash crops such as cotton and tobacco for export to Britain and other places. The Revolutionary War was brought about over many issues, including high taxes on agricultural commodities produced by the colonies.

Understand the Relationship Between Food and Fiber Systems and World Cultures

Historically, climate and geography have determined the plants and animals that grew best in a region. As a result, distinct eating habits emerged for people living in different places on Earth. As cultures and societies developed, religions and other beliefs further guided people's food choices. Food, religion, language, dress, music, and dance are cultural characteristics that have evolved in relation to specific locations.

When people migrate, they tend to bring with them the cultural traditions of their country of origin. American agriculture now produces many products which were first introduced by immigrants. As this country becomes more ethnically diverse, there will be more opportunities for businesses that cater to changing consumer tastes.

As Americans have developed tastes for foods from all over the world, so have international consumers developed a great demand for crops and livestock developed and used in U.S. agricultural products. Plant varieties and animal breeds developed in the U.S. have changed eating habits in many other places of the world; however, the introduction of new varieties of plants and breeds of animals may be complicated by problems with pests and disease. Certain processing methods, such as polishing rice, allow for longer shelf life and shorter preparation time, but leave foods less nutritious than in their unprocessed form.

Understand How Different Viewpoints Impact Food and Fiber Systems

Many important social issues are related to agriculture. To this day in the United States, immigration and migration patterns have been strongly affected by the labor requirements of agriculture. Throughout the history of the United States, agriculture has provided employment opportunities to immigrants from all over the world. Since the beginning of World War II, the farm population of the United States has been declining principally due to improved agricultural technology. Migration from farms to the cities has resulted in the mixing of many different cultures in modern America.

In addition to agricultural labor issues, society is concerned about land use policies, protection of the environment, pesticide use, food safety, and animal welfare to name a few. Other issues include the use of radiation to treat food and the development of genetically engineered foodstuffs.

Science: Food and Fiber-Environmental Interdependence

The environment and agriculture are closely linked. Humans have transformed the environment through agricultural pursuits since before recorded history. Scientific and technological knowledge have made agriculture more productive. Countless innovations have helped solve problems related to all aspects of the food and fiber system. Agricultural abundance has made possible an increase in population worldwide, but this increase has put more demands on the planet's natural resource systems. Scientific observation and investigation have begun to confirm that ecosystems are delicately balanced and globally interrelated, and we can no longer think of agricultural and natural resource production as isolated areas of endeavor. The vitality of the food and fiber system now and in the future depends on public understanding of this interdependence. The need to preserve the quality of the resources used by the food and fiber system -- the land, air, and water all people require to live -- will make the work of those in the agricultural and environmental sciences all the more important in the years to come.

Understand How Ecosystems are Related to Food and Fiber Systems

Agriculture affects natural ecosystems in both positive and negative ways. Many inputs required for agricultural production, such as fertilizers and pesticides, come from outside the natural ecosystem. Once introduced, these chemicals may change the natural balance of the system. For example, a chemical used to control a pest may adversely affect a bird population that normally feeds on the pest or other pest organisms in the system.

Modern agriculture is also very energy intensive, requiring non-renewable fossil fuels in all parts of the food and fiber system. As with any industry, air, water, and soil pollution are produced as a result of the activities of the system. Agriculture further contributes to the depletion of resources and destruction of natural habitats through the draining of wetlands, soil erosion, and expansion into wild areas.

Agriculture also enhances the environment. Landscape design and ornamental plants beautify our homes and communities. Conservation and restoration efforts by agriculturists have re-created habitats for previously threatened species. Agricultural production systems, when designed to work with nature, can even reverse the effects of pollution and poor land management.

For example, all plants improve air quality by capturing carbon dioxide and producing oxygen in the atmosphere. Perennial plants, grasses in particular, with their extensive fibrous root systems, can help reduce soil erosion. Poplar trees can clean sewage water while growing wood for paper pulp production.

Understand Food and Fiber Systems Dependence Upon Natural Resources

Soil, water, sunlight, and air are the primary natural resources necessary for agricultural production; however, agriculture relies on living things and biological processes to transform these basic materials into food and fiber for human use. The myriad life forms upon which agricultural production depends include micro-organisms, plants, and animals. They range from the tiniest algae, bacteria, yeast, and fungi to edible plants, fiber plants, and trees, as well as insects, birds, fish, and even the largest of animals.

In addition to the sun's energy, agriculture is also dependent on non-renewable fossil fuel resources. This energy is spent in the production, packaging, and application of chemical fertilizers and pesticides, in the manufacturing and operation of farm machinery, and in the distribution of agricultural products.

Understand Management and Conservation Practices Used in Food and Fiber Systems

Agriculturalists have long been aware of the need to conserve soil and water resources. Many traditional farming techniques do this by working with nature, rather than against it. Farming along the contour of hills or in terraces is an example of traditional conservation techniques which minimize the loss of soil to erosion. Cover crops are grown not for harvest, but for their soil-building value when they are mowed and turned back into the ground. Cover crops also provide an alternative to leaving the ground bare through a season. The foliage keeps the top soil from baking in the sun, and the roots hold soil in place when it rains. Other traditional conservation practices include crop rotation and the use of hedgerows. Farmers rotate the kinds of plants and animals they raise in one place in order to resist the development of disease-causing organisms. Hedgerows protect fields from the wind and provide habitats for beneficial species that help protect crops and livestock from pests and disease.

Modern agriculture is looking once again to traditional practices and combining them with state-of-the-art technologies to address environmental problems. As the most dangerous pesticides are being phased out of use, regulations regarding the use of those remaining are growing more stringent. New practices such as Integrated Pest

Management (IPM) reduce dependence on pesticides by using natural predators to keep pest numbers in check. Genetic engineering also has the potential to lower pesticide use through increasing plant resistance to disease. Sophisticated drip irrigation and soil moisture monitoring devices tell a grower exactly when, where, and how much water to apply to avoid waste.

Understand the Role of Science and Technology in Food and Fiber Systems

Humans have always used technology in agricultural production. The first technological advances were simple tools such as sticks for planting seeds or digging roots. More sophisticated developments, such as the diversion of irrigation water from rivers and the selection of preferred seed and breeding stock, were critical to the first agricultural societies. Knowledge of plants and animals and the technology of how to produce, process, and preserve them has been handed down to us through generations. Today, agriculture relies on research in nearly every scientific field.

Excellent examples of the application of science to real-world problems may be found in each component of the food and fiber system. One of the most important technologies that has changed agriculture has been the introduction of the internal combustion engine. Machines have effectively replaced humans in most aspects of agricultural production, from plowing to seeding, weeding, and harvesting. While fewer people are needed to do the heavy labor agriculture used to require, a lot of people are still required to support the sophisticated technologies on which agriculture relies. For example, in the area of breeding and selection, scientists are continually working to develop plant varieties which are more nutritious and resistant to pests and diseases. Genetic engineering has revolutionized this area of agriculture.

Many other aspects of agriculture have benefited from scientific research. Milk production, storage, and processing are dependent on what we know about microbiology. Investigation in the area of plant pathology has revealed the role of insects in disease transmission. Chemistry has advanced our understanding of soil fertility and the control of insects and other pests. Physiologists and toxicologists study the breakdown and cycle of agricultural chemicals, and how they accumulate in the tissues of higher organisms.

Though many of our present agricultural and environmental problems are the result of the inappropriate use of technology, most, if not all, of these will need to be mitigated through the application of new, more appropriate technologies. Agricultural engineers will need to find solutions to problems in soil and water conservation, tropical deforestation, and energy conservation. Biologists and microbiologists will work using naturally occurring or genetically engineered microbes to detoxify underground aquifers. Biostatisticians study health conditions and make risk assessments, particularly studying the relationship between chemicals and cancer. Ecologists, like biologists, study living things, but more importantly, they study systemss of living things, or ecosystems.

Business and Economics

Agriculture is the world's largest and most essential industry. Everyone everywhere consumes the products of agriculture for the food they eat, the clothes they wear, and the homes in which they live. An agribusiness is any sector of industry supplying farm inputs or engaged in the production, processing, and distribution of agricultural products. Agribusiness include farming enterprises in which the ethics, principles, and profit-oriented goals of modern industrial business management and accounting are applied to agricultural production. Agribusiness also furnishes the producers of food and fiber with capital, machines, equipment, chemicals, and supplies, as well as managerial and technical services. Revenues generated from the food and fiber system accounted for 16.6% of the U.S. gross national product in 1988. Agricultural exports are a major component of U.S. foreign trade, and the import and export of agricultural commodities are a major concern of foreign policy makers.

Understand that Food and Fiber Systems and Economics are Related

The word conomy comes from the Greek oikos, meaning house or village, and nomos, meaning to manage or distribute. Economics involves managing the income, wealth, and resources of a household, community, or government. Agriculture is related to economics because the development of cultures and their economies has been based, throughout history, on innovations and transformations in agricultural practices and technology. The economy of any community depends on meeting the basic needs of the population through either production or trade.

Agriculture is the field which employs most of the world's people. Though proportionately fewer people still farm today, each step in the production, processing, and marketing of agricultural products generates jobs and economic activity. The major economic activities generated by the food and fiber system include:

- Production -- raising plants, trees, and animals on farms, forests, and ranches.
- Processing -- the refining of raw products into finished goods.
- Supplies and Services - providing the many things producers and processors may require such as chemicals, drugs, energy, equipment, expertise, machinery, or seeds.
- Transportation and Distribution -- moving raw products to processors and finished products to market.
- Management, Marketing, and Trade -- advertising, buying, and selling the products of the food and fiber system.
- Research--development of new crop and livestock varieties, new food and fiber products, and new methods of producing, processing, and storing products. Also finding uses for unutilized and unplanned products which would otherwise become pollution.
- Finance and Insurance -- providing capital to pay for and insure land, machinery, and personnel.

Understand Food and Fiber Systems Have an Impact on Economics at theLocal, National, and International Levels

The food and fiber system involves a production continuum that extends from local farms to factories, markets, and tables in every region of the globe. While in some places farmers sell directly to consumers, the majority of all agricultural products is processed, packaged, and shipped long distances before they reach the consumer.

Each step from production to consumption adds value to agricultural products. For example, what the farmer sells for one dollar is processed and re-sold for more than one dollar. The difference in price from the farmer's sale to the consumer's purchase can be as much as 300%. About 65 cents of every dollar we spend on food pays for things other than the actual production on a farm.

Many business opportunities exist in adding value to agricultural products. Agricultural products are the raw materials of many industries. For example, the sap from tropical rubber trees is used to make car tires and tennis shoes; the fibers which surround the seeds of the cotton plant are made into clothing and paper; and trees become houses, paper, and packaging. Revenues generated by agribusiness contribute substantially to the tax base in the U.S. Food exports are also the number one income source for America abroad, and for many other countries.

Understand the Role of Government Relating to Food and Fiber Systems

Governments work to insure that the market system operates without impediment to decrease the incidence of surpluses and scarcity, and to provide stability to the market. Government regulations exist to insure an abundant and affordable food supply and to protect farmers, consumers, the environment, and the economy. Some of the governmental functions that regulate agriculture in this country include grading, inspections, and safety standards.

Agricultural practices can incur unanticipated downstream costs such as ground water clean-up, dredging of waterways, and health care. When these problems are not addressed by agribusiness, governments may end up paying the bill. Governments also provide much of the funding for research aimed at improving agricultural practices. They also regulate trade through import duties and tariffs. Governments create policies to manage the distribution of water.

Government policies with respect to agriculture are, in part, the result of political action by groups or individuals. People facing a common problem or crisis band together to influence elected officials to help them solve their problems, or take issues directly to the voters as ballot initiatives. There are many groups, often with competing interests, that advocate legislation favoring particular industries, commodities, and use patterns for land, water, and other natural resources. The political process provides a means for settling differences about resource management and agricultural activities that impact the environment.

Understand Major Factors that Influence International Trade of Food and Fiber Systems

In many parts of the world, land ownership and the education level of farmers affects what is grown. International supply and demand influence the types and quantities of products which are produced and traded around the world. Government policies determine the limitations placed upon international trade. World currency exchange conditions influence international trade choices. In order to successfully export and import products, adequate transportation and distribution systems are required. Protectionism affects the balance of trade and the quantity of imports allowed into a country. Wars, political unrest, and related issues influence a nation's ability to produce a surplus for international trade.

Markets which were limited or closed to trade in the past are now opening. The United States is gradually establishing more open trade policies with nations that have traditionally limited or heavily taxed imports. The North American Free Trade Agreement and other trade agreements work to minimize and eliminate taxes on the trade of agricultural products. World food demands are increasing annually and are providing an increasing international market for affordable agricultural commodities. The attempt to feed an increasing world population will affect the choices of commodities produced, perhaps leading to the need to choose between luxury goods for some or staple goods for all.

Food, Nutrition, and Health

You are what you eat, and what you eat are the products of agriculture. Products from the land are transformed through processing, pre-preparation, and packaging. The wide variety of foods now available to consumers makes knowledge of nutrition for good health more important than ever. Packaging, advertising, and changing lifestyles all contribute to the American tendency to eat more fat and fewer fresh fruits and vegetables than we need.

Food safety is a growing concern among consumers. In the case of pesticides, people need to know that there are trade-offs between pesticide use and the production of unblemished fruits and vegetables. Agriculturists have worked to address food safety concerns through new management methods and technology. New technologies such as food irradiation and biologically engineered food products must be explained to consumers and their safety concerns addressed thoroughly and honestly if the technology is to be accepted.

This theme provides some of the best opportunities for engaging students with practical agricultural applications. Making bread, cheese or butter; raising fruits and vegetables; and preserving and preparing various foods are always great learning experiences. These experiences can reinforce learning in science, mathematics, history, and cultural diversity, making these subjects ripe for infusion throughout the curricula.

Understand Food and Fiber Systems Provide Nourishment for People and Animals

Nutrition is related to agriculture because most of what we eat comes from agriculture and the food industry. In America, today's agriculture provides an abundant and affordable supply of the foods we need to survive, grow, and be healthy. Most consumers in this country can choose from a variety of foods year round. Improved transportation and distribution bring us many different foods from across the country and across the globe, though they may not be in season where we buy them.

Recommendations about what constitutes a healthy diet change periodically. A variety of foods is generally thought to be good for providing a balanced diet; however, consumer choices are greatly influenced by whatever is most available to them where they shop. Many of the most convenient foods are not the most healthy or economical.

Education about new findings in nutrition research affect consumer demand for specific foods. To a certain extent, demand influences producer decisions about what types of foods to grow and how to process and market them. The food industry tests and develops new varieties of foods and food-processing methods, and sponsors research to examine the health benefits of specific foods. The food industry also works with health professionals and government agencies to ensure that nutritional benefits of products are accurately represented.

Understand that Food and Fiber Systems Provide the Components for a Healthy Diet

Healthful eating means eating a variety of nutritious foods. Food contains nutrients that our bodies need for growth and good health. These nutrients include: carbohydrates, proteins, minerals, vitamins, fatty acids, and water.

The USDA makes very general recommendations about what the average American should eat. Currently, it suggests we eat foods in relative quantities according to the Food Guide Pyramid. The Pyramid is made up of five major food groups, each containing foods with similar nutrients.

The major food groups, their primary nutrients, and the number of recommended daily servings of such items as meat, beans, and nuts; milk and milk products; fruits; vegetables; breads and grains are important to a healthy diet. Fats and sweets are not considered part of the major food groups because they should be eaten in moderation only. While some fats provide essential fatty acids, sweets are not truly necessary in our diets at all. Foods that are primarily made up of sugar or fat are considered empty calories because they are high in calories yet provide little or no nutrition. Compared to fresh foods, processed foods have more fat, sugar, and salt as well as preservatives to extend shelf life.

An ideal diet, according to the Food Guide Pyramid, should provide all the essential nutrients we need for energy, growth, and development without too many calories or fat. It is important to eat a variety of foods from all the major food groups. Breads, cereals, vegetables, and fruits form the largest part of the total diet, followed by milk and milk products and meat or meat alternates. Fats, sweets, and oils should form the smallest portion of the diet.

Understand that Food and Fiber Systems Provide for Food Choices

Many factors influence how we make our food choices. In the first place, at a very basic level, we eat to ensure our survival; food provides us with calories and nutrients so that our bodies will function and grow. Another important factor in our food decisions is economic; that is, unless we grow it ourselves, we can only eat food we can afford to buy.

Individual preferences and tastes are very important in food selection. Many of these are based on habits, largely determined by our cultural backgrounds. Lately, more and more Americans are purchasing food that is convenient to prepare because they chose to spend their time on activities other than cooking.

In addition to these fundamental factors, our food choices are also influenced by information which shapes our opinions about food. Scientific research has revealed much about the nutritive properties of foods, as well as human requirements for nutrients such as calories, protein, vitamins, and minerals. Health professionals remind us that eating well and exercising not only promotes health and wellness, but reduces risk of disease.

Understand that Food and Fiber Systems Promote a Safe Food Supply

The food supply in America is considered the safest in the world. Still, food safety issues do exist here and elsewhere. According to food safety experts, improper storage, handling, and preparation of food, both at home and at food establishments, pose the number one food safety problem today.

Food safety concerns include micro-biological contamination and drug and pesticide residues in commercially produced food. As public health problems related to these substances continue to emerge, consumers may change some of their purchasing habits or demand better regulation of food production practices. Together, food producers, consumer groups, and government agencies work to develop food safety and nutrition guidelines and regulations. The USDA recently reformed food labeling laws so that nutrition information on packaged foods is more complete and uniform to help consumers make healthier food choices.

I. The Food and Fiber System: Understanding Agriculture

	Benchmarks			
Standards	***K-1***	***2-3***	***4-5***	***6-8***
A. What is agriculture?	**Students will discover that food and fiber originate from plants and animals. They will match and/or illustrate a product and its origin.**	**Students will understand that agriculture provides people's basic needs for food, clothing, and shelter. They will identify agricultural products produced in their region and the basic needs they fulfill.**	**Students will understand that the food and fiber system uses natural resources to provide for people's basic needs. They will be able to describe the importance of soil, air, water and energy to agricultural production.**	**Students will understand that agriculture is a complex system of production, processing, marketing and distribution. They will define agriculture in terms of the components of the food and fiber system.**
B. What are the essential components of the food and fiber system?	**Students will learn about a variety of farms. They will describe different kinds of farms and their products.**	**Students will understand the sequence of steps that a food or fiber product takes from production, processing, marketing and distribution to the consumer. They will describe the journey of an agricultural product from production to the consumer.**	**Students will understand the role of natural resource management in the food and fiber system. They will identify resources (rivers, forests, oceans, range land, farm land...)that contribute to agricultural production, locally, nationally, and globally.** **Students will understand the importance of various components of the food and fiber system. They will explain the role of producers and agribusiness in providing services and products for the food and fiber system.**	**Students will understand the function of the various components of the food and fiber system including natural resource management, production, processing, marketing, distribution, research and development, and regulation. They will discuss the function of each.**

I. The Food and Fiber System: Understanding Agriculture cont'd...

	Benchmarks			
Standards	**K-1**	**2-3**	**4-5**	**6-8**
C. What is society's relationship to the food and fiber system?	Students will appreciate that they use the products of agriculture every day. They will give examples of agricultural products that they use.	Students will recognize that many people work in the food and fiber system. They will identify some of the people in their community whose job it is to provide food, clothing and shelter.	Students will understand the relationship of a societies standard of living to population size and the ability to obtain (through production or trade) agricultural products. They will compare the U.S. standard of living to other countries in the world.	Students will understand that agriculture provides ingredients for industries that produce products that meet human needs other than food, clothing and shelter. They will be able to explain how the medical, cosmetic, cleaning and other industries use the products of agriculture.
D. What is the importance of agriculture locally, nationally, and internationally?	Students will appreciate their local agricultural industries. They will identify local agricultural businesses and products.	Students will appreciate that within their region resources such as water and land are shared between households, businesses, and agriculture. They will provide examples of multiple uses for land and water resources.	Students will understand that many plant and animal products were introduced in this country by traders, explorers, and colonists. They will locate the origins of various agricultural products available in their region today.	Students will understand that agriculture is our oldest, largest, and most essential industry. They will be able to discuss the importance of agriculture to the U.S. and internationally.
E. What are possible careers in agriculture?	Students will learn about a variety of agricultural jobs. Students will generate a list of agricultural jobs.	Refer to I C. (above). Students will learn about a variety of agricultural careers. Students will generate a list of agricultural jobs.	Students will understand the changing nature of the food and fiber system due to technological advances, and the subsequent changes in occupational opportunities for people. They will identify various careers in agriculture today and how they have changed over time.	Students will understand that agriculture has changed over time and that new agricultural inventions and discoveries produce new career opportunities. They will be able to compare and contrast the knowledge, skills and attitudes required for entry level, technical and professional level careers.

II. Historical, Cultural, and Geographic Significance

	Benchmarks			
Standards	***K-1***	***2-3***	***4-5***	***6-8***
A. What role have food and fiber systems played in the evolution of civilization?	**Students will learn that agriculture provides our food, clothing and shelter. They will classify agricultural products as food, clothing and shelter.**	**Students will understand that agriculture has long been the basis of civilization. They will examine their own family backgrounds to determine family experiences with agriculture. They will be able to illustrate land use in their community to show current and historical agricultural uses.**	**Students will understand that early inhabitants of their region relied mostly on hunting and gathering, with varying reliance on agricultural techniques and plant and animal domestication. They will be able to describe the change from hunter/gatherer to agricultural societies.**	**Students will understand the role of agriculture in the development of ancient civilizations. They will be able to discuss the development of agriculture in different parts of the world. They will explain how surplus production led to the development of trade and commerce.**
B. What role have food and fiber systems played in society throughout world history?	**Refer to II, D.** **Students will become aware that festivals such as Thanksgiving are focused on food and agriculture production. They will identify festivals in other cultures that celebrate agriculture.**	**Refer to II, D.** **Students will understand that agriculture evolved in different areas of the world. They will give examples of early civilizations who practiced agriculture.**	**Students will learn that European exploration was, in part, motivated by the desire to obtain exotic foods and spices, in addition to gold. They will be able to trace the origin of products involved in early European exploration.**	**Students will understand the importance of agricultural commodities in the growth of international commerce during the "age of exploration." They will relate how expanded trade led to the development of capitalism and modern economics.**

Standards	*Benchmarks* K-1	2-3	4-5	6-8
C. What role have food and fiber systems played in the history of the United States of America?	**Students will become aware that the founding fathers of America were agriculturalists. They will identify Presidents Washington and Lincoln as farmers.**	**Students will understand that both native and settler populations interacted with the natural environment. They will describe the food, clothing, and shelter of Native Americans and early settlers.**	**Students will understand that, historically, people seeking to meet their basic needs have moved from region to region as resources have become scarce. Students will describe examples of immigration and migration in U.S. history.**	**Students will understand the role agriculture has played in the development of our nation. They will be able to relate agriculture to the causes of the Revolutionary War, Civil War, and the "westward movement."**
D. What is the relationship between cultural practices and agricultural production?	**Students will discover that people all over the world eat different foods. Students will distinguish between foods from a variety of cultures and geographical locations.**	**Students will recognize similarities and differences in food and dress among various cultures. They will compare food and dress in their community and their family's culture of origin.**	**Students will develop awareness for diversity in food, dress, dwellings and customs around the world, and in their own communities. They will identify how their individual tastes in these areas are shaped by a diverse society.**	**Students will understand that climate and geography affect what kinds of food are grown in certain regions and that this has affected what foods are eaten by certain cultures. The students will be able to analyze a particular culture's diet, clothing and dwellings and relate it to climatic and geographical locations from which they originated.**

II. Historical, Cultural, and Geographic Significance cont'd...

	Benchmarks			
Standards	***K-1***	***2-3***	***4-5***	***6-8***
E. How are social issues related to food and fiber systems?	**Students will differentiate between cities and rural areas. They will compare and contrast cities versus rural and country areas.**	**Students will become aware of different characteristics of urban, suburban, and rural areas. They will describe how agriculture meets the needs of the people living in these areas.**	**Students will explore historical and contemporary issues in agriculture including ownership of natural resources, land use, and labor. They will identify contrasting viewpoints regarding the development of agriculture in the U.S.**	**Students will be aware of current social issues related to agriculture and natural resource utilization. They will discuss issues including animal welfare, agricultural labor, pesticide use, ground water contamination, land use, food irradiation, and genetically engineered food.**

III. Science: Agricultural - Environmental Interdependence

Standards	Benchmarks			
	K-1	2-3	4-5	6-8
A. What is an ecosystem?	Students will become aware of the natural life cycle of plants and animals. Students will describe the stages of the life cycle.	Students will learn what an ecosystem is. They will identify the interactions and interdependence between themselves, as a living organism, and their immediate environment. Students will learn the concept of habitat; soil, fresh water, desert, and forest systems. They will describe how a healthy habitat meets the needs of the population.	Students will understand the various natural cycles occurring within and between ecosystems. They will be able to explain energy transfer, food chains, and food webs. Students will be exposed to the concept of cycles; the water cycle, and the rock cycle. They will explain the changes that occur between the phases of these cycles.	Students will understand that nutrients required for plant and animal growth are cycled through the environment. They will be able to analyze the cycling of matter (carbon, oxygen, nitrogen) in ecosystems and discuss conservation and management techniques.
B. How are ecosystems related to food and fiber systems?	Students will learn the parts of plants and their functions. They will produce a representation of a plant and its parts. Students will understand that all living things need food to grow. They will describe how food or lack of food affects living things.	Students will understand the parts of a plant and the basic requirements for plant growth; light, air, water, fertile soil. They will explain what happens when requirements for growth are limited. Students will understand the requirements for animal growth: food, water and air. They will explain the proper care and handling of animals.	Students will know that the types of crops that can be grown in a region depend on the climate and soil. They will discuss how local weather and soil conditions affect crops grown in their area. Students will understand that scientific and technical innovations modify natural environments. They will describe how technological innovations such as irrigation, fertilizer, and greenhouses compensate for naturally limiting factors in crop production.	Students will understand that a multitude of living organisms are found in agricultural ecosystems including micro-organisms and a variety of plants and animals. They will create a model of an agricultural ecosystem to illustrate the interdependence of specific plants, animals, bacteria, fungi and other organisms.

III. *Science: Agricultural - Environmental Interdependence cont'd...*

Standards	*K-1*	*2-3*	*4-5*	*6-8*
	Benchmarks			
C. What natural resources are involved in food and fiber systems?	**Students will become aware of the primary natural resources used in agricultural production. They will identify soil, water, air and light as necessary for animal and plant life.**	**Students will be exposed to some positive and negative effects of agriculture on plant and animal habitats. They will describe a basic farm system and identify inputs and outputs.**	**Students will be exposed to specific natural resource systems upon which agricultural production relies. They will be able to relate natural resource management to sustainable levels of production.**	**Students will understand that in addition to soil, water, sunlight and air, energy is required for food and fiber systems. They will be able to identify areas where energy is used in agriculture including: pumping water, running farm machinery, processing, packing, transport, manufacturing and applying fertilizers and pesticides.**
D. What management and conservation practices are being used to address environmental concerns?	**Students will recognize people's interaction and impact on the environment. They will appreciate and demonstrate their own role and responsibility to the environment.**	**Students will become aware of conservation practices used in agriculture. Students will describe ways to avoid soil erosion, water and air pollution.** **Students will be introduced to the concept of using natural methods to control pests. They will describe the difference between non-beneficial and beneficial insects.**	**Students will understand that farmers apply conservation practices to protect their agro-ecosystems. They will identify conservation practices used to conserve soil, improve soil fertility and conserve water.**	**Students will learn that the use of pesticides to reduce damage to crops and livestock may harm other plants and animals, and that pests tend to develop resistance to pesticides. Students will identify alternative pest control practices used in agriculture production and food storage.**

III. Science: Agricultural - Environmental Interdependence cont'd...

	Benchmarks			
Standards	***K-1***	***2-3***	***4-5***	***6-8***
E. What is the role of science and technology in the food and fiber system?	**Students will understand that tools and machines are used in the food and fiber system. They will identify and/or give examples of tools and machines used to grow food and make food products.**	**Students will learn about inventors and inventions related to agricultural development. They will tell or write about an important invention or inventor in agriculture.** **Students will understand the need to protect crops and food products from loss to pests and spoilage. They will cite examples of technologies used to control these losses such as the use of pesticides and preservation techniques.**	**Students will learn that technological advancements lead to more efficient and specialized agricultural production and increased distribution. They will identify specific technologies that have reduced the need for human labor in agricultural production.** **Students will understand that various processing methods make it possible for food to be stored for long periods of time. They will give examples of food processing methods including salting, smoking, drying, heating, and cooling.**	**Students will understand the role of research and development activities in enhancing the food and fiber system and in maintaining or improving environmental quality. They will examine careers related to agricultural science and technology.** **Students will understand that trade-offs are made with the adoption of new technologies. They will explain how getting food from many different places makes people less dependent on weather, yet increases dependence on transportation and communication.**

IV. Business and Economics

	Benchmarks			
Standards	**K-1**	**2-3**	**4-5**	**6-8**
A. How are food and fiber systems and economics related?	Students will become aware of the monetary value of food. They will explain how food is worth money whether purchased from a store or produced in their garden.	Students will understand that a producer's surplus of product allows for the development of trade. Students will predict what happens when a farmer has an oversupply of products for example eggs, oranges, zucchini, nuts.	Students will be familiar with the concepts of supply and demand, scarcity, and competition. They will give examples of familiar agricultural products that are subject to these economic pressures.	Students will understand that surplus production enables trade (barter) and/or sales for profit. They will give an example of these types of exchange in both historic and contemporary economies.
B. What impact do food and fiber systems have on the economy at the local, national, and international levels?	Students will trace the journey of food and fiber to consumers through production, processing, transportation, trading, selling and distribution. They will sequence the journey of a food item from production to the consumer.	Students will understand that while some farms may sell directly to consumers, most agricultural products are processed, packaged, and shipped long distances. They will explain the steps a food commodity goes through from farm to consumer.	Students will understand that each step in the pathway to market adds value (costs) to the commodity the consumer purchases. They will compare the value of a raw product to a processed one.	Students will be introduced to the many economic activities associated with the food and fiber system. They will be able to describe the major components from farm to consumer, including: Production, Processing, Supplies and Services, Transportation and Distribution, Management, Marketing and Trade, Research and Finance, and Insurance. Students will understand agriculture's importance to local, national and international economies. They will cite examples of the many business opportunities and occupations created by the food and fiber system.

IV. Business and Economics cont'd...

	Benchmarks			
Standards	***K-1***	***2-3***	***4-5***	***6-8***
C. What is the role of government relating to food and fiber systems?	**Students will understand that government has an interest in food and fiber systems. They will explain how the government helps make sure food is safe to eat.**	**Students will be introduced to the role government plays in ensuring public and environmental health and safety. They will identify a problem and propose a course of action for a food or environmental issue in their school or community that is related to agriculture.**	**Students will discover how consumer choices influence agricultural production and government regulation. They will explain the implications of their choices on agricultural production and government policy.**	**Students will be aware of the many governmental agencies which regulate agriculture and natural resources utilization, including regulation of fisheries, forests, and rangeland. They will be able to explain the need for government regulations and outline how regulations can protect consumers, agriculturalists, and the environment.**
D. What are the major factors influencing international trade of food and fiber products?	**Students will become aware that some foods they eat come from another country. They will give examples of common imported foods.**	**Students will understand that world population growth will require an increase in food production. They will be able to explain how international trade assists in meeting food needs.**	**Students will learn that factors such as climate, natural resources and labor costs vary around the globe. They will identify food and fiber products imported from other nations and the economic and climatic conditions that favor this trade.**	**Students will be aware of government policies affecting international trade in agricultural commodities. They will be able to explain the concept of free trade and discuss the costs and benefits of tariffs and duties levied on agricultural commodities.**

V. Food, Nutrition, and Health

Benchmarks				
Standards	**K-1**	**2-3**	**4-5**	**6-8**
A. How is nutrition related to food and fiber systems?	**Refer to V, C. (below) Students will understand that all foods are products of food and fiber systems. They will distinguish between raw and processed foods.**	**Students will understand the five major food groups in the food pyramid. They will produce a representation of the food pyramid.**	**The student will learn the nutritional values of the food groups. They will describe the nutrient value of different foods by comparing food labels.**	**Students will understand that marketing and advertising can affect consumer choices. They will be able to give examples of food products whose nutritional content has been compromised for the sake of convenience or taste. The students will also be able to discriminate between similar foods of differing nutritional content and evaluate how their personal food choices are affected by advertising.**
B. Why do we choose the foods we do?	**Students will become aware that food preferences vary among individuals. They will list the foods they like or dislike.**	**Students will learn the concept of a well-balanced meal. They will identify and create an example of a nutritious meal.**	**Students will understand the factors that influence our food choices (survival, economic, cultural, convenience, advertising information). They will discuss and show how these factors affect food choice.**	**Students will understand that information about the health effects of foods can change how foods are produced and processed. They will cite examples of foods whose nutritional content has changed due to consumer concerns.**

V. Food, Nutrition, and Health cont'd...

	Benchmarks			
Standards	**K-1**	**2-3**	**4-5**	**6-8**
C. What is healthy eating?	**Students will distinguish between foods that provide a healthy diet and foods that should be eaten in moderation. They will identify breads and cereals, vegetables and fruits, milk and milk products, meat, fats and sweets.**	**Students will explore how personal food preferences affect food selection. They will discuss their preferences and relate them to the food pyramid.**	**Students will learn the nutritional content of foods in the food pyramid. They will describe the nutritional content of a balanced meal.**	**Students will understand that a balanced diet is required for proper nutrition, and that foods vary in their percentages of carbohydrates, protein, vitamins and fats. Students will be able to interpret nutritional labels on foods and be able to determine the percentage of calories from fats. They will be able to compare different foods in terms of the nutrients and calories they provide.**
D. How does exercise affect our health?	**Students will become aware that exercise is important to our health. The will give examples of ways people exercise.**	**Students will understand the relationship between human activity and food consumption. They will give examples of the benefits obtained from exercise and healthy eating, and their relationship to overall health.**	**Students will recognize the relationship between food consumption, body metabolism, and human activities. They will examine personal food consumption and compare it to various human activities.**	**Students will understand that exercise improves the efficiency with which our bodies utilize the foods we eat. The students will compare and contrast various forms of physical activities and the calories they burn and associate them with the amount of food needed to maintain a healthy body.**
E. How safe is the food we eat?	**Students will become aware that we need to take care of food so it is safe to eat. They will discuss what can happen when food spoils and how it affects people.**	**Students will learn that food must be handled, prepared, and stored properly to ensure public health and optimum nutrition. They will discuss and demonstrate proper preparation and storage of a variety of foods.**	**Students will recognize changes in food safety and food preservation in the past and present. They will compare historical and current methods of food preservation.**	**Students will be aware of the major factors affecting food safety. They will compare the risks associated with pesticide and microbial contamination of food.**

APPENDIX B

INSTITUTIONAL REVIEW BOARD APPROVAL FORM

OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
HUMAN SUBJECTS REVIEW

Date: 09-30-97 **IRB#:** AG-98-007

Proposal Title: FOOD AND FIBER SYSTEMS LITERACY PROJECT SKILLS ASSESSMENT

Principal Investigator(s): James Leising, Carl Igo

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

ALL APPROVALS MAY BE SUBJECT TO REVIEW BY FULL INSTITUTIONAL REVIEW BOARD AT NEXT MEETING, AS WELL AS ARE SUBJECT TO MONITORING AT ANY TIME DURING THE APPROVAL PERIOD.
APPROVAL STATUS PERIOD VALID FOR DATA COLLECTION FOR A ONE CALENDAR YEAR PERIOD AFTER WHICH A CONTINUATION OR RENEWAL REQUEST IS REQUIRED TO BE SUBMITTED FOR BOARD APPROVAL.
ANY MODIFICATIONS TO APPROVED PROJECT MUST ALSO BE SUBMITTED FOR APPROVAL.

Comments, Modifications/Conditions for Approval or Disapproval are as follows:
This is exempt (anonymous survey). The PI's may wish to note since this is EXEMPT, an informed consent form signed by the parents is not required. However, it is still good research practice to get the information in the informed consent form to the parents (just don't require a signature).

Signature: John H. Wycoff
Chair of Institutional Review Board

Date: October 1, 1997

cc: Carl Igo

APPENDIX C

TEACHER TRAINING AGENDAS

FOOD & FIBER SYSTEMS LITERACY
Field Site Inservice

Objectives

Objective 1. Orient field site staff to the goals of the Food & Fiber Systems Literacy Project and the role that the teachers at each site play in meeting those goals.

Objective 2. Provide field site staff with Framework, Learner Outcomes and instructional materials.

Objective 3. Develop an understanding of the Food & Fiber Framework and demonstrate the sequential approach of the learner outcomes across grade levels.

Objective 4. Demonstrate effective methods of providing hands-on instruction utilizing F&F instructional materials.

Objective 5. Provide teachers with innovative ideas for utilizing instructional materials.

Objective 6. Provide computer instruction to acquaint teachers with searching and using the WWW for integrated instruction.

Objective 7. Prepare teachers to provide feedback to project coordinator and to colleagues at other sites through e-mailing or faxing weekly journals.

Objective 8. Introduce field site staff to the evaluation plan for the project.

Objective 9. Empower teachers to develop action plans for using Food & Fiber lessons during the 97-98 school year.

Objective 10. Teachers and site coordinators will become aware of local Food & Fiber Systems resources and ways those resources can be utilized to improve classroom instruction.

Objective 11. Assist teachers and site coordinators in organizing and forming a Food & Fiber Systems resource committee.

Inservice Training Plan
Montana
May 14-16, 1997

Wednesday, May 14

8:30	Introductions
8:45	pre-test of teachers for evaluation component
9:15	Board vans for Wheat Montana Tour
9:45	Farm
10:45	Bakery
11:30	Lunch at Wheat Montana
12:15	Board vans back to school
1:00	Explain concept of project, Framework, lessons and evaluation
2:15	Break
2:30	Language Arts Activities
4:00	adjourn

Thursday, May 15

8:30	Math Activities completed by teachers
10:00	Make Butter/break (need bagels, muffins, coffee, juice, water)
10:30	Science Activities completed by teachers
12:00	Lunch (on your own)
1:00	Social Studies Activities
2:15	Snack Sack/break (need packaged snack foods, chips, cookies, candy, dried fruit, etc.)
2:30	Bread in a Bag (need warm water, place for bread to rise and oven(s) for baking bread)
4:00	adjourn

Friday, May 16

8:30	Internet and E-mail overview - School computer lab
9:30	Action plan and calendar for teaching lessons pull-out teachers for Internet and E-mail training]
11:00	Teachers share action plans
11:30	Wrap Up/Evaluation

FOOD & FIBER SYSTEMS LITERACY
TEACHER INSTITUTE
Phase II
Montana
September 10, 1997

8:00 Welcome/Introductions -

8:15 Review goals of project -

8:30 Introduce New Lessons and Revised Montana Teachers' Guide -
- Teachers review lessons and add to notebook

9:00 Review Website Developments –
- share mindmap and bookmarks
- instructions for using electronic mail to provide feedback to project staff

9:30-9:45 Break

9:45 Planning for Using Food & Fiber Lessons and Activities -
- Introduce template
- Teachers will use template, lessons and additional resources to develop fall semester plan for using Food & Fiber Framework

Individualized Computer Training -
- Teachers will learn to e-mail bi-weekly journal
- Teachers will learn to download lessons from the website
  9:45 K, 1 and 2 teachers
  10:30 3, 4 and 5 teachers
  11:15 6, 7 and 8 teachers

11:45 Break for Lunch
- Hosted by Food & Fiber Systems project staff

12:30 Lesson Activity –

1:00 Planning for Using Food & Fiber Lessons and Activities –
- Teachers will use template, lessons and additional resources to develop fall semester plan for using Food & Fiber Systems Framework

2:30 Review Evaluation Plan -
- teacher's role in evaluation

2:45 wrap-up and evaluation

3:00 adjourn

Inservice Training Plan
Oklahoma
May 20-21, 1997

Tuesday, May 20

8:30	pre-test of teachers for evaluation component
9:00	Bread in a Bag -
10:30	Make butter/ break
11:00	Explain concept of project, Framework, lessons, and evaluation
12:00	Lunch
12:45	Math Activities completed by teachers
2:15	Snack Sack/Break
2:45	Language Arts activities
3:30	adjourn

Wednesday, May 21

8:45	Tour of Oklahoma Gardening for ideas in creating children's garden plots
10:00	Science Activities
11:15	OSU Curriculum Materials Library - Willard Hall
12:00	Lunch
12:30	Board bus back to school
1:15	Action plan and calendar for teaching lessons pull-out teachers for Internet orientation/training
2:30	Teachers share action plans
3:00	Wrap up and evaluation
3:30	Adjourn

FOOD & FIBER SYSTEMS LITERACY
TEACHER INSTITUTE
Phase II
Oklahoma
August 12, 1997

8:00 Welcome/Introductions -

8:15 Review goals of project -

8:30 Introduce New Lessons and Revised Oklahoma Teachers' Guide -
- Teachers review lessons and add to notebook

9:00 Review Evaluation Plan -
- teacher's role in evaluation

9:15 Review Website Developments -
- show teachers website
- share mindmap and bookmarks
- instructions for using electronic mail to provide feedback to project staff

10:00 Break

10:15 Planning for Using Food & Fiber Lessons and Activities -
- Introduce template
- Teachers will use template, lessons and additional resources to develop fall semester plan for using Food & Fiber Framework

11:45 Break for Lunch
- Hosted by Food & Fiber Systems project staff

1:00 Tin Can Treat -

2:00 Planning for Using Food & Fiber Lessons and Activities -
- Teachers will use template, lessons and additional resources to develop spring semester plan for using Food & Fiber Systems Framework

Individualized Computer Training -
- Teachers will learn to e-mail bi-weekly journal
- Teachers will learn to download lessons from the website

3:40 wrap-up and evaluation

APPENDIX D

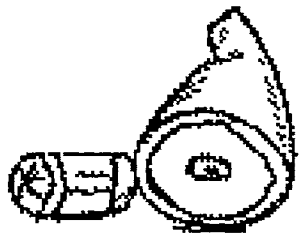
EVALUATION INSTRUMENTS

Food & Fiber Systems Literacy

Pre-test for students in Grades K-1

Teacher Instructions: This instrument consists of 16 questions, incorporating picture recognition answers. Please read each question to your students. The pictures all are accompanied by a written description so that you can assist students in understanding what the picture represents. If your students have trouble understanding words or pictures, please assist them.

1. We get many food items from farms and ranches. Draw a line from each food picture to the plant or animal that we get that food item from.

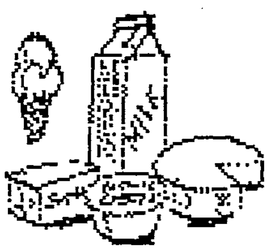


Ham and sausage

Wheat

Bread

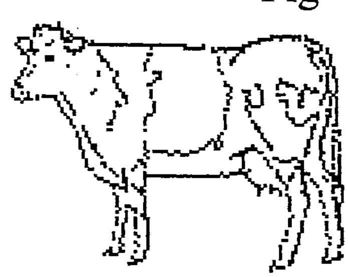
Chicken



Milk, cheese,
ice cream and butter

Pig

Eggs

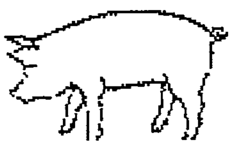


Dairy Cow

2. Draw a line from the product in the first row to the plant or animal it comes from in the second row.

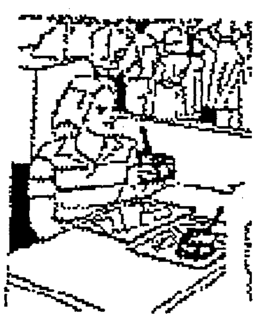
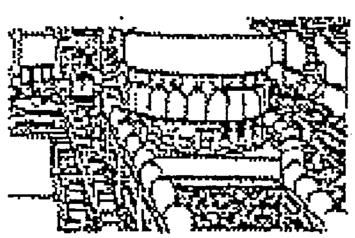
sweater shoe hair brush books

pig trees sheep cattle

3. Look at the pictures below. Draw a circle with a red crayon around the first thing that happens to produce or get milk. Draw a box with a blue crayon around the last thing that happens

drinking milk processing milk milking cow

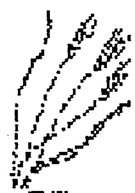
4. Use a red crayon to circle all the pictures that show something we eat. Use a blue crayon to circle all the pictures that show something we use to make clothing. Some pictures may be circled more than once.


sheep


fish


trees


vegetables

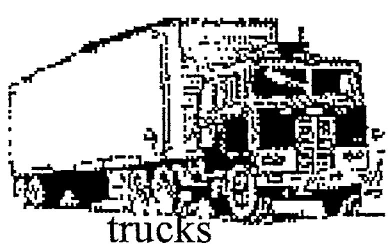

wheat


cotton

5. Use a red crayon to draw a circle around the pictures that show how people got their food 100 years ago.


hunting


grocery stores


trucks


farming

6. Draw a red circle around the pictures of things you might find in a city. Draw a blue circle around the pictures of things you might find on a farm.

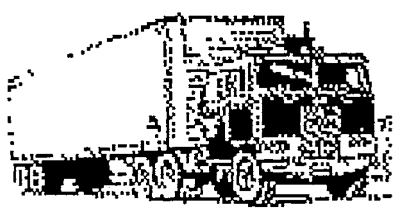
cattle

grocery stores

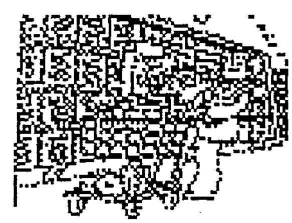
skyscrapers

sheep

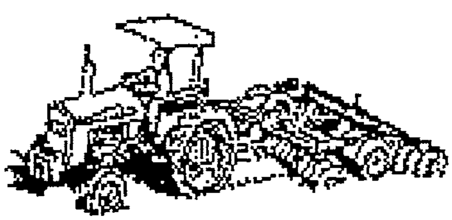
7. Use a red crayon to draw a circle around the first thing that happens when corn is grown. Use a blue crayon to draw a box around the last thing that happens when corn is grown.



truck hauls corn
to grocery store



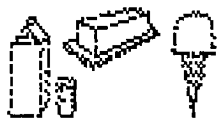
you buy corn
in grocery store



farmer plants corn

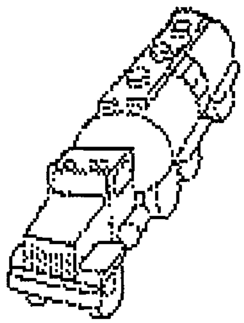
farmer harvests corn

8. Use a red crayon to draw a circle around the first thing that must happen before you can have milk, ice cream or butter. Use a blue crayon to draw a boz around the thing that happens next.

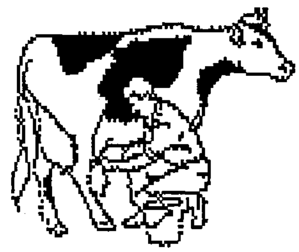


get milk, ice cream or butter from refrigerator

milk goes through processing plant



milk is hauled to processing plant

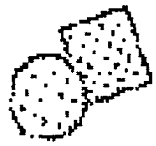


cow is milked

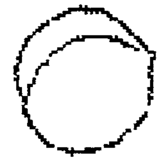
9. Use a red crayon to draw a circle around the leaves of the plant. Use a blue crayon to draw a box around the roots of the plant.

10. Use a red crayon to draw a circle around the foods that come from animals. Use a blue crayon to draw a box around the foods that come from plants.

cheese



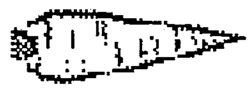
crackers



peach

steak

eggs

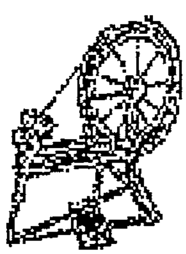


carrot

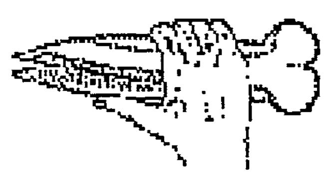
11. Use a red crayon to draw a circle around the first thing that must happen to make a wool sweater. Use a blue crayon to draw a box around the second thing that must happen.

buy sweater in store

sheep grows wool



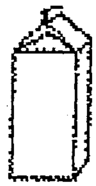
wool is spun into yarn



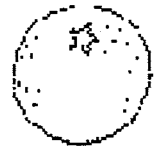
wool is shorn from sheep

12. Use a blue crayon to draw a line from the cow to all foods that belong to the milk, yogurt, and cheese group.

bread

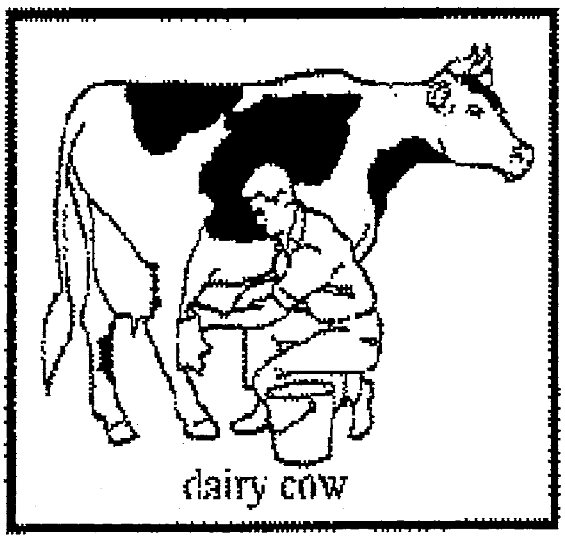


milk



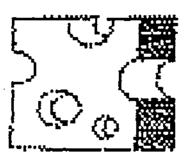
orange

ice cream

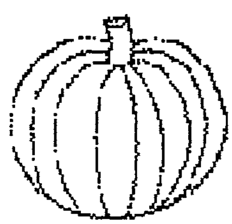


eggs

pear

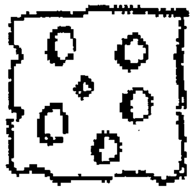


cheese



pumpkin

13. Use a red crayon to draw a circle around the pictures of foods that are not processed (fresh or uncooked). Use a blue crayon to draw a box around each picture that shows a processed or cooked food.


cheese


carrot


eggs


apple


muffin


orange

14. Use a red crayon to draw a circle around the pictures that show foods from the Meat, Poultry, Fish, Dry Beans, Eggs and Nut group.

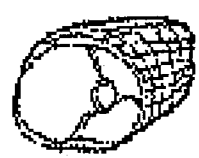

peanut butter


turkey


pear


corn

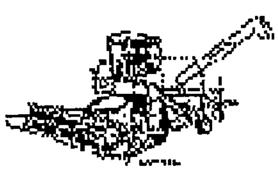

bread


ham

15. During the first Thanksgiving feast, the Pilgrims and the Native Americans ate foods they had gathered, hunted and raised. Are the foods in the picture the same kinds of foods that may have been eaten at the first Thanksgiving? Circle yes or no.

YES NO

16. Use a blue crayon to draw a line to connect the machine in the first row with the food and fiber product in the second row.


combine


wool clippers


milk truck


tractor and baler


sheep


hay


wheat

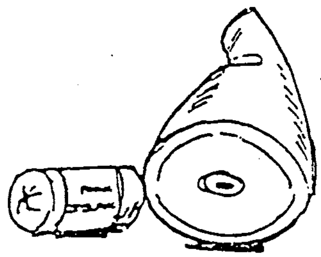

milk

Food & Fiber Systems Literacy

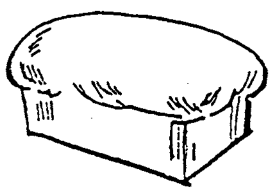
Pre-test for students in Grades 2-3

Teacher Instructions: This instrument consists of 21 questions, incorporating both picture recognition and reading. Please have your students follow along as you read each question. The pictures all are accompanied by a written description. Please also read that description to the students. If your students have trouble understanding words or pictures, please assist them.

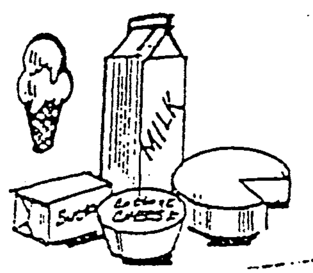
1. We get many food items from farms and ranches. Draw a line from each food picture to the plant or animal that we get that food item from.



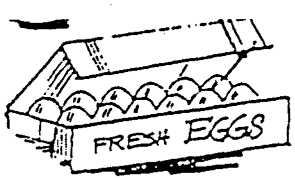
ham and sausage



bread

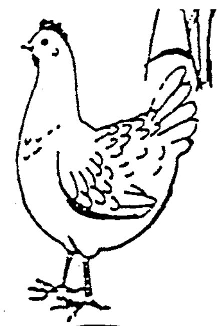


milk, cheese, ice cream and butter

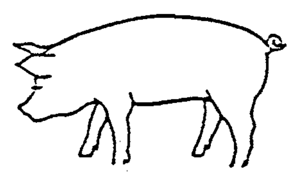


eggs

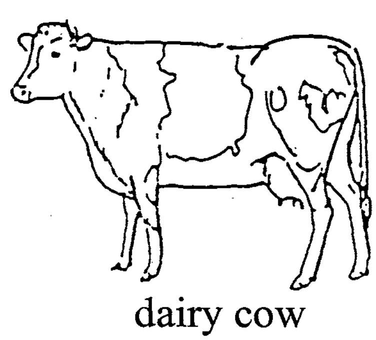
wheat



chicken



pig

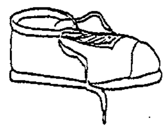


dairy cow

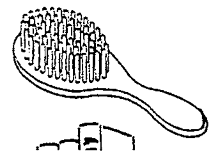
2. Draw a line from the product in the first row to the plant or animal it comes from in the second row.

sweater

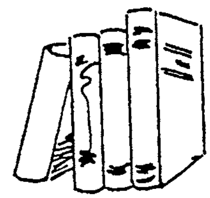
shoe

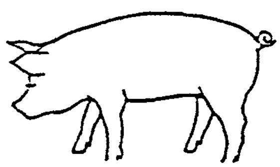


hair brush

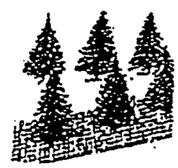


books



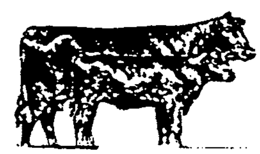


pig



trees

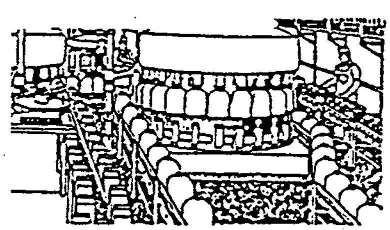
sheep



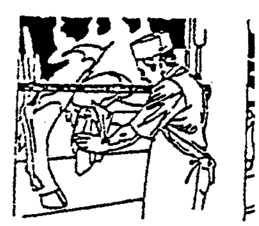
cattle

3. Draw a circle around the first thing that happens to produce or get milk. Draw a box around the last thing that happens.

drinking milk



processing plant



cow being milked

4. Draw a line from an old way of farming in the left column to a more modern way of farming in the right column.

horse and plow	combine
farmer milking by hand	bales of hay
bundles of wheat	tractor and plow
loose hay	milking machine

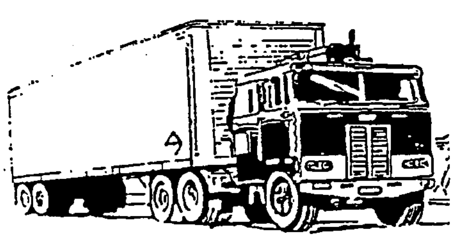
5. During the first Thanksgiving feast in our country, the Pilgrims and Native Americans ate food they had gathered, raised and hunted. Circle the foods they may have eaten.

hamburgers	deer	tacos	turkey	lettuce
corn	beans	nuts	donuts	pumpkin
cornbread	bagels	eggrolls	spaghetti	pineapple

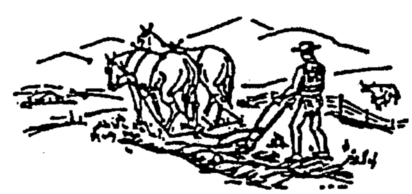
6. Draw a circle around the pictures that show how Pioneers got their food and clothing.

hunting

grocery stores



trucks



farming

7. People in different regions of the world dress differently partly because of the climate (temperature, rainfall, wind). Circle **COOL** or **WARM** in each sentence below to make the statement true.

In the Arctic, people wear clothing to help them stay __________.

cool warm

Near the equator, people wear clothing to help them stay _________.

cool warm

8. Circle **YES** or **NO** to each statement below.

Do people in the city rely on things that farmers and ranchers grow so they can live?

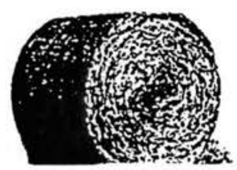
YES NO

Do people who do not live in towns need things that are made by people in cities?

YES NO

9. Draw a line from the farm product in the first row to the related harvesting machine in the second row.

sheep



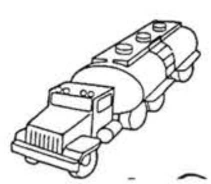
hay

wheat

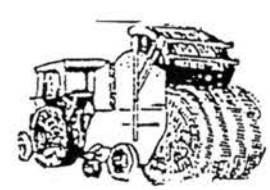
milk

combine

wool clippers



milk truck



tractor and baler

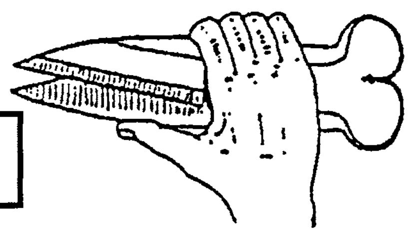
10. Draw a circle around the things plants must have to live. There will be more than one correct answer.

Air Rocks Soil Sun Water

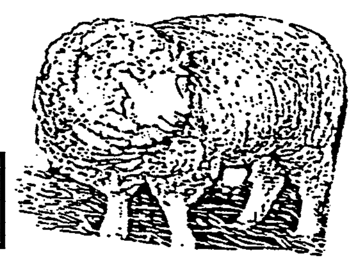
11. Circle the things animals must have to grow. There will be more than one correct answer.

Air Food Light Music Water

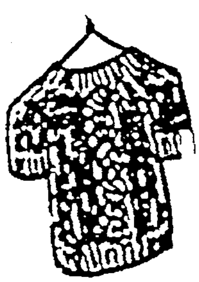
12. The pictures below represent the process used in making a wool sweater. Rank the pictures in order 1 through 4 to show the way things must happen to make the sweater.

☐ 

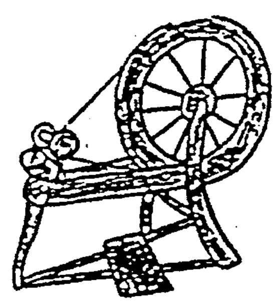
wool is shorn from sheep

☐ 

sheep grows wool

☐ 

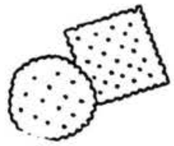
sweater

☐ 

wool is spun into yarn

13. Draw a circle around the foods that come from animals. Draw a box around the foods that come from plants.

cheese



crackers

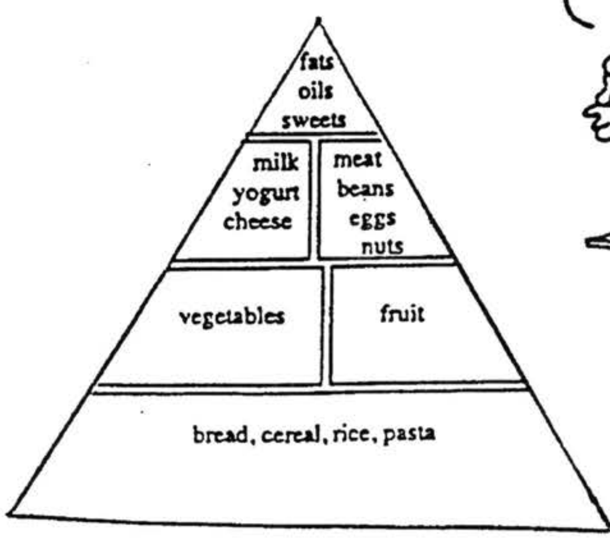
peach

steak

eggs

carrot

14. Draw a line from the parts of the hamburger to the section of the USDA Food Guide Pyramid where that part fits.



hamburger bun

lettuce

pickle

cheese

beef pattie

15. Draw a circle around the breakfast menu which is more nutritious.

hot cereal with milk buttered toast orange juice	donuts frosted cereal hot chocolate

16. Draw a circle around the lunch menu which is more nutritious.

cheeseburger french fries candy bar soda pop	cheeseburger carrot sticks apple milk

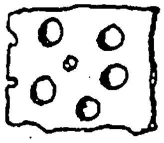
17. Circle three things a person could do to become more healthy.

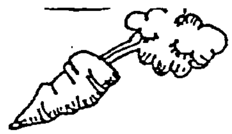
watching T.V. every day after school	riding a bicycle
brushing teeth after meals	eating an apple
eating potato chips	drinking soda pop

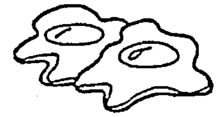
18. Put an X through each of the unsafe food handling practices listed below.

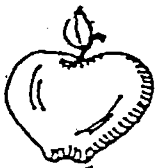
wash hands before meals	thaw meat on the counter
drink from the milk carton	keep pets away from eating areas
check dates on food packages	eat unwashed fruit

19. Draw a circle around the pictures showing food before it is cooked. Draw a box around each picture that shows a processed or cooked food.

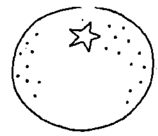

cheese


carrot


eggs

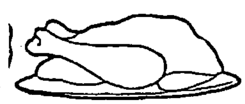

apple

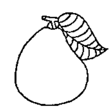

muffin

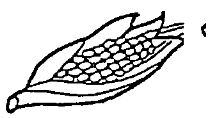

orange

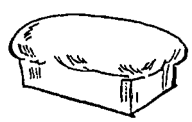
20. Draw a circle around the pictures that show foods from the Meat, Poultry, Fish, Dry Beans, Eggs and Nut group.

peanut butter


turkey


pear


corn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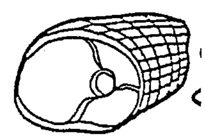

ham

21. Many different people are involved in the Food and Fiber Industry. Circle the jobs which deal in some way with Food and Fiber Systems.

construction worker	waitress	policeman
letter carrier	butcher	tree trimmer
golf course manager	banker	computer technician

15. During the first Thanksgiving feast, the Pilgrims and the Native Americans ate food they had gathered, hunted and raised. Are the foods in the picture the same kinds of foods that may have been eaten at the first Thanksgiving? Circle yes or no.

YES NO

16. Use a blue crayon to draw a line to connect the machine in the first row with the food and fiber product in the second row.

Food & Fiber Systems Literacy

Pre-test for students in Grades 4-5

Instructions: On the following pages are 31 questions about the Food & Fiber System. Please read each question carefully and choose the correct answer or answers for each question. If you do not understand a particular question or term, you should ask your teacher for help.

1. Where do the products from column A come from? Write the correct number from column B to its match in column A. There may be more than one correct answer.

Column A	Column B
_____Meat	1. Animals
_____Vegetables	2. Water
_____Clothing	3. Forests
_____Shelter	4. Plants
_____Fertilizer	5. Factory
_____Table	6. Scientists
_____Fish	7. Store
_____Crayon	8. Restaurant
_____Make-up	9. Trucker
_____Towel	10. Furniture Store
_____Brush	11. Clothing Store

2. Plants are important to our health. Place an X in front of the four natural resources that are important to the health of the plant.

_____Oxygen	_____Water	_____Sunlight
_____Salt	_____Soil	_____Carbon Dioxide

3. Natural resources provide us with raw materials to make products people can use. Choose the number that will match which resource is being managed. There may be more than one correct answer.

Resources	Managed
1. Rivers	_____Barge
2. Farm Land	_____Grazing
3. Forests	_____Tractor
4. Oceans	_____Irrigation
5. Range Land	_____Energy

Circle True or False to the following questions.

4.	True	False	The producer of an agricultural product will plant the crop.
5.	True	False	A country that grows many crops is more wealthy than a country that produces fewer crops.
6.	True	False	When Settlers came to the United States they found crops that were native to their homeland.
7.	True	False	Scientific inventions have helped farmers grow better crops.
8.	True	False	Some farm machinery have computers installed in them.
9.	True	False	More people are farmers now than 100 years ago.
10.	True	False	There are more choices of jobs in agriculture today than 100 years ago.
11.	True	False	Before there were towns in the United States, farmers grew food only for themselves.
12.	True	False	Before there were large towns in the United States, people traded goods with their friends and neighbors.
13.	True	False	When people planted gardens 100 years ago, they irrigated with a garden hose and sprinkler.
14.	True	False	The U.S. government gave away land to Homesteaders who agreed to live on that land and farm it for a certain period of time.

15. True False Sometime grasses and other plants are cultivated to help keep the soil from blowing or washing away.

16. True False Sprinklers use less water than flood irrigation.

17. True False Scientific discoveries and new machine developments, such as harvesters, herbicides, and sprinklers have increased the amount of food a farmer can produce.

18. True False Convenience and price affect the choice of foods we eat.

19. True False Advertising does not influence what kinds of food we eat.

20. True False To eat healthy means to eat only fruits and vegetables.

21. True False An increased energy level is a benefit of exercise.

22. True False You can safely store pasteurized milk at room temperature.

23. True False In the early 1800's people would keep their food in a refrigerator to keep it from spoiling.

Circle the correct answer for each question.

24. European explorers, like Columbus, traveled the world in search of

    cheese and meat grains spices farmers

25. To move from one country to another means to

    migrate trail brand immigrate

26. Plants get their energy from (the)

salt life cycle sun air

27. Plants, animals, soil, microorganisms make up a(n)

farm ecosystem resource association

28. The types of crops which can be grown in a certain region depend upon

rainfall or irrigation soil temperature all of these

29. Fresh vegetables are usually less expensive during which time of the year?

spring summer fall winter

30. Which activity uses up the most energy?

fishing bicycling walking playing checkers

31. How many different sections are on the USDA Food Guide Pyramid?

four five six seven

Food & Fiber Systems Literacy

Pre-test for students in Grades 6-8

Instructions: On the following pages are 30 questions about the Food & Fiber System. Please read each question carefully and choose the correct answer or answers for each question. If you do not understand a particular question or term, you should ask your teacher for help.

Circle True or False to answer each question.

1. True False Agriculture is the foundation of a nation's standard of living.

2. True False Agribusinesses include all the industries that supply agriculture with goods and services.

3. True False Agriculture has constantly changed with the changing needs of society.

4. True False Agriculture is the oldest and most essential industry in the world.

5. True False People have always obtained their food from a grocery store.

6. True False Food availability did not play a key role in the United States history.

7. True False Few issues affecting society today are related to agriculture.

8. True False The economy of any community depends on meeting the basic needs of the population through production or trade.

9. True False About 25 cents of every dollar we spend on food pays for things other than the actual food production on a farm.

10. True False Global market forces affect supply and demand for agricultural products.

11. True False Supply influences producer decisions about what type of product to grow, process and market.

12. True False Improved transportation and distribution bring us many different foods from around the country as well as the world.

13. True False When people are physically active, they will use less calories.

14. True False Children need exercise in their lives.

Multiple Choice: Circle the correct answer for the following questions.

15. Agriculture involves the management of several areas including:

A. Forests and natural resources.
B. Computers
C. Vehicles
D. Houses
E. All of the Above

16. The essential components of agriculture are:

A. Production
B. Processing
C. Marketing
D. Regulation
E. All of the Above

17. Even though the majority of people in the world still work directly in agriculture production, what is the percentage of those working in agriculture production in the United States?

A. 15%
B. 30%
C. 2%
D. 50%

18. What are some different careers related to agriculture?

A. Lawyers
B. Bankers
C. Astronomers
D. Bio-technicians
E. All of the Above

19. When Columbus was traveling the world, he was in search of

A. Spices and sugar
B. Farmers
C. Meats
D. Grains

20. The factors which determine the plants and animals that grow best in any given region of the world are __________ and __________ .

A. Climate and Geography
B. Fathers and Mothers
C. Food and Water
D. Politics and Government

21. Plants, animals, soil, and micro-organisms make up a(n)

A. Food chain
B. Ecosystem
C. Association
D. Atmosphere

22. What are two factors that influence our food choice

A. Survival and economics
B. Growth and happiness
C. Growth and health
D. Business and endurance

23. Food contains nutrients that are needed for

A. Happiness
B. Growth and health
C. Endurance
D. Being suppressed

24. What are the primary natural resources necessary for food production?

A. Soil
B. Water
C. Air
D. Sunlight
E. All of the above

25. What are the primary food safety problem(s) today?

A. Improper storage
B. Improper preparation
C. Improper handling
D. All of the above

Matching:

26. Match the raw product in column A to their processed products in column B. There may be more than one correct answer.

_____Sap from Rubber trees	A.	Houses, paper, and packaging
_____Wool	B.	Clothing
_____Leather	C.	Tennis shoes, car tires
_____Cotton	D.	Shoes, Purses
_____Trees		

27. Match the preventive measure in column A to their counterparts in Column B.

______Cover crops	A. Protection from wind
______Rotation of crops	B. Natural predators to insects
______Hedge rows	C. Lower soil erosion
______Integrated pest management	D. Resistance to diseases and insects
______Drip irrigation	E. Soil-building value

28. Match the technological advance in column A to its result in Column B.

_____Internal Combustion Engines	A. Milk Production, storage, processing
_____Genetic Engineering	B. Soil fertility
_____Microbiology	C. Less Labor and more production
_____Chemistry	D. Breeding and selection

29. We need natural resources to live. Write the corresponding number(s) of the producer in column B to its product in column A.

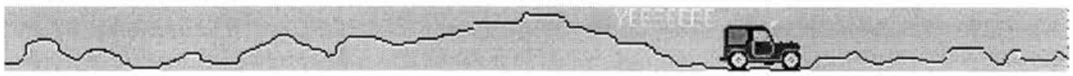
Column A	Column B
______Meat	1. Animals
______Vegetables	2. Water
______Clothing	3. Forests
______Shelter	4. Plants
______Fertilizer	5. Factory
______Table	6. Scientists
______Brush	7. Store
______Towel	8. Restaurant
______Crayon	9. Trucker
______Make-up	10 Furniture Store
______Fish	11 Clothing Store

30. Name the 6 areas of the USDA Food Guide Pyramid.

APPENDIX E

TEACHER FEEDBACK FORM

Food & Fiber Systems Literacy Project
Test Site Teacher's Only
Teacher Journal



It's an adventure, tell us about it!

Attention! The form will not be sent unless the following two lines are filled out.

Name: ☐

Email: ☐

Teacher's Name ☐ School CA-Beamer ▾

Grade Level(s) Taught with this lesson:
K ☐, 1 ☐, 2 ☐, 3 ☐, 4 ☐, 5 ☐, 6 ☐, 7 ☐, 8 ☐,
Other ☐ (Explain below)

Lesson Source

- ☐ **Food & Fiber Notebook/Webpage**
- ☐ **Other Webpage**
- ☐ **Other, please explain** ☐

Lesson Title ☐

Date Taught ☐

Core Subjects Addressed ☐

Food & Fiber Key Question(s) Adressed:

I. Understanding Agriculture

- ☐ A. What is agriculture?
- ☐ B. What are the essential components of the food and fiber system?
- ☐ C. What is society's relationship to the food and fiber system?
- ☐ D. What is the importance of agriculture locally, nationally, and internationally?
- ☐ E. What are possible careers in agriculture?

II. Historical, Cultural, and Geographical

- ☐ A. What role have food and fiber systems played in the evolution of civilization?
- ☐ B. What role have food and fiber systems played in society throughout world history?
- ☐ C. What role have food and fiber systems played in the history of the USA?
- ☐ D. What is the relationship between cultural practices and agricultural production?
- ☐ E. How are social issues related to food and fiber systems?

III. Science: Agricultural-Environmental Interdependence

- ☐ A. What is an ecosystem?
- ☐ B. How are ecosystems related to food and fiber systems?
- ☐ C. What natural resources are involved in food and fiber systems?
- ☐ D. What management and conservation practices are being used to address environmental concerns?
- ☐ E. What is the role of science and technology in the food and fiber system?

IV. Business and Economics

- ☐ A. How are food and fiber systems related?
- ☐ B. What impact do food and fiber systems have on the ecomony at the local, national, and international levels?
- ☐ C. What is the role of government relating to food and fiber systems?
- ☐ D. What are the major factors influencing international trade of

food and fiber products?

V. Food, Nutrition, and Health

- ☐ **A. How is nutrition related to food and fiber systems?**
- ☐ **B. Why do we choose the foods we do?**
- ☐ **C. What is healthy eating?**
- ☐ **D. How does exercise affect our health?**
- ☐ **E. How safe is the food we eat?**

Related Activities Used (Fill in if more than primary activity completed. You may have to hit the enter key when you get to the end of the line.)

Met learner outcomes? Yes ☐ No ☐

Would you use this lesson again? Yes ☐ No ☐

Enough background? Yes ☐ No ☐

Student enthusiasm? Positive ☐ Neutral ☐ Negative ☐

Time length of lesson? ☐ Too Long ☐ Just Right ☐ Too Short

Suggested changes? (How would you improve this lesson?)

Additional Comments

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Questions? Email me

Home

VITA

Carl G. Igo

Candidate for the Degree of

Doctor of Philosophy

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Area of Specialization: Educational Administration

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