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THE INFLUENCE OF AGRISCIENCE AND NATURAL RESOURCES ON STUDENTS' SCIENCE ACHIEVEMENT SCORES

By

James Joseph Connors

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ABSTRACT

THE INFLUENCE OF AGRISCIENCE AND NATURAL RESOURCES ON STUDENTS' SCIENCE ACHIEVEMENT SCORES

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Over the past several years, poor science test results have increased the demand for improved science education for American students. New and innovative methods of presenting scientific material are needed to improve student achievement and enthusiasm for learning science.

One solution to this dilemma has been to increase students' interest in science by using agricultural and natural resources concepts to teach science. Teaching science through agriculture incorporates agriculture into the curricula to more effectively teach science.

This research study sought to show that students who enrolled in agriscience and natural resources comprehend science principles on an equal level as students who did not enroll in agriscience and natural resources. The study also surveyed Michigan agriscience and natural resources educators to determine their attitudes, perceptions, and knowledge about the new Michigan Agriscience and Natural Resources (ANR) Curriculum.

A standardized science test was used to measure students' science knowledge. A mailed questionnaire was used to determine ANR teachers' perceptions about the new curriculum.

The results showed that there was no difference in the science achievement test scores of students who had and had not enrolled in agriscience and natural resources. The variables that explained the most variance in science test scores were the number of science credits completed and the students' overall grade point average.

The analysis of the teachers' survey found that Michigan agriscience and natural resources educators were teaching a high percentage of the science objectives in the Michigan Agriscience and Natural Resources Curriculum. Respondents had a positive attitude about agriscience but a moderate level of knowledge about the Michigan ANR curriculum. Regression analysis found the hours of technical in-service explained a significant amount of the variance in the percent of science objectives taught by teachers.

To my two best friends,
my wife Becky whose love and support
made it all possible,
and to Jim Brousseau who always
offered support and encouragement.

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CHAPTER I

INTRODUCTION

The past decade has seen many calls for education reform in the United States. Parents, teachers, and educational professionals have called for new and innovative approaches to teaching English, mathematics, and science. According to the "Nation at Risk" Report (National Commission on Excellence in Education, 1983) "There was a steady decline in science achievement scores of U.S. 17-year-olds as measured by national assessments of science in 1969, 1973, and 1977" (p. 9).

The trend in science achievement scores has not improved. Former Secretary of Education William Bennett (1988) wrote that "A new assessment places American science students in rough international perspective" (p. 13). Ten year-olds placed 8th among 15 countries tested, 14 year-olds placed 14th of 17 countries. Advanced science students fare even more poorly: 9th place of 13 countries in physics, 11th of 13 in chemistry and last in biology. These poor science test results have increased the demand for improved science education for American students. Typically, these demands have only led to more hours added to the school day or more days added to the school year.

Does increasing the amount of science instruction students receive improve science literacy or science achievement scores? The American Association for the Advancement of Science (1989), in its "Project 2061 Report: Science for All Americans" stated that, "A fundamental premise of Project 2061 is that the schools do not need to be asked to teach more and more content, but rather to focus on what is essential to scientific literacy and to teach it more effectively" (p. 4).

The National Science Foundation (1983) in its report, "A Revised and Intensified Science and Technology Curriculum Grades K-12 Urgently Needed for Our Future" stated "The teaching emphasis at all grade levels is largely upon learning the names of plants and animals, their structural parts and the function of each. The students' complaint is that 'there are too many names and terms to learn' (p. 11)."

Longer school days and the reliance on outdated curriculum are not viable methods of improving science literacy among today's students. The continued low achievement of science students in America is proof that a new strategy for instructing the adults of tomorrow is desperately needed.

New and innovative methods of presenting scientific material are needed to improve student achievement and enthusiasm for learning science. The National Science Foundation (1983) reported that:

> Recent research in cognitive process and science teaching shows that curriculum materials and teaching strategies that are application and activity-oriented and involve realistic problem solving produce improved results in learning content and process and in developing positive attitudes. (p. 3)

The use of realistic, activity-oriented instruction is not new or unique to science instruction. One curriculum area that has relied on activity-oriented instruction is agricultural education. The field of agricultural education has placed significant emphasis on hands-on activities for over 75 years. The use of field-based instruction, using livestock, crops, and soils has been the backbone of agricultural education. Agricultural education has always been proud of its production agriculture roots. Moffit and Gratz (1987) wrote that "Traditional courses of study in secondary agricultural education have emphasized the production agriculture aspect and have done little to incorporate the scientific nature of the total agricultural industry" (p. 22). This statement is no longer true for most modern agricultural education programs. Iverson and Robinson (1990) stated "An integrated agricultural science and technology program is proposed that is based on quality standards that transcends general, academic and vocational lines, and that replaces traditional vocational agriculture programs" (p. 21). Kirby (1990) went so far as to say "Teachers have incorporated agriscience projects, some of an experimental nature to assist students in developing thinking and science skills." As agricultural education restructures to agriscience education, more programs are developing an increased emphasis on the scientific aspects of the agricultural and natural resources industries. The National Research Council (1988) in its report titled "Understanding Agriculture: New Directions for Education" stated that "Teaching science through agriculture would incorporate more agriculture into curricula, while more effectively teaching science" (p. 11). Budke (1991) stated specifically that agricultural education is an ideal setting for teaching principles of biology and physical science. Budke stated that:

> A logical program change in agricultural education is toward increased emphasis on biological and physical science principles directly addressing the increased scientific nature of agriculture and appealing to a broader audience of students who are interested in science oriented agriculturally related occupations. Agriculture provides an ideal setting for demonstrating and applying biological science and physical science principles. (p. 4)

As a result of this move to agriscience based programs, the Michigan Department of Education in 1989 contracted with the Department of Agricultural and Extension Education at Michigan State University to develop a model agriscience and natural resources curriculum for agricultural education programs in Michigan. Following the development of the basic core curriculum units, agricultural education programs in Michigan began a restructuring process to be officially recognized as agriscience and natural resources programs by the Michigan Department of Education. However, even as more agriscience programs develop in Michigan, teachers, parents, and administrators continue to question the rationale for teaching science through agriculture.

Statement of the Problem

As more people call for reform in the American educational system, there is a growing need for improved instructional methods. Agriscience and natural resources programs utilize activity-oriented instruction methods to instruct students in science. However, many parents, educators, and administrators do not feel that agriscience and natural resources classes are viable alternatives to more traditional science courses for high achieving college-bound students.

Is agriscience and natural resources a legitimate science course? Do students who enroll in agriscience and natural resources classes perform as well on science tests as students who take more traditional science classes? These are two of the questions that this research study attempted to answer.

Purpose and Objectives

The purpose of this research is to compare students enrolled in agriscience and natural resources courses with students in traditional science courses on science achievement tests. Specific objectives of the study were to:

1. Determine the influence of science courses (including agriscience and natural resources) and demographic variables on students' science achievement test scores.
2. Determine the number of science objectives from the Michigan Agriscience and Natural Resources Curriculum that are being taught by agriscience and natural resources educators.
3. Determine agriscience and natural resources educators' attitudes towards the concept of agriscience instruction.
4. Determine agriscience and natural resources educators' knowledge about the Michigan Agriscience and Natural Resources Curriculum.
5. Determine demographic information on Michigan agriscience and natural resources educators.

Research Hypothesis

The following research hypothesis will give direction to this study.

1. Students who had agriscience and natural resources courses will have mean scores on standardized science achievement tests equal to students who did not have agriscience and natural resources courses.

Definition of Terms

To facilitate better understanding of this study, several terms commonly used in agriscience and natural resources and science education will be defined.

Agriscience and natural resources will be defined as the application of agricultural and natural resources principles and practices to the teaching of science to elementary, middle school, and high school students.

Alternative science classes are defined as science courses other than biology, chemistry, and physics that qualify for science credit. Classes such as earth science, physical science, and agriscience and natural resources would be considered alternative science classes.

Below average students are students who are not preparing to attend college, and who do not receive passing grades in traditional science classes. These students are therefore placed in alternative science classes to receive the science credits needed for graduation.

Cross-referenced science objectives are the objectives of the Michigan Agriscience and Natural Resources Curriculum that have been cross-referenced with the State of Michigan's Science Objectives for secondary students.

Michigan Agriscience and Natural Resources Curriculum is the name selected by Michigan secondary agricultural teachers to represent the new curriculum focus in Michigan.

Science achievement is defined as the scores obtained on general tests of science knowledge.

Traditional science classes include biology, chemistry, and physics. Advanced science and advanced placement (AP) classes are also considered traditional science classes.

Vocational agriculture is defined as classes formerly taught in secondary schools that provide opportunities for students to prepare for, or advance in, occupations requiring knowledge and skills in agriculture.

Limitations of the Study

This study was limited to high school seniors in four selected Michigan high schools during the 1991-92 school year. The high school seniors voluntarily completed the science achievement test. The study was also limited to those high school seniors who were present in school the day of testing.

The survey of agriscience and natural resources teachers was limited to those teaching agriscience and natural resources during the 1991-92 school year.

Basic Assumptions

The researcher assumed the results of the science achievement tests were an accurate portrayal of the scientific knowledge attained by participating high school seniors. It was assumed that agriscience and natural resources teachers provided truthful information about their attitudes, perceptions, and knowledge about the Michigan Agriscience and Natural Resources Curriculum and the concept of agriscience instruction.

CHAPTER II

REVIEW OF LITERATURE

Introduction

Many researchers have investigated the interaction of agriculture and natural resources education and science education. A review of literature uncovered many studies on the methods of science instruction, attitudes of students and teachers towards science, and the use of agricultural concepts to teach science principles. This chapter is organized into two sections. Section I will review studies in three areas: science objectives taught in agricultural and natural resources classes, science instruction using inquiry and field-based instruction, and science instruction using principles of agriscience and natural resources. Section II includes a review of the literature related to the attitudes of students and teachers about science education, and the attitudes of teachers about the use of agriscience and natural resources principles for teaching science.

Section I

Science in Agriculture

Science has always been a major part of agricultural education programs. However, only within the past ten years has research shown that agricultural education courses teach a significant number of science objectives. In 1984, before the current move to agriscience instruction, Moss (1984) studied agricultural education programs in North Carolina and found that "twenty-four (24) of the 60 competencies in the 'Introduction to Agriculture/Natural Resources' course were identified as being similar to competencies taught in high school courses such as biology, earth science, and physical science" (p. 4). Moss also found that a smaller number of competencies taught in an ornamental horticulture class were directly related to competencies taught in biology and physical science classes.

A general study that showed that science competencies are included in the curricula of secondary vocational education programs was conducted by Anderson and Boddy (1985). Anderson and Boddy found that "specific secondary vocational programs that contain significant components of chemistry, biology, and physics related skills are: production agriculture, and horticulture" (p. 8).

A similar study was conducted by Moss (1986) on the science competencies taught in vocational agriculture in Louisiana. He found that:

> The greatest similarity between the curriculum in vocational agriculture and a specific high school science course is in environmental science. Forty-four agricultural instructional objectives from the Basic Program of Vocational Agriculture in Louisiana were of similar content to the objectives taught in environmental sciences. (p. 4)

The findings of this study agreed with the results of Moss' previous study that showed that a large number of science objectives were taught in vocational agriculture classes. Moss (1986) also reported that:

> A total of 76 instructional objectives from the Basic Program of Vocational Agriculture in Louisiana curriculum guide were identified as science related objectives. Of the 76 instructional objectives identified, 13 objectives were overlapping with objectives taught in high school biology. Four objectives overlapped with objectives taught in general science, and three objectives are similar to competencies taught in physical science. (p. 3)

In 1988 Moss conducted a follow-up study to determined the science-related objectives taught in the Advanced Program of Vocational Agriculture in Louisiana. The findings showed the 'Advanced Program of Vocational Agriculture' included science objectives that overlapped those taught in five state approved science courses. The most overlap occurred in the environmental science course.

From the studies of the Louisiana Vocational Agriculture Program, Moss found that science competencies taught in vocational agriculture were very similar to the science competencies taught in Louisiana environmental science courses. However, the study by Moss (1984) of North Carolina vocational agriculture courses found that biology and physical science were the courses that were most similar to North Carolina vocational agriculture classes.

Science Taught As Inquiry

Agricultural education is not the only subject to use hands-on, inquiry methods of instruction. Traditional science courses have also used unique instructional techniques to increase students' interest in science.

Roth (1989) described the inquiry approach to teaching science by stating, "the inquiry perspective contends that students will develop better understandings of the nature of science and will be more interested in science if they are engaged in 'doing' science" (p. 18).

Several research studies have shown that the inquiry method of teaching science produces higher achievement scores than traditional science instruction. Wagner (1983) studied the science achievement of elementary students related to the method of instruction used to teach science. The two methods used in the study were the inquiry approach and a reading-recitation approach. Wagner (1983) concluded, "there was a significant difference in (1) total achievement gains between the methods; (2) process skills gains between the methods." While this study was limited to elementary science students, it shows that those students taught by an inquiry approach had achievement gains significantly greater than those taught by a reading-recitation approach. A 1984 study conducted in Nigeria compared the teaching of biology as inquiry with the traditional didactic approach in secondary schools. Awodi (1984) found, "students in the inquiry group attained a significantly higher level of achievement than students in the traditional group." The researcher concluded, "the inquiry method is a more effective method of teaching science than the traditional lecture method (Awodi, 1984)."

Another study which compared the inquiry approach and the traditional method of instruction was conducted by Doty in 1985. Doty's study analyzed the affects the two methods of instruction had on students' science process skills, attitudes towards science and achievement in science. Doty (1985) found that "subjects in the inquiry group did differ significantly from those in the traditional group in science achievement." A thorough review of the literature has shown that students taught using the inquiry method did better on science achievement tests than students taught using the traditional, didactic method of science instruction.

The didactic method of teaching science was also compared to activity based science instruction. In 1981, Oloke compared an indoor-outdoor laboratory method to a traditional method of teaching. This study, like the Awodi study discussed earlier, was conducted with secondary school students in Nigeria. This study found that the indoor-outdoor laboratory method of teaching ecology was more effective than the traditional method of teaching ecology in producing cognitive gain and that it was at least as effective in promoting a positive ecological attitude among students.

Using Agriculture To Teach Science

One of the most prominent methods of using an inquiry or "hands-on" approach to teach science is in agriculture. Students have the opportunity to study biological concepts such as reproduction, genetics, nutrition, and photosynthesis through "hands-on" activities using plants and animals. Budke (1991) stated, "agriculture provides a marvelous vehicle for teaching genetics, photosynthesis, nutrition, pollution control, water quality, reproduction, and food processing where real live examples can become part of the classroom experimentation and observation" (p. 4).

The use of agricultural principals to teach science was stressed by members of the National Council for Agricultural Education. Pope and Staller (1991) stated that "The National Council for Agricultural Education . . . has initiated a program to move science education from 'textbook based' to 'activity based' instruction using real-world examples as they apply to the agricultural sciences" (p. 36).

The move to using agricultural principles to teach science has been supported by several research studies. Ryan (1983) studied the effect of an agriculture program on the academic achievement of eighth grade students. A pre-test, post-test control group design was used to measure achievement of both the experimental and control groups. The experimental group received thirty-minutes of science instruction in the classroom and thirty-minutes of instruction on an agricultural farm. The control group received 60 minutes of science instruction within a traditional classroom setting. Science achievement was measured using the Stanford Achievement Test. The study showed the experimental group made significantly greater academic growth in science than the control group.

In 1988, Whent and Leising used a post-test only, control group design to compare the science achievement scores of students studying the California Basic Core Curriculum in Agriculture and a traditional biology curriculum. Whent and Leising reported, "agricultural students in test schools achieved slightly higher on the biology test than did bio-science students" (p. 14). The researchers concluded that agriculture students were mastering the state science standards on an equal level with students in general science classes.

Enderlin and Osborne (1991) studied science achievement of middle school science students. The researchers compared a laboratory oriented agriculture approach with a traditional science instruction approach in teaching a plant science unit. Enderlin and Osborne also used a post-test only, control group design for their study. The researchers concluded, "student acquisition of science knowledge differs significantly between those students who receive agriculturally oriented laboratory instruction in science and those students who receive traditional science instruction."

An increase in science interest was witnessed in high school students who were taught plant breeding and genetics using a new plant variety. Fisher (1991) conducted a descriptive survey research study to show the results of using a new plant cultivar, "Fast Plants" (Brassica rapa), to teach middle school and high school science concepts. Fisher (1991) stated, "Increases in the time spent on plant study, in student use of live plant material, and in student learning . . . were seen." New, innovative science activities using agricultural principles has helped to increase students' science achievement and improve their attitudes towards science. Other agriculture and natural resources based science learning programs include "Bottle Biology," "Project Wild," and "Project Learning Tree." Along with "Fast Plants," these innovative programs are using agricultural principles to increase science achievement scores and improve both students' and teachers' attitudes about science.

Section II

Attitudes About Science

Research has shown activity-based science courses have a positive affect on students' and teachers' attitudes towards science education. Akinmade (1982) found that "urban seventh grade students enrolled in classrooms where hands-on science was taught were found to have significantly more positive attitudes than their suburban counterparts taking traditional science courses." Moore (1983) had similar results in his study of the effects of guided experiences with animals on the beliefs, attitudes, behavior intentions, and knowledge of students in grades three through eight. This study used the pretest-posttest control group design. The study used a researcher developed instrument titled, "Knowledge and Feelings About Animals Inventory" to measure students' attitudes and achievement. Moore (1983) reported, "experimental group posttest results showed significant positive gains in attitudes, beliefs, behavioral intentions, and knowledge over the control group posttest results."

Another study that investigated science attitudes was conducted by Burkhart in 1982. Burkhart used a pretest-posttest control group design and the Science Attitude Inventory (SAI) to compare students who enrolled in an activity centered science course and those who enrolled in traditional science courses. Burkhart (1982) found that "data showed a significant difference . . . in favor of the experimental group. This strongly suggests that an inquiry oriented science class, placing emphasis on a 'hands-on' approach, can affect a student's attitude toward science." Branch (1983) and Kern (1984) reported similar results. Branch conducted a developmental study in earth and environmental science. The researcher reported that "results indicated that students who received science instruction in the form of a generalized approach to problem study . . . became more positive in their views toward school science (Branch, 1983)." Using a field oriented approach, Kern studied the enhancement of student values, interests, and attitudes in an earth science laboratory. Results showed, "students under the field-oriented approach left the course feeling much higher levels of importance, interest, and enjoyment associated with the learning experience than did students in the traditional lab (Kern, 1984)." These studies have shown that activity based science courses improve students' attitudes about science. However, the attitudes of the teachers are equally as important as the attitudes of the students.

Attitudes About Agriscience

Teaching science by using agriscience and natural resources principles is a relatively new concept. Many experienced agricultural educators have expressed concern about shifting emphasis away from traditional production agriculture instruction to the new agriscience and natural resources program. Teacher attitudes about the new agriscience and natural resources curricula are important to the success of the implementation process.

Pepple (1982) studied factors associated with teacher use and effectiveness of the Illinois Rural Core Curriculum in Agriculture. The study found that the core curriculum influenced teachers to use a greater variety of classroom instructional methods (Pepple, 1982). Pepple found that respondents who had in-service workshop instruction had a higher implementation rate than respondents who did not have in-service workshop instruction. This finding showed the importance of complimenting curriculum development activities with in-service training for teachers who will be using new curriculum materials.

The issue of teachers' attitudes towards change was also studied by Norris and Briers in Texas. In 1986, the Texas Department of Education began to restructure its curriculum from production agriculture classes to semester courses in agribusiness and agricultural technology. Norris and Briers (1989) reported that:

> Teachers' perceptions toward the change process (need for the change, manner in which the change was managed, amount of teacher input into the change, etc.) was the single best indicator of the teachers' free choice and actual decision concerning adoption of the change.

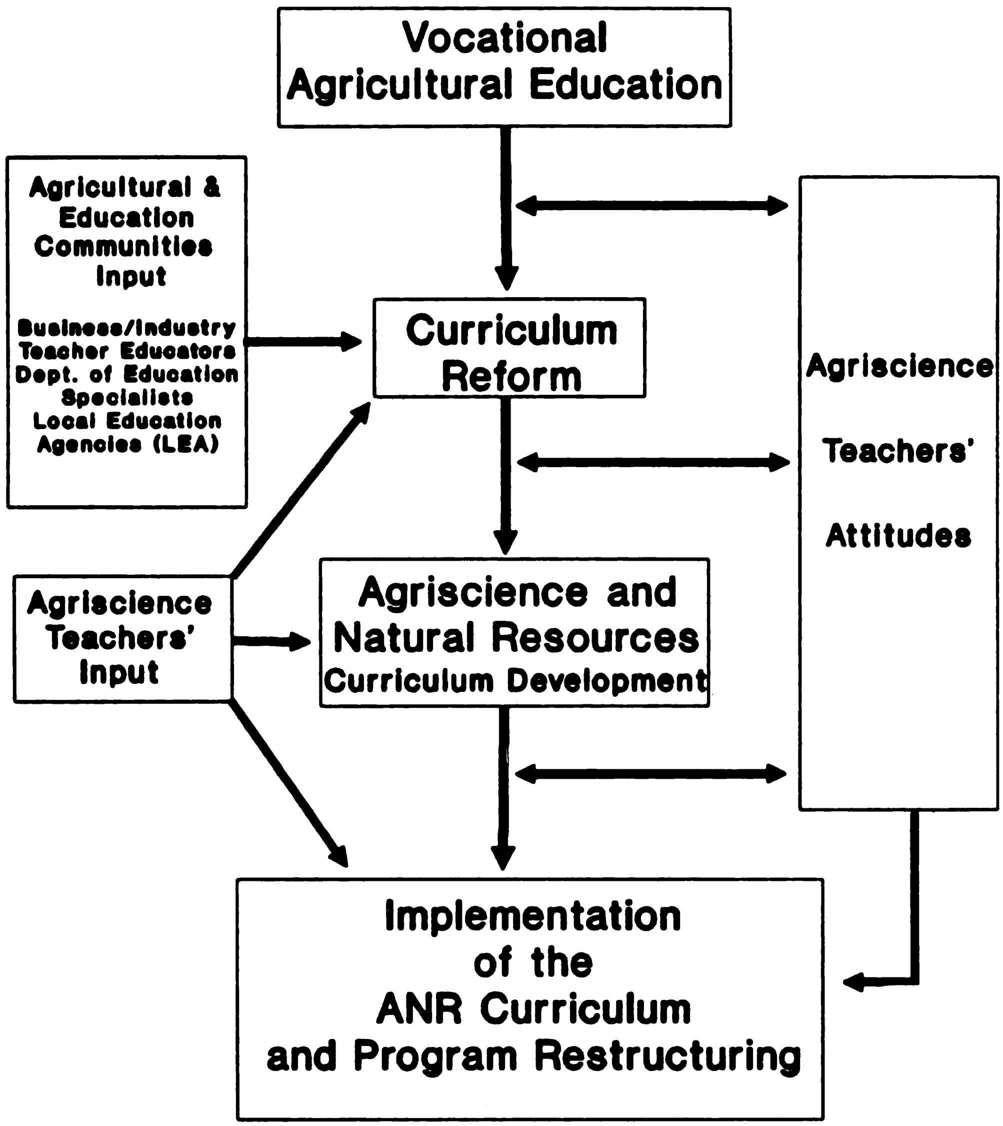
This supports Pepple's (1982) findings that teachers are more likely to have a positive attitude towards curriculum reform if they actively participate in the reform process. However, the study by Norris and Briers had severe limitations. It was not a random sample of Texas agricultural education teachers, and therefore was not generalizable past the sample population.

A similar study of teachers' attitudes towards curriculum reform was conducted in Ohio. Peasley and Henderson (1991) conducted a descriptive study of teacher use, attitudes, and knowledge of agriscience curriculum in Ohio. Peasley and Henderson found that 25% of the teachers were teaching more than 75% of the content objectives of the Ohio agriscience curriculum. This would suggest that the new Ohio agriscience curriculum was not widely adopted by Ohio agricultural education teachers. This result led the researchers to state, "high school teachers of production agriculture in Ohio are teaching a moderate level of the agriscience content." However, the researchers concluded, "Ohio high school teachers of production agriculture could be described as having a positive attitude toward the notion of an agriscience core curriculum and the term agriscience (Peasley and Henderson, 1991)." The researchers also reported, "teachers with more positive attitude towards agriscience tended to teach a slightly higher level of agriscience curriculum." Peasley and Henderson indicated that, although teachers surveyed in this study seemed to have a positive attitude towards agriscience, it appeared the Ohio basic core agriscience curriculum was not being widely adopted by "production agriculture" teachers. The researchers indicated that teachers' positive attitudes about the agriscience curriculum did not correspond to a large adoption rate for the new curriculum.

Conceptual Framework

It is important to develop a clear picture of the concept of agriscience and natural resources education. A diagram of the paradigm shift that has occurred from vocational agricultural education to agriscience and natural resources education is shown in Figure 1. The shift includes input from members of the agricultural and education communities and from agricultural education teachers.

An important part of the shift, which was discussed in the review of literature, is the attitudes of agricultural teachers. It was been shown that agricultural teachers' attitudes can influence curriculum reform activities, curriculum development, curriculum implementation, and program restructuring.



<u>Figure 1</u>. Agricultural education paradigm shift.

Figure 2 represents the paradigm shift occurring in science education. Agriscience and natural resources courses have now become a part of the accepted high school science program in many schools. This study attempted to identify science achievement scores of students enrolled in science and agriscience and natural resources classes.

The related literature has provided important information that will guide this research study. Figures 3 through 6 show the operational frameworks for Objectives 1 through 4 respectively. These operational frameworks, based on the review of literature, were developed to provide direction to this study.

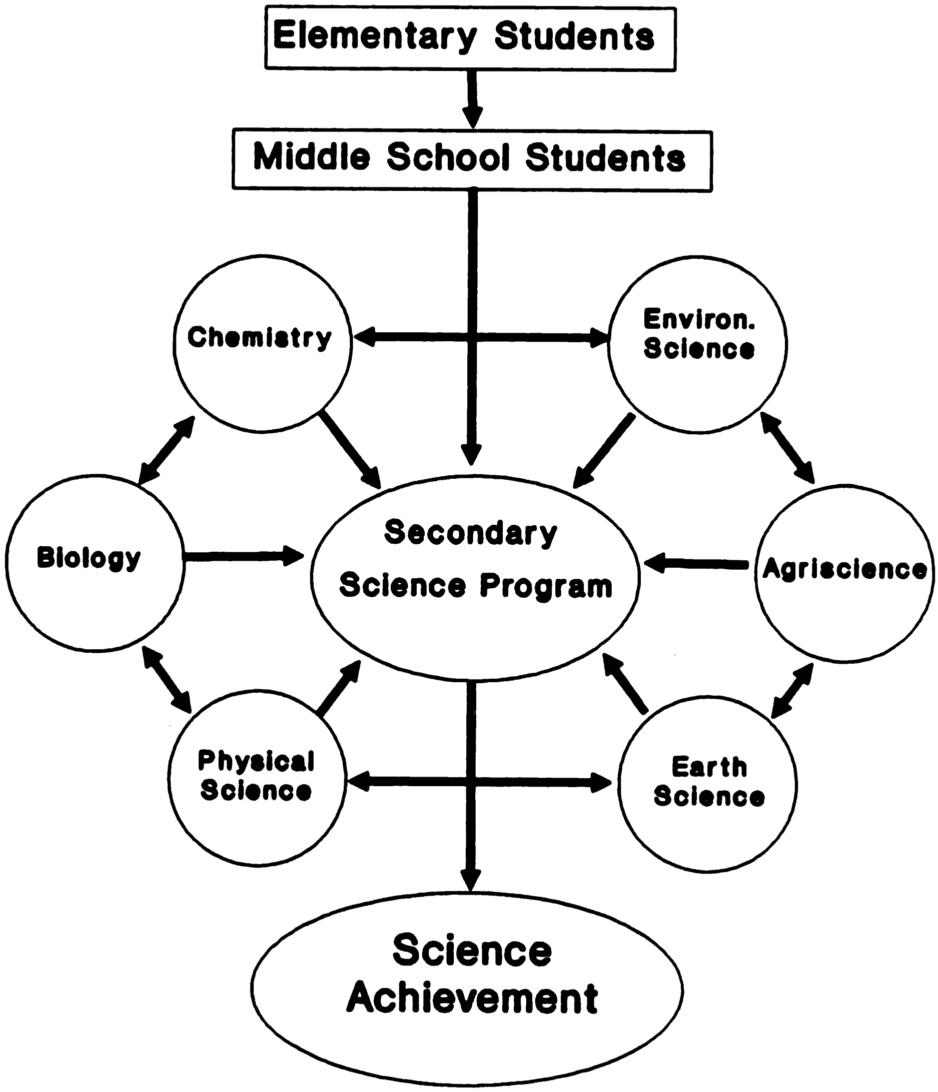


Figure 2. Science education paradigm shift.

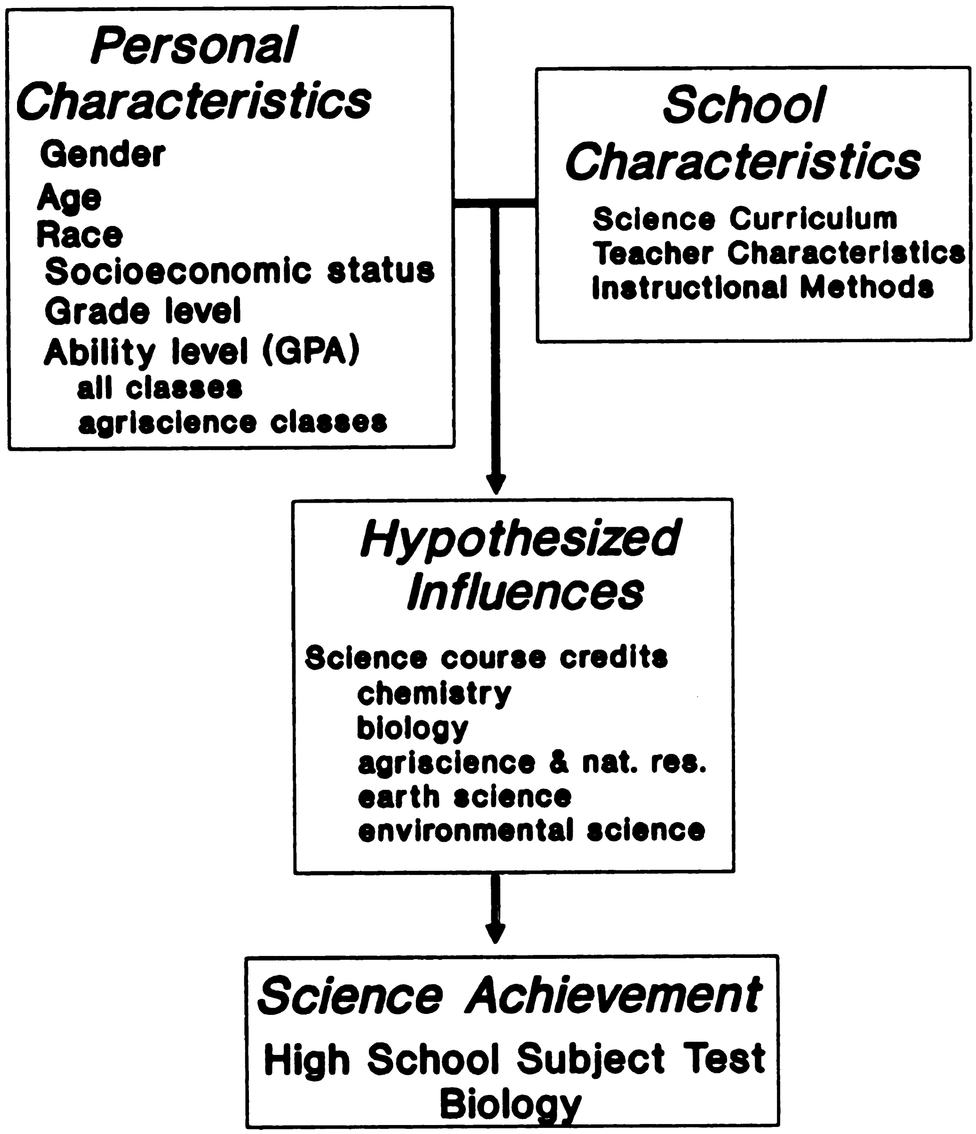


Figure 3. Operational Framework for Objective 1.

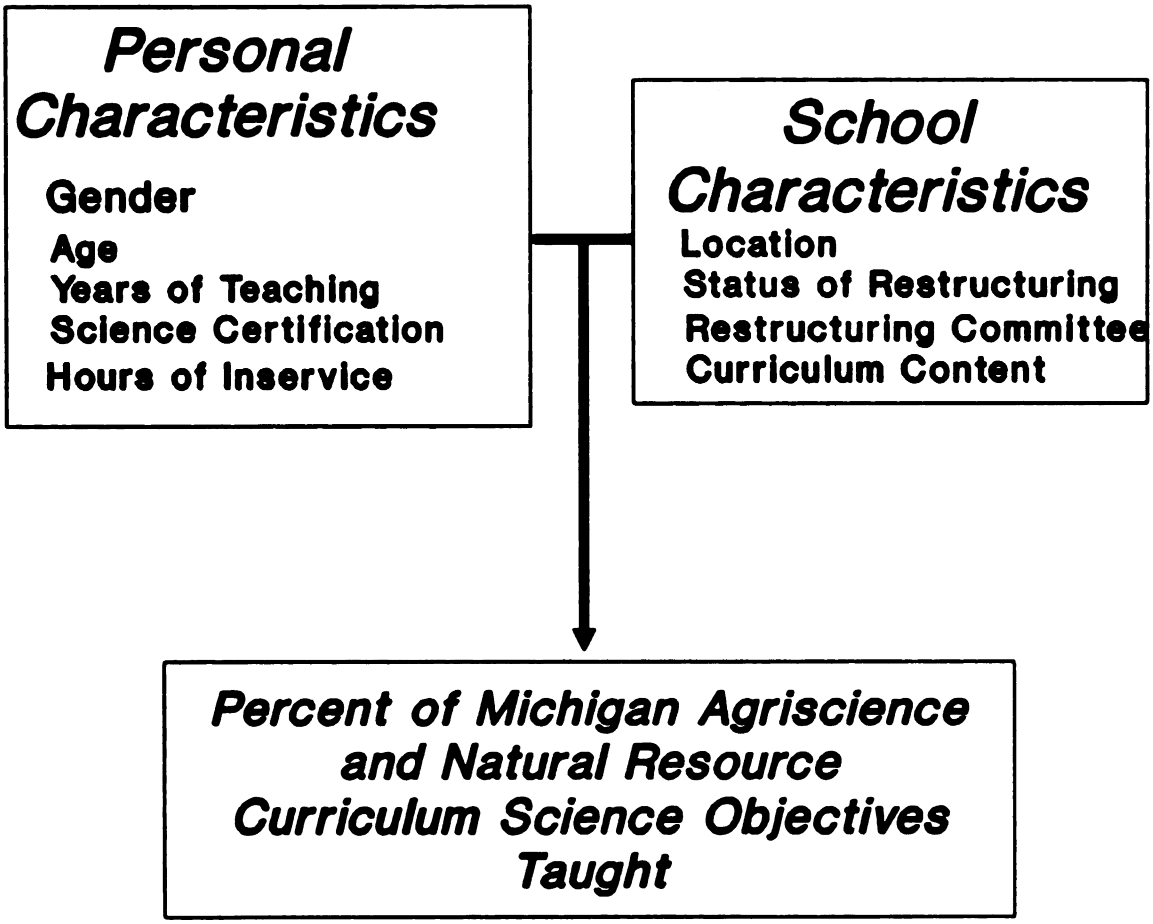


Figure 4. Operational Framework for Objective 2.

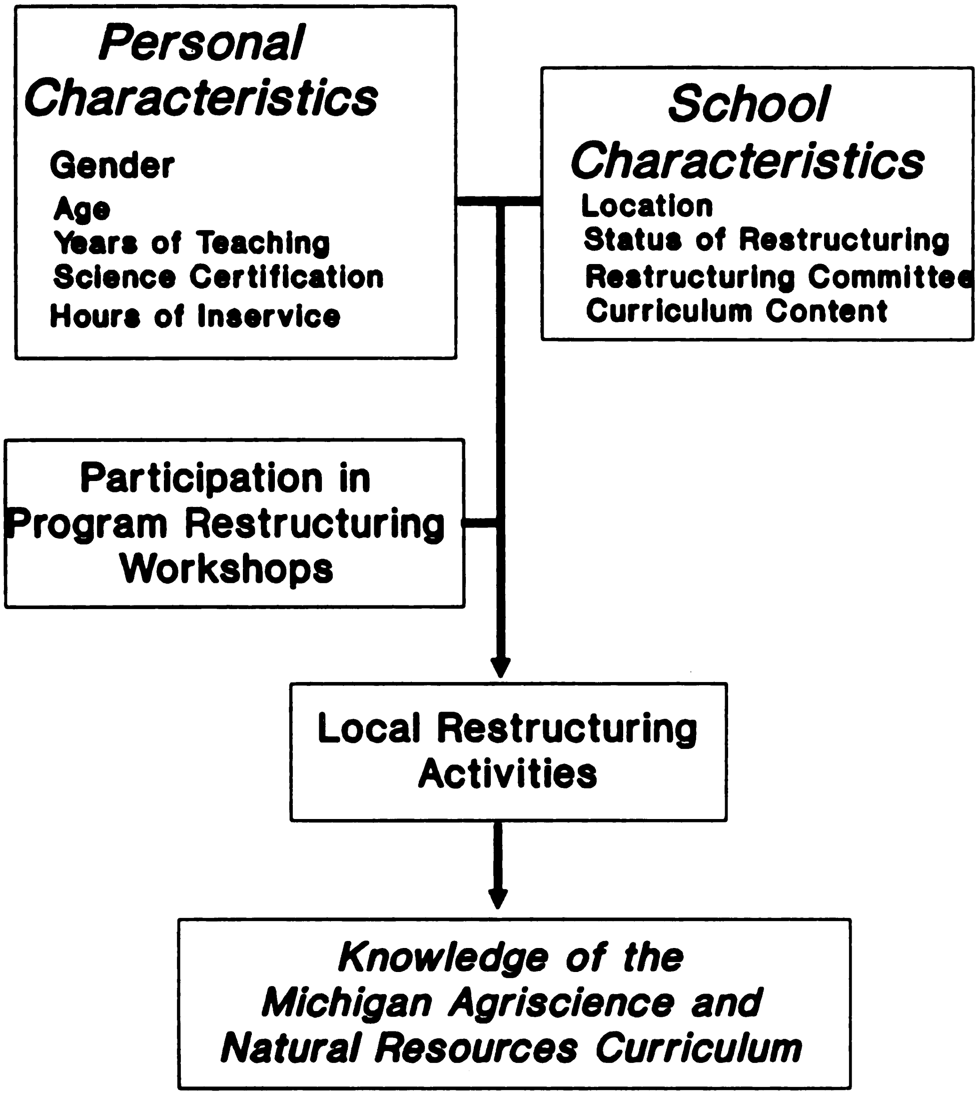
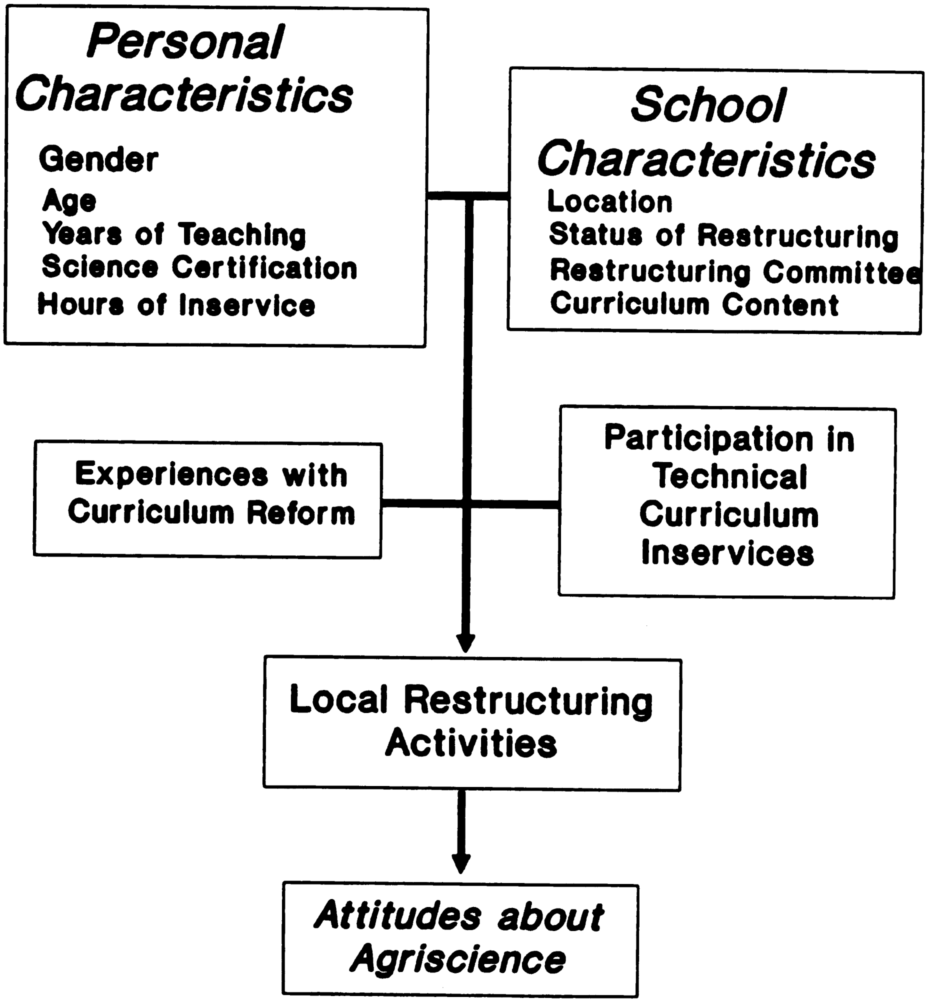


Figure 5. Operational Framework for Objective 3.



<u>Figure 6</u>. Operational Framework for Objective 4.

Conclusion

The research studies discussed earlier showed that science principles and concepts have been taught in agricultural education classes for many years. Agricultural education courses closely resemble such courses as biology, earth science, physical science, and environmental education. One method agricultural teachers have used to successfully incorporate science concepts into the curriculum is by teaching science through inquiry. Many research studies have shown that students' science achievement and attitudes towards science have improved when their teachers used the inquiry method of instruction.

Agricultural teachers have also taught science concepts using hands-on, activity based instruction. This hands-on method of instruction has been shown to be ideal for teaching science concepts. The development of new curricula in agriscience and natural resources has placed agricultural education in the position to become a legitimate alternative to traditional, lecture based science courses. However, the attitudes of students and teachers about agriscience and natural resources are important to the success of new agriscience courses. Teachers must be thoroughly involved in the development of new curriculum materials and in-service training activities before they fully adopt the concept of agriscience education. Only after it has been shown that teachers, administrators, parents, and students accept agriscience and natural resources curricula, will they become a part of the science instruction for all students.

Therefore, this study attempted to show that students who enrolled in agriscience and natural resources classes had science achievement scores equal to students who enrolled in traditional science classes. The study also determined Michigan agriscience and natural resources educators' perceptions of the Michigan Agriscience and Natural Resources Curriculum.

CHAPTER III

METHODOLOGY

Introduction

The methods and procedures used in this study are presented in this chapter. Sections include: an overview of the objectives, the research designs including the populations, variables, instruments, and analyses used in the study.

This study was a pre-experimental study with a descriptive survey research component. Therefore, the study employed two research designs. The design for the pre-experimental study was a static-group comparison design. The descriptive survey component used a one-shot case study, pre-experimental design. Table 1 describes the objectives of the study, the research design that was used to meet the objectives, and the measuring instrument that was used to obtain necessary research data.

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Table 1

Research objectives, designs, and instruments

Objectives	Research Designs	Instrument
1. Determine the influence of science courses (including agriscience and natural resources) on students' science achievement test scores.	Static Group Comparison	Student Science Achievement Test
2. Determine the number of science objectives from the Michigan Agriscience and Natural Resources Curriculum that are being taught by agriscience and natural resource educators.	One-Shot Case Study	Teacher Survey
3. Determine agriscience and natural resources educators' attitudes towards the concept of agriscience instruction.	One-Shot Case Study	Teacher Survey
4. Determine agriscience and natural resources educators' knowledge about the Michigan Agriscience and Natural Resources Curriculum.	One-Shot Case Study	Teacher Survey
5. Determine demographic information on Michigan agriscience and natural resources educators.	One-Shot Case Study	Teacher Survey

Objective 1

Objective 1 investigated the influences on science achievement of high school seniors in four Michigan high schools. The objective stated:

1. Determine the influence of science courses (including agriscience and natural resources) on students' science achievement test scores.

The following sections will address the research design, internal and external validity, variables, and analyses used to test this objective.

Pre-Experimental Design

The static-group comparison design, as described by Campbell and Stanley (1963), was used to test Objective 1. The static-group comparison design uses two groups of subjects. Only one group receives the treatment, while the other group acts as the control for the experiment. Campbell and Stanley (1963) wrote, "this is a design in which a group which has experienced X is compared with one which has not, for the purpose of establishing the effect of X" (p. 12). The diagram of the static-group comparison design is as follows:

$$\begin{array}{cc} X & O_1 \\ \hline & O_2 \end{array}$$

Validity

Internal Validity

The static-group comparison design controlled for four threats to the internal validity listed by Campbell and Stanley (1963). The design controlled for history, testing, instrumentation, and regression. These threats were controlled because the subjects only received one test. Because subjects did not receive a pretest, the threat to history, testing, instrumentation, and regression was eliminated. The threat of the interaction of selection and maturation was also controlled by using stratified random sampling to select the schools which took part in the study and a census of all seniors in those schools. The threats from selection, mortality, and maturation were present because each individual subject was not randomly selected and there was no pretest to determine if the independent variable caused the change in the dependent variable. However, because all seniors in the participating schools took part, these threats were controlled through randomization.

External Validity

The research design which was used was checked for external validity using the threats identified by Bracht and Glass (1968). Bracht and Glass placed the threats to external validity into two classes: population, and ecological. The first threat to population validity was the comparison of the experimentally accessible population and the target population. The target population of this study was all seniors in high schools that offered agriscience and natural resources in Michigan. The experimentally accessible population was all seniors in Michigan high schools that had restructured agriscience and natural resources programs. A stratified random sample was drawn from the experimentally accessible population. The generalization from the sample to the experimentally accessible population was based on sound experimental procedures. Therefore, the results of the stratified sample can be generalized to the experimentally accessible population.

To generalize to the target population it must be shown that the experimentally accessible population was similar to the target population. The experimentally accessible population was all high schools in Michigan that have completed the restructuring process to agriscience and natural resources programs. The target population consisted of high schools that had agriscience and natural resources programs but had not completed the restructuring process.

The second threat to population validity was the interaction of personological variables and the treatment. The treatment, agriscience and natural resources courses, may have affected some students differently than others. This threat was reduced by the use of stratified randomization to select schools that were part of the sample and by taking a census of all seniors in those schools. One personological variable was also controlled by building it into the study. Only high school seniors were studied. This reduced the threat of using students from different grade levels. Gender, socioeconomic status of the students' families, the students' grade point averages for all their classes, their science courses, and their agriscience and natural resources classes were extraneous variables to the design. These variables' affect on the dependent variable was investigated in this study.

One threat to the ecological validity of the study was the explicit description of the independent variable. The independent variable in this study was the number of credits earned in agriscience and natural resource courses. Agriscience and natural resources courses are part of an agriscience and natural resources program that has been restructured under the guidelines of the Michigan Department of Education. Agriscience and natural resources programs include courses in natural resources and Michigan agriculture, plant science, and animal science. The number of science credits completed was measured using Carnegie units. One Carnegie unit is equal to a full-year course, or one hour a day for 180 days. Therefore, six semester classes per year for four years represents 24 Carnegie units.

The threat of multiple treatment interference was not present in this study. The independent variable, course credits in agriscience and natural resources courses, was the only naturally occurring treatment. Therefore, there was no possibility of multiple treatment interference.

The Hawthorne effect could have been a threat to the external validity of this study because the subjects were aware that they are participating in a research study. The high school seniors who constituted the experimentally accessible population knew the science achievement test they were taking was part of a research study. However, the students had no opportunity to alter their responses to the test just because it was part of a research study. The science achievement of students was measured using a standardized science achievement test. High school students are tested throughout their high school years to measure their knowledge in math, science, and English. Because of this, the subjects probably did not alter their responses to the test questions, therefore no Hawthorne effect was present.

The same was true for the novelty and disruption effects of the treatment. Because the subjects did not receive an active treatment, there was no novelty or disruption from a "new" or "unique" treatment. The threat to external validity by the experimenter was also non-existent. The experimenter did not play a part in the treatment and therefore did not effect the results. The threat to pretest sensitization was also eliminated in this study. Because there was no pretest, the students were not sensitized to the test measuring the dependent variable. Posttest sensitization was also reduced in this study because only high school seniors were studied. The test for the dependent variable was administered near the end of their high school years. Therefore, the chance of the posttest helping students acquire the concepts from science was very small. Because there was no pretest, the threat from the interaction of history and treatment effects was reduced. Therefore, naturally occurring events in life did not have an effect on the treatment and was not a threat to the generalizability of the study.

The measurement of the dependent variable was not a threat to the external validity of the study. This was because the dependent variable, science achievement, was measured using a standardized science test that was proven to be a reliable measure of science knowledge.

The final threat to the external validity of the study was the interaction of time of measurement and treatment effects. This was controlled by testing high school seniors' science achievement near the end of their high school years. At the time of testing, most of the subjects had completed all their science classes in high school. This eliminated the effect of measuring the dependent variable immediately after the treatment.

The use of the static-group comparison design provided a great deal of control from both the threats to internal and external validity of the study. Because the threats were controlled, the results of the sample were generalizable to the experimentally accessible population and to the target population of this study.

Face Validity

The standardized science achievement test that was used in this study was developed by a professional test development company, American Testronics. This company regularly develops high school subject tests for 17 different areas. The tests were professionally designed and have been used by many high schools nationwide to measure cognitive knowledge of high school students. The high school biology subject matter test from American Testronics was used because it contained sections related directly to the objectives of the Michigan Agriscience and Natural Resources Curriculum.

Content Validity

The content validity of the high school science achievement test was determined by the professionals at American Testronics who developed the instrument. American Testronics used curriculum specialists from high schools and universities to develop the tests. American Testronics (1990) stated that, "For each subject test, they [curriculum specialists] determined major content areas through extensive analysis of curriculum materials from national organizations, leading subject-area textbooks, and materials and objectives from various school systems across the country" (p. 5). These procedures ensured a valid subject matter test.

Reliability

Reliability is defined by Borg and Gall (1983) as the "level of internal consistency or stability of the measuring device over time" (p. 281). Reliability for the science achievement test was determined by the company that developed the test, American Testronics. American Testronics (1990) reported, "for the *High-School Subject Tests*, the reliability coefficients have been computed using the Kuder-Richardson Formula 20 (KR20)" (p. 7). A Kuder-Richardson reliability coefficient of .85 was reported for the Biology test, the high school subject matter test that was used to measure the dependent variable.

Population

The target population for Objective 1 of this study was 156 high school seniors in four Michigan high schools that offered agriscience and natural resources programs. The experimentally accessible population was all seniors in four Michigan high schools that had restructured agriscience and natural resources programs. A random sample of the experimentally accessible population was selected. From this sample of high schools, a census of all 156 seniors was studied.

Variables

Independent Variables

The independent variable for Objective 1 was the number of credits earned in science by high school seniors. The science credits used included credits in: chemistry, biology, agriscience and natural resources, earth science, and environmental science. The science credits were measured using Carnegie units. The Carnegie units of measurement were described earlier in the section on internal validity. Information pertaining to the number of science credits completed is shown in Appendix D.

Extraneous Variables

The extraneous variables to this design included personal characteristics of the subjects and characteristics of the schools that were part of the sample population. The personal characteristics of the subjects included gender, socioeconomic status of the students' families, grade level, and students' ability level as indicated by their grade point averages in all classes, and agriscience and natural resources classes. These variables were controlled by building them into the design of the study. The students' gender, socioeconomic status, and grade point averages were all measured and analyzed to determine their influence on the dependent variable. The grade level of the subjects was held constant by only studying high school seniors in the schools that were part of the sample population. The school characteristics that acted as extraneous variables to this design included the science curriculum taught in the school, teachers' characteristics, and instructional methods utilized to teach science. These extraneous variables were controlled by randomly selecting the schools that were a part of the sample population, and by taking a census of all seniors in those schools. The use of randomization thus reduced the threat that these extraneous variables had on the dependent variable.

Dependent Variables

The dependent variable in this design was science achievement of high school students. It was measured using a standardized science achievement test. The test was a high school subject test for biology knowledge (see Appendix B). The biology test was selected because it contained content areas related to the objectives taught in agriscience and natural resources classes.

Data Analysis

High school subject test

The high school subject tests were analyzed by the Scoring Office at Michigan State University. Students' score sheets were analyzed for correct and incorrect responses to the test questions. The Scoring Office also provided means, standard deviations, and percentile ranks for all four schools tested.

Demographic information

To obtain demographic information on the high school seniors who completed the test, a family information questionnaire was developed (see Appendix C). The questionnaire was developed by the researcher to determine the socioeconomic (SES) status of each student's family. The SES calculation has been used by Lee (1983), Bogie (1976), Marini and Greenberger (1978), DeBoard et al. (1977), and Gottfredson (1981) to determine the effect socioeconomic status had on students' vocational and occupational aspirations of high school students. The instrument contained questions about each student's father's and mother's occupation and highest level of education. Questions to determine the family's income and kind of household possessions were also included in the instrument.

The questionnaire also asked for the students' gender, age, racial identification, grade point average (GPA), and grades in all their science classes. To ensure statistical accuracy, the GPAs and science grades reported by each student were cross-referenced with the school's records for each student who completed the test.

The information obtained from the family information questionnaires was coded and analyzed to determine a socioeconomic score for each student. Each answer to the socioeconomic questions was given a corresponding numeric value (see Appendix C). A Z score for each student was then calculated on each question. The Z scores for each question were then added together and divided by the number of variables to determine a socioeconomic (SES) score for each student. The Z scores were recoded into quartiles for reporting purposes. Raw Z scores were used in the multiple regression analysis for Objective 1.

Analysis tests

The analysis tests that were used for Objective 1 were analysis of variance (ANOVA), multiple regression, and semi-partial regression. Semi-partial regression was used to determine which set of variables had the greatest effect on the dependent variable. Alpha was set *a prior* at .05.

Objectives 2 - 5

Objectives 2 through 5 of the study addressed the perceptions of Michigan agriscience and natural resources educators towards the Michigan Agriscience and Natural Resources Curriculum. The objectives were as follows:

2. Determine the number of science objectives from the Michigan Agriscience and Natural Resources Curriculum that was being taught by agriscience and natural resource educators.
3. Determine agriscience and natural resources educators' attitudes towards the concept of agriscience instruction.

4. Determine agriscience and natural resources educators' knowledge about the Michigan Agriscience and Natural Resources Curriculum.
5. Determine demographic information on Michigan agriscience and natural resources educators.

Pre-Experimental Design

Objectives 2 through 5 were studied using descriptive survey research. The descriptive survey component of this study used a one-shot case study, pre-experimental design. Campbell and Stanley (1963) discussed this design when they stated "Much research in education today conforms to a design in which a single group is studied only once, subsequent to some agent or treatment presumed to cause change" (p. 6). The design is outlined as follows:

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The one-shot case study is used as a minimum reference point for guiding future research studies. The design lacks control of all the threats to internal validity stated by Campbell and Stanley. However, this design was only used as a guide for the descriptive survey research part of the study. Because descriptive research seeks only to explore phenomena and gain new insights into current events in life, the use of the one-shot case study design did not weaken this part of the study.

Validity

Internal Validity

The one-shot case study is a pre-experimental design that lacks any control of variables in the study. However, the purpose of this descriptive survey research study was to accurately describe the current attitudes and characteristics of Michigan agriscience and natural resources educators, and not to control any variables.

The one-shot case study design has definite weaknesses in the areas of history, maturation, selection and mortality. History and maturation were threats because the researcher could not differentiate between the effect of the Michigan Agriscience and Natural Resources Curriculum and the effects from history or the maturation of the respondents. The threat to selection was controlled by conducting a census of all Michigan agriscience and natural resources educators. Mortality was a threat because some of the subjects in the census did not respond for reasons which might have been caused by their perceptions of Michigan Agriscience and Natural Resources Curriculum. This threat was addressed by controlling for non-response error.

External Validity

The descriptive survey part of this study was checked for external validity using the threats identified by Bracht and Glass (1968). Bracht and Glass placed the threats to external validity into two classes: population and ecological. The first threat to population validity was the comparison of the experimentally accessible population and the target population. This threat was controlled by conducting a census of all Michigan agriscience and natural resources educators. Because all educators were surveyed, the target and experimentally accessible populations were the same.

The threat from the interaction of personological variables and the treatment was not present in this part of the study because there was no active independent variable. The independent variable was the naturally occurring use of the Michigan Agriscience and Natural Resources Curriculum by educators.

The independent variable was the use of the Michigan Agriscience and Natural Resources Curriculum. The curriculum consists of four basic core units. However, only units 100, 200, and 300 are cross-referenced with the Michigan State Science Objectives as outlined by the State Department of Education. All agriscience and natural resources teachers were familiar with the curriculum.

The threat from multiple treatment interference was not present in this study because no active treatment was given to the population. The subjects' use of, and perceptions about, the Michigan Agriscience and Natural Resources Curriculum were the only naturally occurring treatments.

The Hawthorne effect was a threat to this study because the educators knew the questionnaire was part of a research study. The educators may have altered their responses because the questionnaire was distributed from the Department of Agricultural and Extension Education, the same department that developed the Michigan Agriscience and Natural Resources Curriculum. This may have caused the educators to change their answers and give the curriculum positive ratings. This was also the reason why the threat from novelty and disruptive effects was present in this study. The Michigan Agriscience and Natural Resources Curriculum was a newly developed curriculum that the educators had only been using for two years. The novelty of using the new curriculum may have caused the educators to respond differently to the survey questions.

The experimenter effect was also a threat to this study. Because the cover letters were signed by the individual who organized the curriculum development effort, educators might have altered their responses on the questionnaire.

Posttest sensitization, interaction of history and treatment effects, measurement of the dependent variable, and interaction of time of measurement and treatment effects were not present in this study because there was no active treatment given to the educators. The survey questionnaire only sought the educators' perceptions and attitudes about the Michigan Agriscience and Natural Resources Curriculum.

Face Validity

The instrument was checked for face validity by professionals in the area of agriscience and natural resources. The questionnaire was edited and changed to improve its appearance.

Content Validity

The content validity of the instrument was also verified by a panel of experts familiar with agriscience and natural resources education. Changes were made to improve the clarity and reduce ambiguity in certain questions.

Reliability

The instrument was checked for reliability with a sample of Michigan agriscience and natural resources educators. Reliability was calculated using the Statistical Package for the Social Sciences (SPSS/PC+). Cronbach's alpha coefficients ranged from .72 to .95.

Population

The target population for the descriptive survey was all Michigan agriscience and natural resources educators. Because there were only 140 agriscience and natural resource educators in Michigan during 1991-92, a census of all educators was conducted. Therefore the experimentally accessible population was also the target population for the survey. The survey had a final response rate of 122 teachers, or 87% of the population.

Reducing Sampling Bias

Frame Error

Frame error was controlled by checking the list of Michigan agriscience and natural resources teachers with agricultural education specialists from the Department of Agricultural and Extension Education at Michigan State University. The list was double checked with the agricultural education supervisor from the State Department of Education. Agriscience and natural resources teachers who had retired or resigned were taken off the list and new teachers were added.

Selection bias

Selection bias was eliminated from this study by conducting a census of all Michigan agriscience and natural resources educators. This eliminated the possibility of certain teachers having a better chance than other teachers of receiving a survey.

Non-response error

Non-response error was controlled by following the Total Design Method (Dillman, 1978). A postcard reminder was sent to all Michigan agriscience and natural resources educators. Nonrespondents were then sent a follow-up letter with a replacement questionnaire. A total of three follow-up mailings were sent with replacement questionnaires.

Returned questionnaires were coded by the date they were received. Early respondents were compared to late respondents on their responses to survey questions. T-tests were used to test for any differences. No significant differences existed between early and late respondents. Miller and Smith (1983) stated, "research has shown that late respondents are often similar to nonrespondents" (p. 48). Because the late respondents were not significantly different from the early respondents, the results are generalizable to the target population.

Instrument Development

The survey instrument (see Appendix F) used in this study was developed from a similar survey conducted by Peasley and Henderson (1991). Part I contained 70 objectives from Units 100, 200, and 300 of the Michigan Agriscience and Natural Resources Curriculum. Michigan agriscience and natural resources educators were asked to indicate whether or not they taught each of the 70 objectives in their agriscience and natural resources classes. ANR teachers in horticulture programs indicated whether or not they taught 27 objectives in units 100 and 200, Natural Resources and Michigan Agriculture and Plant Science.

Part II used a seven-point semantic differentiation scale to determine Michigan agriscience and natural resources educators' attitudes towards the concept of agriscience. Thirteen pairs of adjectives were included to determine if respondents had a negative or positive attitude about agriscience.

Part III contained 11 Likert scale questions used to determine Michigan agriscience and natural resources educators' perceptions of agriscience and natural resources as an alternative to production agriculture programs.

Part IV contained 10 questions used to determine Michigan agriscience and natural resources educators' knowledge about the Michigan Agriscience and Natural Resources Curriculum development process. Part V contained 12 demographic questions about respondents' gender, age, race, years of teaching, and program characteristics.

Data Analysis

The survey instruments were analyzed using the Statistical Package for the Social Sciences (SPSS/PC+) (SPSS Inc., 1991). The data was analyzed using frequencies, means, and standard deviations. Statistical tests used included correlations, semi-partial regression, and multiple regression.

CHAPTER IV

FINDINGS

Objective 1

Objective 1 was to determine the influence of science courses (including agriscience and natural resources) on students' science achievement test scores. The independent variable for Objective 1 was the number of science credits earned in science by high school seniors. The dependent variable was high school seniors' scores on the High School Subject Test-Biology. Extraneous variables to this objective included students' gender, socioeconomic status of the students' families, grade level, and students' grade point average. Variables were analyzed using multiple regression.

Independent Variables

A total of 156 seniors from four Michigan high schools took the high school science achievement test. The four high schools that participated in the research study were Beal City, Cassopolis, Benzie, and Port Hope. Table 2 shows the number of male and female seniors from the four participating schools. Fifty-four percent of the seniors were male and 46% were female.

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Table 2

Gender of high school seniors by school

School	Male		Female		Column Totals	
	N	%	N	%	N	%
Beal City	12	41.0	17	59.0	29	18.7
Cassopolis	28	61.0	18	39.0	46	29.7
Benzie	37	54.0	32	46.0	69	44.5
Port Hope	6	55.0	5	45.0	11	7.1
Row Totals	83	54.0	72	46.0	155	100.0

Seniors at participating high schools completed a family information survey (see Appendix J). The survey contained questions pertaining to the students' parents' or guardians' occupation and level of education, family income, and household possessions. Each response was coded with a specific value.

Parents' Occupation

Over 32% of the seniors listed craftsman as the occupation of their father or male guardian. Twenty-six percent of the respondents listed clerical as the occupation of their mother or female guardian. Table 3 shows the frequencies and percentages for each occupation of students' parents or guardians.

Table 3

Occupation of students' parents or guardians

Occupation	Father/male guardian		Mother/female guardian	
	N	%	N	%
Laborer	23	15.8	5	3.9
Service	5	3.4	16	12.5
Operative	21	14.4	6	4.7
Craftsman	38	26.0	7	5.5
Farmer, Farm Manager	10	6.8	3	2.3
Protective Services	3	2.1	1	0.8
Proprietor or owner	19	13.0	7	5.5
Sales	1	0.7	5	3.9
Clerical	4	2.7	42	32.8
Professional	6	4.1	17	13.3
Technical	2	1.4	2	1.6
Manager/ Administrator	9	6.2	11	8.6
School Teacher	3	2.1	6	4.7
Professional-physician	2	1.4	0	0.0
Totals	146	100.0	128	100.0

Parents' education level

The highest level of education for a majority of the seniors' fathers and mothers was high school. Smaller percentages had attended either vocational/technical school or some college. Table 4 shows the frequencies and percentages in each category.

Table 4

Highest level of education

Level of Education	Father/male guardian		Mother/female guardian	
	N	%	N	%
Less than high school	11	7.5	8	5.3
High school graduate	81	55.1	77	51.0
Vocational/trade, business school, or less than 2 years of college	44	29.9	54	35.8
Completed college	9	6.1	11	7.3
Advanced degree	2	1.4	1	0.7
Total	147	100.0	151	100.0

Parents' Income

Over 35% of the seniors indicated that their families' income was between $20,000 and $34,999, followed by $35,000 or more, and $19,000 or less. Twenty-three percent of the seniors did not know their families' income or did not respond to the question. Table 5 shows the frequencies and percentages in each income category.

Table 5

Family income

Income	Frequency	Percent
$19,000 or less	21	13.5
$20,000 to $34,999	55	35.3
$35,000 or more	44	28.2
Don't know/ or missing	36	23.1
Total	156	100.0

Household Possessions

Seniors were asked whether they had specific possessions available to them in their home. Some of the possessions listed included a place to study, newspapers, books, calculator, computer, VCR, and CD player. Responses were coded with a value of two if the item was available, or a value of one if the item was not available. Scores were then included in the socioeconomic status calculation. Table 6 outlines the number and percentage of respondents who had the item in their home. All respondents, 100%, indicated that they had a color television in their home. Only 30.1% of respondents had a compact disc (CD) player, and 34.5% had a computer in their homes.

Table 6

Household possessions

Items	N	%
A specific place to study	84	54.2
A daily newspaper	117	75.5
Encyclopedia, reference books	133	86.9
Typewriter	125	80.6
Electric dishwasher	75	48.4
Two or more working cars/trucks	144	92.9
More than 50 books	136	87.7
Own room	134	87.0
Pocket calculator	146	94.8
Color TV	155	100.0
Computer	53	34.6
Video tape recorder (VCR)	148	95.5
Computer disc (CD) player	46	30.1

Z scores were calculated for each individual's socioeconomic status. Z scores were then categorized into quartiles for reporting purposes. Raw Z scores were used for regression analysis.

Seniors were asked four demographic questions. The questions asked for the seniors' gender, age, race, and current grade point average. As stated earlier, 54% of the high school senior were male and 46% were female. The youngest senior was 17 years old and the oldest was 19 years old. The mean age for all the seniors was slightly over 17½ years. Over 86% of the seniors were white, 7.2% were black, 2.0% were American Indian, 1.3% were Asian, and 0.7% were Hispanic. Table 7 illustrates the number and percentage of each race from the four high schools that participated in the study.

Table 7

Race of high school seniors by school

Race	Beal City	Cassopolis	Benzie	Port Hope	Row Totals
American Indian	0	2 (4.4%)	1 (1.4%)	0	3 (2.0%)
Asian	0	1 (2.2%)	1 (1.4%)	0	2 (1.3%)
Black	0	11 (24.4%)	0	0	11 (7.1%)
White	28 (100%)	28 (62.2%)	66 (95.7%)	10 (90.9%)	132 (86.3)
Hispanic	0	0	0	1 (1.4%)	1 (0.7%)
Other	0	3 (6.7%)	1 (1.4%)	0	4 (2.6%)
Column Totals	28 (18.3%)	45 (29.4%)	69 (45.1%)	11 (7.2%)	153 (100%)

The seniors were asked to specify their current grade point average. In order to increase the validity of the research, the information that the seniors provided was double checked with their official school records. Where discrepancies existed, the official grade point average was used for analysis. Seniors were also asked to list the different science classes they had completed and the grade they received. Grade point averages for students who had completed classes in agriscience and natural resources were calculated.

The mean grade point average for all students was 2.70 with a standard deviation of .69. The total number of science credits and agriscience and natural resources credits was determined from the questionnaires. The mean number of science credits completed for all respondents was 2.79. The mean number of agriscience credits completed was .79. Over 100 seniors, 68.6%, never had a class in agriscience and natural resources. Forty-nine students, 31.4%, did have classes in agriscience and natural resources. Table 8 displays the means, standard deviations, minimum, and maximum number of credits for the respondents. Raw data for the science credits completed is in Appendix D.

Table 8

Mean number of science and agriscience and natural resources credits completed by respondents

Class	Mean	S.D.	Min.	Max.	N
Science credits	2.79	1.13	.5	6.0	156
Agriscience and Nat. Resources	1.47	.79	.5	3.5	49

Dependent Variable

The High School Subject Test - Biology that was used to measure science achievement consisted of 60 multiple choice questions. The mean score of all seniors who completed the test was 22.79.

Analysis

Correlational Analysis

Correlations were performed to determine if the dependent variable, score on the science achievement test, could be correlated with demographic variables of the students. Because all variables were measured on the interval scale, Pearson product-moment coefficients were used for the correlations. The correlations found a substantial positive (Davis, 1971) correlation between students' grade point average and their science achievement test scores. There were moderate correlations between students' scores and the number of science credits they had completed. Results of the correlations are shown in Table 9.

Table 9

Correlations between students' science achievement scores and various demographic variables

Variable	Coefficient	Description
Overall G.P.A.	.57	Substantial
Science credits	.49	Moderate
Agriscience and Nat. Resources G.P.A.	.27	Low
Socioeconomic status	.24	Low
Agriscience and Nat. Resources Credits	-.07	Negligible

Regression Analysis

A multiple regression analysis was conducted on the variables related to Objective 1. The multiple regression analysis was conducted to determine if relationships existed between the independent variables and the dependent variable, science achievement test scores.

Semi-partial multiple regression coefficients were calculated for three variable sets. The first set included six demographic variables. The semi-partial regression (sR^2) was .08 for the demographic variable set. Then the overall grade point averages were added to the equation. The GPA produced a semi-partial coefficient (sR^2) of .27. The final variable set was the number of science credits completed. Semi-partial regression (sR^2) for this variable set was .07. Table 10 shows the results of the semi-partial regression analysis.

Table 10

Semi-partial regression coefficients for independent variable sets with science achievement scores

Variable Set	sR^2	F
Demographic variables	.08	.0177 *
Overall G.P.A.	.27	.0000 *
Science credits	.07	.0000 *
Total	.43	.0000 *

* p<.05

A multiple regression analysis was conducted to determine which independent variables were associated significantly to the students' scores on the science achievement test. The beta value indicates the amount of change associated with the intercept for each unit of the variable being measured. There was a direct change for dichotomous variables and an indirect change for continuous variables. The comparison group for the regression analysis was white senior high school students. Students' overall G.P.A. and the number of science credits completed were the significant variables in the regression. Table 11 contains the data from the regression analysis.

Table 11

Multiple regression of students' science achievement scores on their independent variables

Independent Variables	Beta (β)	t value
Intercept	-6.26	.67
Demographic variables		
ANR students/ non ANR students	-1.56	.13
Gender	-1.26	.19
Age	.74	.36
Blacks	-1.14	.56
Race (other than black or white)	2.20	.26
Overall G.P.A.	4.70	.00 *
Science credits	2.08	.00 *

* $p<.05$
$R^2 = .43$

Hypothesis test

The hypothesis for Objective 1 was as follows:

H_0 Students who had agriscience and natural resources courses will have mean scores equal to students who did not have agriscience and natural resources courses.

Using the research hypothesis as a guide, an alternate hypothesis, H_1, was developed.

H_1 Students who had agriscience and natural resources courses will have mean scores that are not equal to students who did not have agriscience and natural resources courses.

For testing purposes, the hypotheses were diagramed as follows,

$$H_0 \quad \mu_1 = \mu_2$$

$$H_1 \quad \mu_1 \neq \mu_2$$

The regression analysis was used to determine if seniors who had agriscience and natural resources (ANR) classes differed from seniors who did not have ANR classes on the science achievement test. Alpha was set *a prior* at .05. Because H_0 was a non-directional hypothesis, a two tailed t-test was used. Two-tailed probability was .13 with a t value of -1.48. No significant differences were found between the two groups. Therefore, H_0 was tenable. The alternative hypothesis, H_1, was rejected.

Objective 2

Objective 2 sought to determine the number of science objectives from the Michigan Agriscience and Natural Resources Curriculum that were being taught by Michigan agriscience and natural resources educators. The objectives that were listed in the questionnaire were from Units 100, 200, and 300 of the Michigan Agriscience and Natural Resources Curriculum. These objectives were selected because they were cross-referenced with the State Science Objectives for Secondary Students as specified by the Michigan Department of Education. Raw data for each objective are located in Appendix K.

The percentage of objectives taught for each respondent was calculated. However, because the survey included both teachers in comprehensive agriscience and natural resources programs and teachers in primarily horticulture programs, the percentage of objectives taught by Michigan agriscience and natural resources educators should be viewed with caution.

To clarify this, percentages were calculated separately for Michigan agriscience and natural resources educators (70 objectives) who teach Units 100, 200, and 300, and horticulture teachers (27 objectives) who teach Units 100 and 200 only. Table 12 lists the mean percentage of objectives taught, the standard deviation, minimum, maximum, and number of respondents.

Table 12

Mean percentage of Michigan Agriscience and Natural Resources Curriculum objectives taught

Group	Mean	S.D.	Min.	Max.
All Respondents (n=110)	81%	19%	0	100%
ANR teachers (n=80) (not including hort.)	83%	18%	0	100%
ANR teachers (n=28) (horticulture only)	79%	16%	44%	100%

The percentage of objectives taught was also placed into quartiles for reporting purposes. The largest percentage of all three groups taught between 75 and 100% of the curriculum objectives. Table 13 shows the number and percentage of respondents in each quartile.

Table 13

Percentage of Michigan Agriscience and Natural Resources Curriculum objectives taught by quartiles

Percent	All Teachers		ANR (except hort.)		ANR (hort. only)	
	N	%	N	%	N	%
1 - 25%	7	6.6	2	2.6	0	0.0
26 - 50%	22	20.8	2	2.6	3	10.7
51 - 75%	24	22.6	21	27.3	8	28.6
76- 100%	53	50.0	52	67.5	17	60.7
Totals	106	100.0	77	100.0	28	100.0

Correlational Analysis

Correlations were performed to determine if relationships existed between independent variables and the dependent variable, the percentage of science objectives taught. The correlation found that rural schools, the hours of technical in-service teachers received, and science certification of the teachers were found to have moderate positive correlations with the percentage of science objectives taught. Urban and suburban schools and the gender of the teacher were found to have moderate negative correlations with the dependent variable. Table 14 contains the results of the correlations.

Table 14

Correlations between students' science achievement scores and various demographic variables

Variable	Coefficient	Description
Urban schools	-.44	Moderate
Rural schools	.40	Moderate
Science certification	.39	Moderate
Gender of teachers	-.39	Moderate
Suburban schools	-.32	Moderate
Hours of in-service	.23	Moderate

Regression Analysis

A semi-partial regression was conducted to determine the influence of two different variable sets on the dependent variable, percentage of science objectives taught. The first variable set included demographic variables of the teacher. This set produced a semi-partial coefficient (sR^2) of .56. The independent variable set included program variables and the science certification of the teacher. It produced a semi-partial coefficient (sR^2) of .12 for a total R^2 of .68. Table 15 illustrates the results of the semi-partial regression.

Table 15

Semi-partial regression coefficients for independent variable sets with percentage of science objectives taught by teachers

Variable Set	sR^2	F
Demographic variables	.56	5.27 *
Independent variables	.12	4.37 *
Total	.68	4.37 *

* $p<.05$

A multiple regression analysis was conducted on the variables related to Objective 2. The multiple regression analysis was conducted to determine if relationships existed between the independent variables and the dependent variable, percentage of science objectives taught. Significant variables in the regression included teachers from rural schools, schools in a town, and the hours of in-service teachers had completed. Table 16 displays the results from the regression analysis.

Table 16

<u>Multiple regression of the percentage of science objectives taught by teachers on their independent variables</u>

Independent Variables	Beta (β)	t value
Intercept	.31	.45
Demographic variables		
Age	-.01	.14
Gender	-.08	.39
Urban schools	-.09	.60
Town schools	.41	.00 *
Rural schools	.26	.02 *
Years taught	.01	.12
Program variables		
Program restructured	-.00	.91
Hours of in-service	.00	.04 *
Restructuring committee	.16	.41
Science certification	.10	.57

* $p<.05$
$R^2 = .68$

Objective 3

Objective 3 was to determine Michigan agriscience and natural resources educators' attitudes towards the concept of agriscience instruction. Two parts of the questionnaire addressed this objective, a semantic differentiation scale and a Likert scale.

Attitudes About Agriscience

Teacher attitudes towards agriscience were measured using a semantic differentiation scale. The semantic differentiation scale included 13 questions with a pair of descriptors. One descriptor was positive and the other was negative. Each pair of descriptors were separated by seven ratings spaces, three positive, three negative and a neutral. Responses were coded as 1-very strongly negative, 2-strongly negative, 3-slightly negative, 4-neutral, 5-slightly positive, 6-strongly positive, and 7-very strongly positive. Frequencies and percentages for each of the 13 pairs of descriptors are located in Appendix K. Table 17 shows each pair of descriptors, the mean, and the standard deviation for all responses.

Table 17

Semantic differentiation statistics for teachers' attitudes about agriscience

Descriptors	Mean	S.D.
Dispensable/indispensable	5.54	1.44
Bad/good	6.21	.98
Unimportant/important	6.10	1.11
Ineffective/effective	5.62	1.33
Boring/exciting	5.61	1.19
Old/new	5.38 *	1.34
Static/dynamic	5.61	1.18
Archaic/innovative	5.66	1.10
Unnecessary/necessary	5.90	1.28
Unessential/essential	5.85	1.20
Doubtful/sure	5.45	1.31
Unwanted/wanted	5.37 *	1.47
Worthless/valuable	5.91	1.28

* = Slight positive. All others were strong positive.

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A mean for each respondent on the 13 semantic differential questions was calculated. These means were then calculated into one mean for all respondents. Overall, the respondents rated the concept of agriscience a 5.70 on a 7 point scale.

Regression Analysis

A semi-partial (sR^2) regression and a multiple regression were performed to determine the relationships between the independent and dependent variables. The dependent variable for this objective was the respondents' mean score on the 13 semantic differentiation questions.

The semi-partial (sR^2) regression included two variable sets. The demographic variable set included teachers' age, gender, years of teaching, and location of the school. These demographic variables had a semi-partial regression (sR^2) coefficient of .23. The second variable set added into the equation was the program variables, including program restructuring, hours of in-service, the presence of a restructuring committee, and the science certification of the teacher. This variable set had a semi-partial (sR^2) regression of .09. The results of the semi-partial regression are located in Table 18.

Table 18

Semi-partial regression coefficients for independent variable sets with teachers' semantic differentiation mean score

Variable Set	sR^2	F
Demographic variables	.23	1.45
Independent variables	.09	1.23
Total	.32	1.23

A multiple regression analysis was conducted on the variables related to Objective 3. The multiple regression analysis was conducted to determine if relationships existed between the independent variables and the dependent variable, percentage of science objectives taught. The regression analysis found that none of the variables in the equation were significantly associated with the dependent variable. Results are displayed in Table 19.

Perceptions of Michigan Agriscience and Natural Resources Curriculum

Michigan agriscience and natural resources educators were also asked 11 Likert scale questions about their perceptions of agriscience and natural resources. The 11 questions addressed issues such as whether agriscience and natural resources was appropriate for all students, should

Table 19

Multiple regression of teachers' mean agriscience semantic differentiation scores on the independent variables

Independent Variables	Beta (β)	t value
Intercept	3.91	1.93
Demographic variables		
Age	-.01	-.152
Gender	.34	.650
Urban schools	.01	.01
Town schools	.97	1.310
Rural schools	.33	.592
Years taught	-.02	-.605
Program variables		
Program restructured	.43	1.10
Hours of in-service	.01	.886
Restructuring committee	.18	.178
Science certification	.95	1.02

$R^2 = .32$

be given science credit, and was supported by the community. The Likert scale questions used a 5 point scale. The scale was coded as 1-strongly disagree, 2-disagree, 3-undecided, 4-agree, and 5-strongly agree. The means for all 11 Likert scale questions is shown in Table 20. Frequencies and percentages for each question are located in Appendix K.

Table 20

Statistics for Likert scale questions on teachers' perceptions of agriscience and natural resources

Question		Mean	S.D.
1.	An ANR program in high school will give students a solid base for a career in agriculture and natural resources.	4.38	.68
2.	An ANR course should be recommended to all high school students.	3.92	1.01
3.	High school science credit should be awarded for ANR courses.	4.73	.48
4.	My community supports the concept of agriscience and natural resources.	4.12	.83
5.	Teaching an ANR curriculum enables me to more effectively meet the needs of my students.	4.05	.86
6.	An ANR curriculum attracts a diverse group of students.	3.95	.98
7.	I am a supporter of the change to agriscience and natural resources programs.	4.29	.88
8.	I believe that traditional production agriculture programs are better than agriscience and natural resources programs.	2.06	.89
9.	There is evidence to support the change to an ANR based curriculum.	4.11	.74
10.	An ANR program is appropriate for my community.	4.22	.74
11.	ANR programs should be placed in the science department of high schools.	3.99	1.04

Regression Analysis

A semi-partial (sR^2) regression and a multiple regression were performed to determine the relationships between the independent and dependent variables. The dependent variable for this part of Objective 3 was the respondents' mean score on the 11 Likert scale questions.

The semi-partial (sR^2) regression included two variable sets: the demographic variable set and program variables set. The variables in each set were the same as for the semantic differentiation regression. The demographic variables had a semi-partial regression (sR^2) coefficient of .49. The program variable set had a semi-partial (sR^2) regression of .15. The results of the semi-partial regression are located in Table 21.

Table 21

Semi-partial regression coefficients for independent variable sets with Likert scale mean score

Variable Set	sR^2	F
Demographic variables	.49	4.51 *
Independent variables	.15	4.33 *
Total	.64	4.33 *

* $p<.05$

A multiple regression analysis was conducted on the Likert scale mean score for Objective 3. The regression analysis found the years of teaching experience and the intercept, teachers from suburban schools, were significantly associated with the dependent variable, mean perception score. Table 22 outlines the information from the regression analysis.

Table 22

Multiple regression of teachers' mean Likert scale scores on the independent variables

Independent Variables	Beta (β)	t value
Intercept	3.20	3.85 *
Demographic variables		
Urban schools	.51	1.52
Gender	-.11	-.593
Age	.01	.460
Town schools	.49	1.820
Rural schools	.42	2.05
Years taught	-.02	-2.23 *
Program variables		
Program restructured	.04	.304
Hours of in-service	3.87	.930
Restructuring committee	-.12	-.252
Science certification	1.01	2.99

* $p<.05$
$R^2 = .64$

Objective 4

Objective 4 was to determine agriscience and natural resources educators' knowledge about the Michigan Agriscience and Natural Resources Curriculum. The section on agriscience curriculum knowledge contained 10 true/false questions pertaining the development and implementation of the Michigan Agriscience and Natural Resources Curriculum. The mean number of correct responses from all respondents was 6.43, with a standard deviation of 1.16. The minimum number of correct responses was four and the maximum was 10. Table 23 lists the question, the correct answer, and the percentage of correct and incorrect responses.

Regression Analysis

A semi-partial (sR^2) regression and a multiple regression were run to determine the relationships between the independent and dependent variables. The dependent variable for Objective 4 was the respondents' mean score on the 10 knowledge questions.

The semi-partial (sR^2) regression included two variable sets: the demographic variable set and program variables set. The variables in each set were the same as for the semantic differentiation and Likert scale regressions. The demographic variables had a semi-partial regression (sR^2) coefficient of .31. The program variable set had a semi-partial (sR^2) regression of .11. The results of the semi-partial regression are displayed in Table 24.

Table 23

Teachers' knowledge of the Michigan Agriscience and Natural Resources Curriculum

	Question	Correct Answer	Percent Correct	Percent Incorrect
1.	There are four basic core units in the Michigan ANR curriculum.	True	100.0	0.0
2.	There are 11 advanced/ specialized modules in the curriculum.	True	81.0	19.0
3.	The curriculum is cross-referenced with the State Science Objectives for Secondary Students as specified by the Michigan Department of Education.	True	94.5	5.5
4.	The curriculum can be purchased from the Dept. of Ag. and Extension Education at MSU.	False	17.9	82.1
5.	The title and contents of the curriculum was selected by MSU teacher educators in agriculture, MSU agricultural professors, and Dept. of Education staff.	False	21.8	78.2
6.	All agricultural and horticultural programs in Michigan must complete the restructuring process to become ANR programs in 1993.	True	95.5	4.5
7.	It is recommended that students who complete an ANR course should receive science credit towards graduation.	True	96.5	3.5
8.	Students who complete certain advanced/specialized courses will be eligible to receive advanced placement credits towards a B.S. degree at MSU.	True	77.1	22.9
9.	Hours of in-service teachers receive towards qualification to teach the new curriculum are currently being recorded by the Dept. of Ag. and Ext. Ed. at MSU	False	14.3	85.7
10.	Comprehensive high school ANR programs must teach three of the four basic core units of the Michigan ANR curriculum.	False	41.3	58.7

Table 24

Semi-partial regression coefficients for independent variable sets with teachers' mean knowledge scores

Variable Set	sR^2	F
Demographic variables	.32	1.75
Independent variables	.11	1.64
Total	.42	1.64

A multiple regression analysis was conducted on the knowledge score for Objective 4. The multiple regression analysis was conducted to determine if relationships existed between the independent variables and the dependent variable, knowledge score. The regression analysis found that teachers from rural schools and the constant, suburban schools, were significantly associated with the dependent variable, score on the knowledge questions. Table 25 contains the results of the multiple regression.

Table 25

Multiple regression of teachers' mean knowledge scores on the independent variables

Independent Variables	Beta (β)	t value
Intercept	9.00	2.72 *
Demographic variables		
Urban schools	-2.98	-1.82
Gender	-1.40	-1.83
Age	.02	.477
Town schools	-2.08	-1.88
Rural schools	-2.00	-2.13 *
Years taught	-.05	-.918
Program variables		
Program restructured	.95	1.79
Hours of in-service	-.01	-.722
Restructuring committee	-.32	-.153
Science certification	1.01	2.99

* $p<.05$
$R^2 = .64$

Objective 5

Objective 5 was to determine demographic information about Michigan agriscience and natural resources educators. Demographic questions pertained to personal characteristics and characteristics of the agriscience and natural resources program in which the respondent taught. Personal questions included gender, age, race, years of teaching experience, science certification, and hours of technical in-services attended. Program questions included the location of the school, status of program restructuring, assembling of a restructuring committee, and the status of restructuring committee meetings. Michigan agriscience and natural resources educators also provided comments concerning the Michigan Agriscience and Natural Resources Curriculum.

Almost 80% of the Michigan agriscience and natural resources educators who responded to the questionnaire were male, 20.5% were female. Figure 7 shows the number and percentage of respondents by gender.

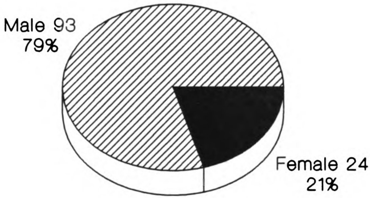


Figure 7. Gender of Michigan agriscience and natural resources educators.

The youngest respondent was 23 years old, the oldest was 60 years old. The mean age of all respondents was 41 years. Raw data on the ages of the respondents is located in Appendix K. Figure 8 lists the categorized ages of the respondents.

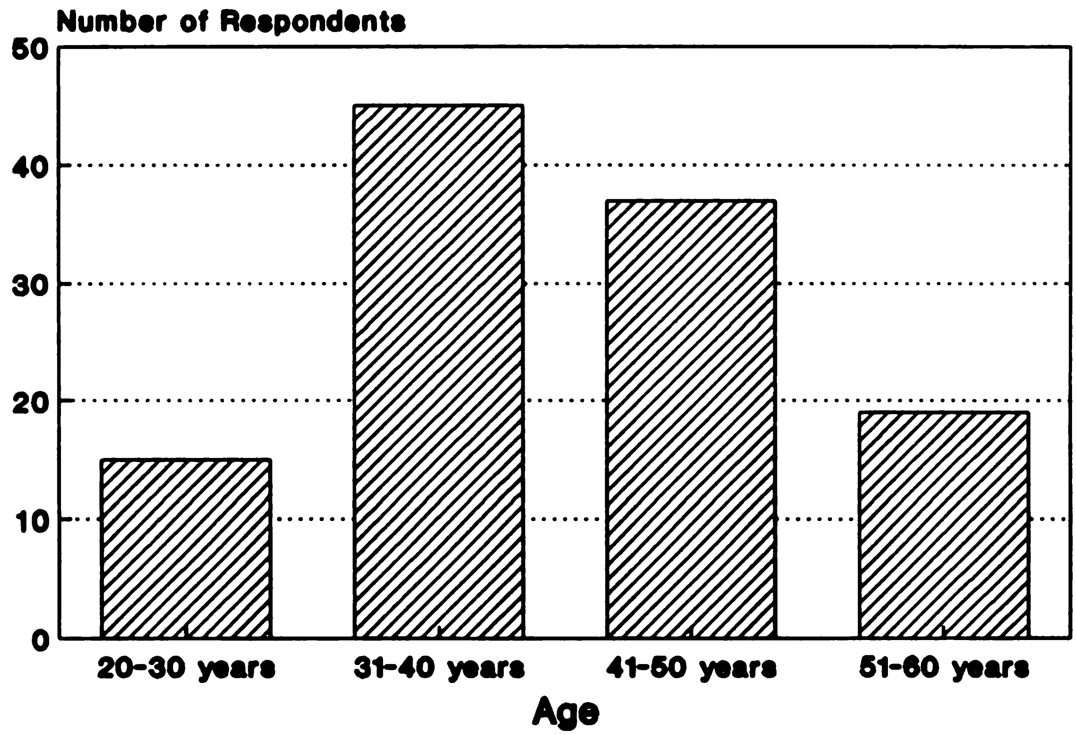


Figure 8. Age of respondents by category

All 116 Michigan agriscience and natural resources educators who responded indicated that they were white. No other race was represented among the respondents.

The educators were asked to state the number of years they have taught. The minimum number of years taught was one, and the maximum number was 35 years. The mean years of teaching experience of all respondents was 15 years. Figure 9 shows the years of teaching experience. Years were grouped for reporting purposes.

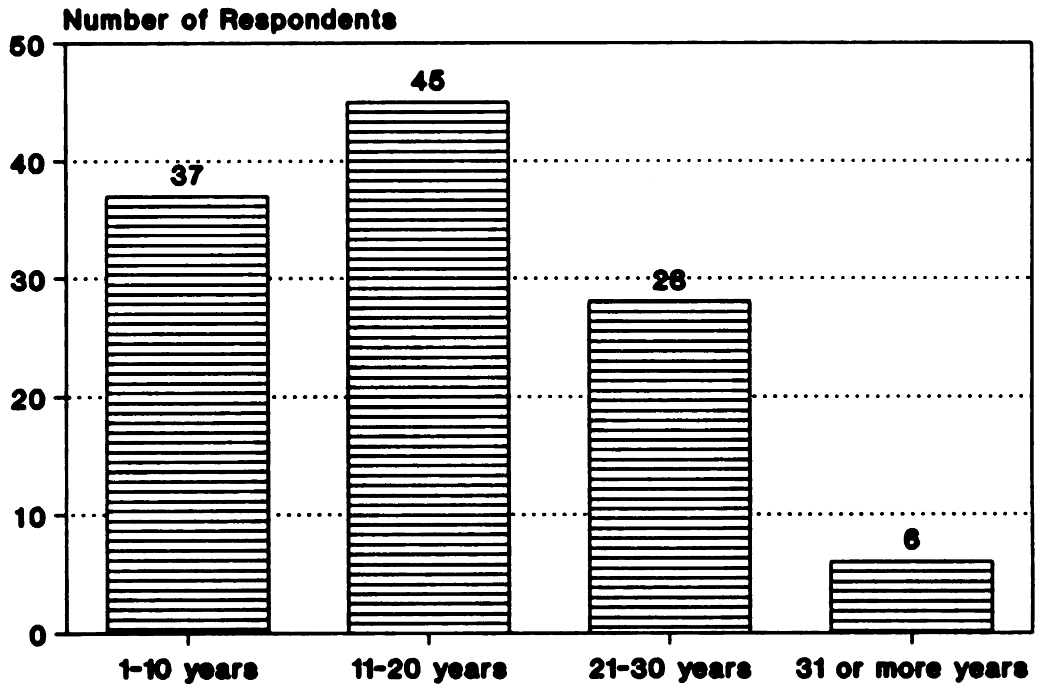


Figure 9. Years of teaching experience of Michigan agriscience and natural resources educators

The largest group of respondents indicated that their schools were located in a rural area. Eleven percent taught in schools in towns, 16.5% in suburban schools, and 9.6% in urban schools.

Michigan agriscience and natural resources educators were also asked if they were certified to teach science. Over 87% of the respondents were certified to teach science. Only 15 teachers, 13%, were not certified to teach science. Sixty percent of these teachers taught in horticultural programs. Figure 10 displays the frequencies and percentages for each group of educators.

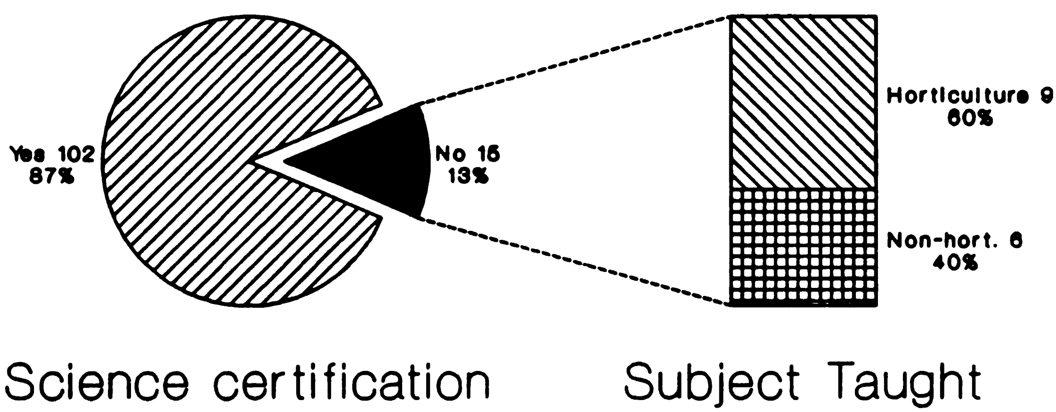


Figure 10. Number of Michigan agriscience and natural resources educators with science certification

Michigan agriscience and natural resources educators were asked how many hours of the 86 required for recertification to teach the new Michigan Agriscience and Natural Resources Curriculum they had completed. The minimum number of hours completed was zero (0). The maximum number of hours completed was the required 86 hours. Figure 11 outlines the hours of technical updating respondents had completed by respondents by categories.

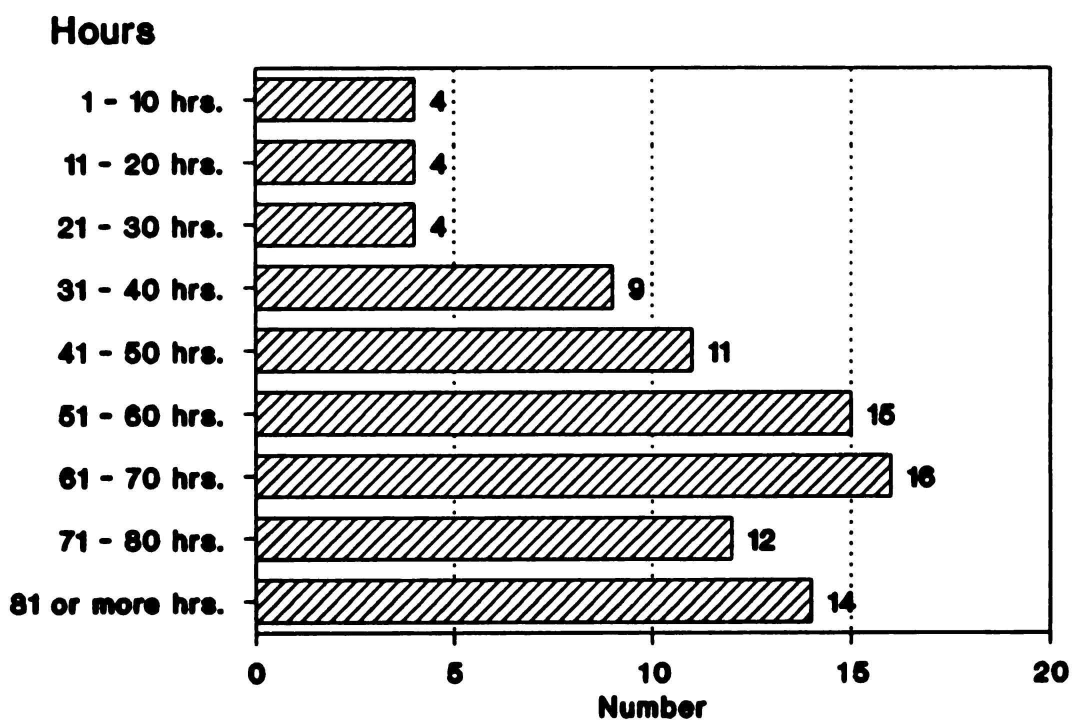


Figure 11. Hours of technical updating completed by Michigan agriscience and natural resources educators.

The questionnaire also asked if respondents' agricultural education program had restructured to become an agriscience and natural resources program. Thirty-four respondents, 28.8%, indicated that their programs had restructured. Figure 12 illustrates the number and percentage of programs which have restructured.

The questionnaire asked if the agricultural education program had assembled a restructuring committee and whether they had held any meetings. Over 66% of the programs had assembled a restructuring committee, and 73% of those committees had met at least once. The minimum number of meetings held by the committees was one. The maximum number of meetings held was 10. The mean number of meetings of the restructuring committees was three. Figure 13 shows the number of programs that had assembled a restructuring committee and whether those committees had met.

Comments

Michigan agriscience and natural resources educators were given space on the questionnaires to provide written comments about the curriculum. A sample of the comments is shown below. Comments were categorized into positive, negative, and general comments. A complete listing of all comments from respondents is located in Appendix K.

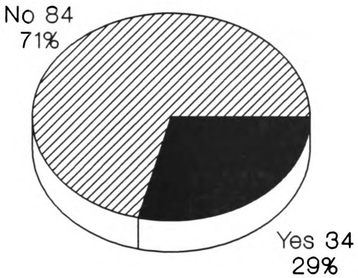


Figure 12. Number of programs which have restructured to become Michigan Agriscience and Natural Resources programs.

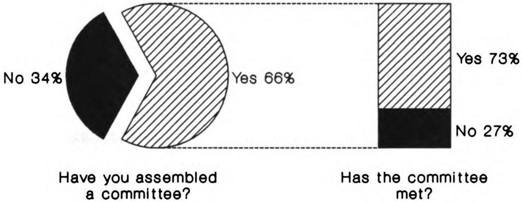


Figure 13. Number of restructuring committees assembled and whether they have met.

<u>Positive Comments</u>

"I'm all for the switch over. Getting science credits for ag. courses is long overdue. But why all these committees and course requirements. Home Ec and other programs are also changing without all of these requirements. Lets concentrate on getting some good young professionals sticking with ag and reopening some closed programs. Feel free to call me on any of these issues."

"The idea of restructuring is great, however, there is FAR too much paper work to be done."

"The Content of the new curriculum is great, but I need help in actually effectively implementing the content into the everyday classroom."

"Really enjoy meeting and sharing with other agriscience teachers"

<u>Negative Comments</u>

"A major drawback of the new curriculum and offering science credit is the increase in one-year students with no interest in FFA or pursuing an Ag-Sci. curriculum."

"1. Time. Time. Time   2. May need a booster shot to get restructuring program off the ground."

"The process is very lengthy and time consuming. I know it is useful and constructive to do an internal evaluation but there simply not enough hours in the day to get everything done. It seems to be alot of open pushing, needlessly. Simply, give me the curriculum and let me teach."

"I haven't recently received an update to my 86 hours earned since Op.Synergism last fall."

General Comments

"What will happen to the restructuring & implementation of the new curriculum now that university support people are gone? Have we been railroaded again?"

"I am personally still unsure about participation in the restructuring process. Although I am very supportive of the changes, I do believe we have accomplished most of the changes envisioned by the restructuring process...and still have work to do."

"Agriscience instructors are pretty much "one-person" departments. It would be very helpful if they got together regularly to exchange ideas and information. Funding cuts leave many of us wondering how committed the state is in seeing agriscience succeed."

"I teach Floral Design, Greenhouse Management Grounds Maint. My students (mostly adults) do not want Agriscience. Agriscience belongs in the high school not our Vo-Ed Center."

"This survey does not address the true usability of the curriculum. I personally find it cumbersome even though my instruction will reflect heavy science emphasis. My instructional material comes 95% from somewhere other than the curriculum."

"These questions on hours are they trick questions? Some of us do know that this recording of hours has not been done for a period of time. Also the AP or articulation is not in place yet."

"I'd like to see a grad. class taught to specify many of the answers to these questions-specifically! This is very new & would benefit new & prospective ANR educators."

"* Agriscience is only as good as the instructor."

"Traditional ag program & FFA at our school are dead. If we don't get some serious leadership out of the State Dept. of Education and restored funding from Lansing I see Ag Education in Michigan going the same way as the family farm. A myth just waiting to be put to history."

"We need a way to monitor the implementation of agriscience, to ensure this quality education. There should be some accountability."

Analysis

In order to supplement the analysis contained in the multiple regression, the survey of Michigan agriscience and natural resources educators was also analyzed using analysis of variance (ANOVA) and correlations.

Analysis of Variance

An analysis of variance was performed to determine if differences existed between the location of respondents' schools and the percentage of objectives taught. The ANOVA found that there were significant differences between the location of schools on the percentage of objectives taught. Table 26 contains the ANOVA results.

A post-hoc Tukey test was conducted to determine the location of the schools which differed significantly. The Tukey test found that schools located in a town or in a rural area significantly differed from schools in urban areas. This indicates that ANR teachers in a rural area or town taught a significantly higher percentage of the science objectives contained in the Michigan Agriscience and Natural Resources Curriculum than teachers in urban areas. Teachers in rural schools also differed from teachers in suburban schools. Table 27 shows the results of the Tukey test.

Table 26

Analysis of variance for location of schools and the percentage of objective taught

Source of Variation	Mean Square	D.F.	F	Signif. of F
Between Groups	.4892	3	9.3532	.0000 *
Within Groups	.0523	98		
Total	.065	101		

* Significantly different at the .05 level

Table 27

Tukey test for significant differences between school location on percentage of objectives taught

School Location	Rural	Town	Suburban	Urban
Mean Percent	.7403	.7363	.5311	.3914
Rural				
Town				
Suburban	*			
Urban	*	*		

* Significantly different at the .05 level

Analysis of variance tests were conducted for differences between location of the teachers' schools and their mean attitude, perception, and knowledge scores. No significant differences were found between the location of teachers' schools and the teachers' mean attitude or perception scores. Table 28 and 29 lists the results of the ANOVA tests.

Table 28

Analysis of variance for location of schools and the teachers' mean attitude score

Source of Variation	Mean Square	D.F.	F	Signif. of F
Between Groups	1.813	3	2.037	.113
Within Groups	.890	106		
Total	.916	109		

Table 29

<u>Analysis of variance for location of schools and the teachers' mean perceptions score</u>

Source of Variation	Mean Square	D.F.	F	Signif. of F
Between Groups	.492	3	2.114	.103
Within Groups	.233	103		
Total	.240	106		

The ANOVA for differences between the location of teachers' schools and their scores on the knowledge questions produced significant differences between groups. The results of the ANOVA are presented in Table 30.

Table 30

<u>Analysis of variance for location of schools and the teachers' mean knowledge score</u>

Source of Variation	Mean Square	D.F.	F	Signif. of F
Between Groups	4.094	3	3.221	.027
Within Groups	1.271	86		
Total	1.366	89		

A post-hoc Tukey test was performed to determine which groups significantly differed. The Tukey test found that no significant differences existed.

Correlation analysis

Correlations were performed to determine if the dependent variable, percent of objective taught, could be correlated with other demographic variables of the teachers or the agriscience and natural resources program. Pearson product-moment coefficients were used for the correlations because all variables were measured on the interval scale.

The correlations found that there was a moderate negative correlation between the age of the teachers and their score on the perceptions questions (Davis, 1971). That is, the older teachers tended to have lower mean scores on the perceptions questions.

There was a low negative correlation between the teachers' age and their score on the attitudes section. This suggests, as did the earlier correlation, that older teachers tended to have lower mean scores on the attitudes questions. Low negative correlations were also found between teachers' age and the percentage of objectives taught and their score on the knowledge questions. Results of the correlations are located in Table 31.

Table 31

<u>Correlations between age of teachers and percent of objectives taught, attitude, perceptions, and knowledge scores</u>

Variable	Coefficient	Description
Perception score	-.33	Moderate
Attitude score	-.22	Low
Percent of objectives taught	-.08	Negligible
Knowledge score	-.02	Negligible

Correlations were performed to determine the relationship between the years of teaching experience by teachers with the percentage of objectives taught, and their mean scores on the attitude, perceptions, and knowledge questions. A moderate negative correlation was found between the years of teaching experience by teachers and their perceptions of agriscience score. Therefore, the more years of experience by teachers, the lower their perceptions of agriscience. There was a low negative correlation between the years of experience and their attitudes score. Negligible correlations were found between teachers' years of experience and the percentage of objectives taught and their scores on the knowledge questions. Table 32 shows the results of the correlation tests.

Table 32

Correlations between years of teaching and percent of objectives taught, attitude, perceptions, and knowledge scores

Variable	Coefficient	Description
Perception score	-.34	Moderate
Attitude score	-.25	Low
Knowledge score	-.07	Negligible
Percent of objectives taught	-.05	Negligible

Correlations were also performed between the number of hours of technical in-service hours teachers had completed and the percent of objectives taught, attitude, perceptions, and knowledge scores. There were low correlations between the hours of in-service completed and the teachers attitude, perceptions, and knowledge scores. Results are shown in Table 33.

Table 33

Correlations between hours of technical in-service completed and percent of objectives taught, attitude, perceptions, and knowledge scores

Variable	Coefficient	Description
Perception score	.26	Low
Attitude score	.19	Low
Knowledge score	.12	Low
Percent of objectives taught	.01	Negligible

Summary

The analysis of the data from this research study showed that a student's overall grade point average and the number of science credits completed explained the most variance in science achievement scores. Multiple regression indicated that there was no significant differences in the science achievement scores of students who had agriscience and natural resources and those that did not have agriscience and natural resources classes.

The descriptive survey found that Michigan agriscience and natural resources educators taught an average of 81% of the science objectives contained in the Michigan Agriscience and Natural Resources Curriculum. The mean number of correct responses from all teachers on the 10 curriculum knowledge questions was 6.43.

A complete summary of the results, conclusions, and implications of this research is presented in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS, AND IMPLICATIONS

A brief overview of the objectives, research methods, and results of this study is presented in the first section of this chapter. A discussion of the major conclusions that were reached as a result of this research is included in the second section. The third section contains a number of recommendations based on the findings and conclusions.

Summary

This research study included two major parts: a pre-experimental study of the influences on students' science achievement scores, and a descriptive survey study of the perceptions of the Michigan Agriscience and Natural Resources Curriculum by Michigan agriscience and natural resources educators.

The independent variables for the experimental study included gender, socioeconomic status, overall grade point average (G.P.A.), G.P.A. in agriscience and natural resources classes, and the number of credits of science and the number of credits of agriscience and natural resources completed. The dependent variable was the score on a standardized science achievement test.

The descriptive survey questionnaire was sent to all Michigan agriscience and natural resources educators. The questionnaire contained questions pertaining to the science objectives from the Michigan Agriscience and Natural Resources Curriculum that teachers cover in their classes, their attitudes and perceptions about agriscience and natural resources education, and their knowledge of the Michigan Agriscience and Natural Resources Curriculum.

The following is a summary of the objectives that guided this research study, and the major findings described in Chapter IV.

Objective 1

Determine the influence of science courses (including agriscience and natural resources) on students' science achievement test scores.

1. Fifty-four percent of the high school seniors who completed the science achievement test were male, 46% were female.
2. The seniors were 2% American Indian, 1.3% Asian, 7.2% Black, 86.3% white, and 0.7% Hispanic.

3. The minimum score for all seniors on the science achievement test was 9 out of 60. The maximum score was 52 out of 60. The mean score for all 156 seniors in the study was 23.
4. There were no differences between students who have had agriscience and natural resources classes, and those that have not had ANR classes on their science achievement test scores.
5. There was a substantial positive correlation between students' overall grade point average and their score on the science achievement test.
6. There was a moderate positive correlation between the number of science credits seniors had completed and their score on the science achievement test.
7. The variables that had the greatest relationship to the dependent variable, score on the science achievement test, were students' overall grade point average, and the number of science credits they completed.
8. The independent demographic variables in the research study explained 43.1% of the variance in the dependent variable, score on the science achievement test.

Objective 2

Determine the number of science objectives from the Michigan Agriscience and Natural Resources Curriculum that are being taught by agriscience and natural resources educators.

1. Michigan agriscience and natural resources educators were teaching 81% of the science objectives contained in the Michigan Agriscience and Natural Resources Curriculum.
2. Michigan agriscience and natural resources educators who taught in comprehensive programs were teaching 83% of the science objectives in the Michigan Agriscience and Natural Resources Curriculum.
3. Michigan agriscience and natural resources educators who taught in horticulture programs were teaching 79% of the science objectives in the Michigan Agriscience and Natural Resources Curriculum.
4. Fifty percent of all Michigan agriscience and natural resources educators, 67.5% of teachers in comprehensive programs, and 60.7% of horticulture teachers taught at least 75% of the science objectives in the curriculum.

Objective 3

Determine agriscience and natural resources educators' attitudes towards the concept of agriscience instruction.

1. All 13 pairs of semantic differentiation descriptors were rated either slightly or strongly positive.
2. Michigan agriscience and natural resources educators rated the agriscience curriculum slightly wanted, new, and sure.
3. Michigan agriscience and natural resources educators rated the agriscience curriculum strongly indispensable, good, important, effective, exciting, dynamic, innovative, necessary, essential, and valuable.
4. Overall, Michigan agriscience and natural resources educators rated the concept of agriscience instruction a 5.70 on a 7 point semantic differentiation scale.
5. Michigan agriscience and natural resources educators' agreed with nine of the 11 Likert scale questions on their perceptions of the Michigan Agriscience and Natural Resources Curriculum.
6. Respondents strongly agreed that high school science credit should be given for agriscience and natural resources classes.

7. Respondents disagreed that traditional production agriculture programs are better than agriscience and natural resources programs.
8. The multiple regression found the years of teaching experience to have a significant relationship with teachers' mean score on the 11 Likert questions on their perceptions of agriscience and natural resources.

Objective 4

Determine agriscience and natural resources educators' knowledge about the Michigan Agriscience and Natural Resources Curriculum.

1. The minimum number of correct responses on the knowledge questions was four.
2. The maximum number of correct responses on the knowledge questions was 10.
3. The average number of correct responses on the knowledge questions was 6.43.
4. Multiple regression found a significant relationship between the location of a teacher's school, specifically rural schools, and the teacher's score on the knowledge questions.

Objective 5

Determine demographic information on Michigan agriscience and natural resources educators.

1. Over 79% of the Michigan agriscience and natural resources educators who responded to the questionnaire were male, 20.5% were female.
2. The youngest Michigan agriscience and natural resources educator was 23 years old and the oldest was 60 years old. The mean age of all Michigan agriscience and natural resources educators was 41 years.
3. All Michigan agriscience and natural resources educators who responded to the questionnaire were white.
4. The years of teaching experience ranged from one to 35 years. The mean number of years of teaching experience was 15 years.
5. Over 60% of the respondents' schools were located in a rural area, 11.3% were in a town, 16.5% were suburban schools, and 9.6% were urban schools.
6. Eighty-seven percent of the Michigan agriscience and natural resources educators were certified to teach science.
7. The minimum number of technical hours of in-service completed was zero. The maximum number of hours completed was 86. The mean for all respondents was 57 hours.

8. Almost 29% of the teachers indicated that their ANR programs had restructured.
9. Over 66% of the programs had assembled a restructuring committee. Seventy-three percent of the restructuring committees had held a meeting. The average number of meeting held was three.
10. There was a moderate negative correlation between teachers' age and their perceptions score.
11. There was a moderate negative correlation between teachers' years of teaching and their perceptions score.
12. Semi partial regression of the percent of science objectives taught found that teachers' demographic characteristics had a semi-partial regression (sR^2) of .56, and program restructuring variables had a semi-partial regression (sR^2) of .11.
13. Multiple regression analysis indicated that the independent variables explained 67.5% of the variance in the dependent variable, percent of science objectives taught.
14. Multiple regression analysis found the variables that had the greatest relationship to the dependent variable were the location of the school, either in a town or a rural area, and the hours of technical in-service teachers completed by the teacher.

Conclusions

Statements of major study conclusions reached as a result of the findings are presented in the following sections. A brief discussion of the conclusion, with references to related studies, is included after each statement.

Conclusion #1: High school seniors who had agriscience and natural resources classes performed equally as well as seniors who did not have agriscience and natural resources classes on the science achievement test.

The multiple regression, while controlling for extraneous variables such as age, gender, socioeconomic status, GPA, and the number of science credits completed by students, found no significant differences between seniors who had ANR classes and those that did not have ANR classes. This conclusion is similar to what was found by Whent and Leising (1988). Whent and Leising found that agricultural students in test schools achieved slightly higher scores on a biology test than did bio-science students. They concluded that agricultural students were mastering the state science standards on an equal level with students in general science classes. This finding is similar to the conclusion reached as a result of this study.

Conclusion #2: High school seniors' overall grade point averages and the number of science credits they completed had a direct relationship to their scores on the science achievement test.

The findings of this study showed that there was a substantial positive relationship between student's overall grade point average and their score on the science achievement test. This suggests that the higher a student's overall grade point average, the better that student will perform on science achievement tests.

The results also showed there was a moderate positive relationship between the number of science credits students completed and their score on the science achievement test. Therefore, the more science classes students' had completed, the higher their score on science achievement tests. This, along with Conclusion #1, demonstrates the importance of enrolling in science classes and increasing one's grade point average.

Conclusion #3: Michigan agriscience and natural resources educators are teaching a large percentage of the science objective in the Michigan Agriscience and Natural Resources Curriculum.

The descriptive survey found that all Michigan agriscience and natural resources educators taught an average of 79% of the science objectives in the curriculum. Fifty percent of all Michigan agriscience and natural resources educators taught over 75% of the science objectives listed in the Michigan Agriscience and Natural Resources Curriculum. Over 67% of Michigan ANR teachers in comprehensive programs taught at least 75% of the science objective, and 60.7% of Michigan ANR teachers in horticulture programs taught at least 75% of the science objectives.

This finding contrasts results found by Peasley and Henderson (1991). Peasley and Henderson studied Ohio agriscience teachers on the percent of the objectives from the Ohio agriscience curriculum they taught. They found that 25% of the Ohio agriscience teachers were teaching more than 75% of the content objectives of the Ohio agriscience curriculum.

Peasley and Henderson concluded that the new Ohio agriscience curriculum was not widely adopted by Ohio agricultural education teachers. The results of this study suggest that Michigan agriscience and natural resources educators had widely accepted the new Michigan Agriscience and Natural Resources Curriculum and were teaching a large percentage of the science objectives included in the curriculum.

<u>Conclusion #4:</u> Michigan agriscience and natural resources educators had a strongly positive attitude toward the concept of agriscience instruction.

Michigan agriscience and natural resources educators rated all 13 pairs of semantic differentiation descriptors either slightly or strongly positive. As an example, respondents thought agriscience was indispensable, important, effective, exciting, dynamic, innovative, and valuable.

Michigan ANR teachers also agreed with nine of the 11 Likert scale questions about their perceptions of agriscience and natural resources. Respondents strongly agreed that agriscience classes should receive science credit. Michigan ANR teachers did not think traditional production agriculture programs were better than agriscience and natural resources programs.

These findings agree with the results of Peasley and Henderson (1991). They found that Ohio high school teachers of production agriculture had a positive attitude toward the Ohio agriscience core curriculum and the term agriscience.

<u>Conclusion #5:</u> Michigan agriscience and natural resources educators had a moderate knowledge of the Michigan Agriscience and Natural Resources Curriculum development project.

Michigan agriscience and natural resources educators' mean score on the 10 knowledge questions was 6.43. This indicates that teachers' knowledge of curriculum development efforts was moderate. This finding is contrary to what Peasley and Henderson found. In their study of Ohio agriscience teachers, they found the teachers to have a relatively high level of knowledge about statewide agriscience curriculum development activities.

This finding suggests that Michigan agriscience and natural resources educators had not been properly informed of the curriculum development activities that were conducted by the Michigan Department of Education and the Department of Agricultural and Extension Education at MSU.

Conclusion #6: Michigan agricultural education programs have not widely restructured to become agriscience and natural resources programs.

Only 29% of the respondents indicated that their programs had restructured to become agriscience and natural resources programs. This percentage was higher than the percentage provided to the researcher by the Michigan Department of Education. However, it may be closer to the actual percent of programs that have completed the restructuring process, but have yet to file the official restructuring forms with the Department of Education because of concerns over program funding.

This finding should be scrutinized by the officials at the Michigan Department of Education. Perhaps Michigan ANR teachers have widely accepted the concept of agriscience, but are not ready to accept the Department of Education's plan for funding the new agriscience and natural resources programs.

Conclusion #7: The hours of technical in-service that teachers attended had a significant effect on the percent of science objective taught by Michigan agriscience and natural resources educators.

There was a significant relationship between the hours of technical in-service training a teacher received and the percent of science objectives taught. This suggests that in-service training is vital to improving the acceptance of a new curriculum and increasing the percentage of objectives taught from the new curriculum.

This finding agrees with the study by Pepple (1982). He studied the factors associated with teacher use and effectiveness of the Illinois Rural Core Curriculum in Agriculture. Pepple concluded that respondents who had in-service workshop instruction had a higher implementation rate than respondents who did not have in-service workshop instruction.

Conclusion #8: Older teachers and teachers with a large number of years of teaching experience had lower perceptions of the Michigan Agriscience and Natural Resources Curriculum.

There were moderate negative relationships between teachers' age and their years of teaching experience with their scores on the perceptions questions. However, when correlated with the percent of objectives taught there were low negative relationships. This suggests that although older teachers with more years of experience had negative perceptions of agriscience, it did not stop them from teaching the objectives of the curriculum.

Implications

A number of implications concerning the Michigan Agriscience and Natural Resources Curriculum can be drawn from this study. Implications are followed by a brief discussion.

Implication #1: Agriscience and natural resources programs teach science concepts on an equal basis as other traditional science courses.

The result of this study showed that there was no difference in the science achievement of students who had completed agriscience and natural resources classes and those that did not have ANR classes. This finding should be used to show that students who complete agriscience and natural resources classes should be given science credit towards graduation. It should also be used to illustrate to school administrators that an agriscience and natural resources program is a valid course that should be included in all schools' science courses.

Implication #2: Agriscience and natural resources educators should be kept informed of progress of curriculum activities at all phases of development.

In order for ANR teachers to fully accept a new curriculum, they must be included in each step of the development procedure. Teachers' input allows them to take ownership of the project and be able to defend the final document.

All teachers, whether they are involved in the development of the curriculum or not, must be regularly advised of the progress and content of the curriculum materials. Teachers who are not aware of curriculum development activities will not support or adopt the new curriculum initiatives.

Implication #3: All curriculum development activities must include plans for proper funding of programs which adopt the new curriculum.

The State Department of Education must take steps to clarify the funding requirement for agriscience and natural resources programs. Programs will only complete the restructuring process if they know that they will not lose funding. Curriculum development activities that are accompanied by program restructuring initiatives must include adequate funding guidelines, or the entire process will be in jeopardy of failing. Only a combined effort by curriculum development specialists and governmental agencies to develop and financially support new curriculum initiatives can succeed.

However, there are always limitations and constraints placed on curriculum development activities. Ideally, every new curriculum would be accompanied by comprehensive in-service training sessions on how to utilize the new teaching materials. Unfortunately, most curriculum development efforts lack the financial resources necessary to adequately disseminate new curriculum materials and provide in-service training to teachers.

Implication #4: Any curriculum development activities must include organized in-service workshops.

The findings of this study supported other research that showed curriculum development activities must include in-service workshops in order for teachers to adopt and teach the new curriculum. Teachers do not blindly accept and teach new curriculum materials. In many cases, teachers need up-dating on the technical content of new curriculum materials. In-service workshops help teachers understand the content and the processes used for teaching new curriculum materials. However, as stated above, financial support for in-service training is woefully inadequate.

Recommendations for future research

Listed below are six recommendations, arising directly or indirectly from this study, that suggest future research in this area.

1. Replicate the static-group comparison design with a larger number of schools that offer agriscience and natural resources.
2. Conduct a pretest-posttest control group study of high school students who have enrolled in a semester of agriscience and natural resources to determine the increase in science achievement as a result of agriscience and natural resources class.
3. Conduct a survey of science teachers in schools with agriscience and natural resource programs to determine their attitudes and opinions of teaching science through agriculture.

4. Conduct a Delphi study of Michigan agriscience and natural resources educators to determine their concerns about using the Michigan Agriscience and Natural Resources Curriculum.
5. Survey ANR students about their attitudes and perceptions of agriscience and natural resources class.
6. Survey Michigan agriscience and natural resources educators to determine which basic core and advanced/specialized units of the Michigan Agriscience and Natural Resources Curriculum they teach in their programs.

Conclusion

This research has attempted to show that agriscience and natural resources is a legitimate science course for all high school students and that the Michigan Agriscience and Natural Resources Curriculum has been accepted, and is being taught, by Michigan agriscience and natural resources educators.

The results have shown that students who enroll in agriscience and natural resources perform as well as students who do not enroll in agriscience and natural resources on standardized science achievement tests. This research also found that Michigan agriscience and natural resources teachers are teaching a large percentage of the science objectives in the curriculum, and they have a positive perception of agriscience education.

This study should be evaluated by future researchers in the area of agriscience and natural resources education and curriculum development. Recommendations from this study should be reviewed when planning future research projects in agriscience and natural resources curriculum development.

APPENDICES

APPENDIX A

UNIVERSITY COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS

MICHIGAN STATE UNIVERSITY

OFFICE OF VICE PRESIDENT FOR RESEARCH
AND DEAN OF THE GRADUATE SCHOOL

EAST LANSING • MICHIGAN • 48824-1046

April 3, 1992

James Connors
408 Agriculture Hall

RE: INFLUENCES ON SECONDARY SCIENCE ACHIEVEMENT, IRB #92-123

Dear Mr. Connors:

The above project is exempt from full UCRIHS review. The proposed research protocol has been reviewed by a member of the UCRIHS committee. The rights and welfare of human subjects appear to be protected and you have approval to conduct the research.

You are reminded that UCRIHS approval is valid for one calendar year. If you plan to continue this project beyond one year, please make provisions for obtaining appropriate UCRIHS approval one month prior to March 19, 1993.

Any changes in procedures involving human subjects must be reviewed by UCRIHS prior to initiation of the change. UCRIHS must also be notifed promptly of any problems (unexpected side effects, complaints, etc.) involving human subjects during the course of the work.

Thank you for bringing this project to my attention. If I can be of any future help, please do not hesitate to let me know.

Sincerely,

David E. Wright

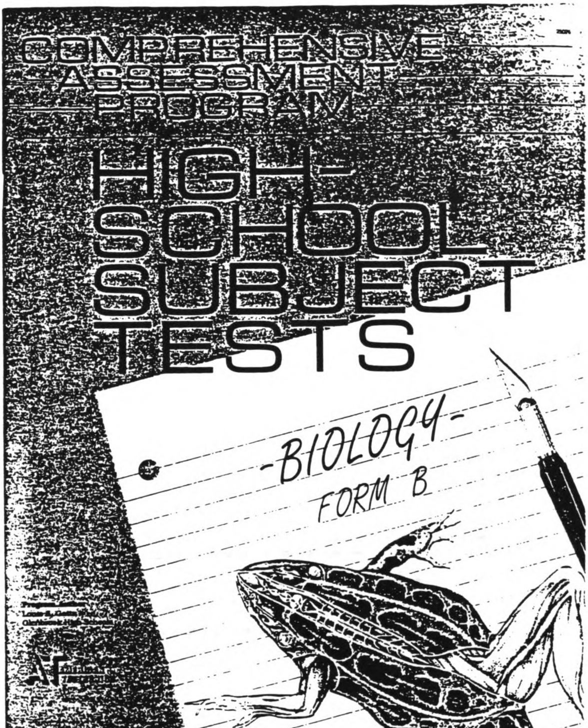
David E. Wright, Ph.D., Chair
University Committee on Research Involving
Human Subjects (UCRIHS)

DEW/pjm

cc: Dr. Carroll Wamhoff

APPENDIX B

HIGH SCHOOL SUBJECT TESTS
BIOLOGY - FORM B


COMPREHENSIVE
ASSESSMENT
PROGRAM
HIGH-
SCHOOL
SUBJECT
TESTS
-BIOLOGY-
FORM B

Select the one best answer for each item and mark the corresponding letter on the answer sheet

SAMPLE

The skeletal system of the body is primarily made up of

A. bones. **C. nerves.**
B. muscles. **D. organs.**

1. Over the years, a basic research tool for the biologist has been the light microscope. Which statement below about the the basic light microscope represents a *valid limitation* of the instrument?

   A. It only produces black and white images.
   B. It cannot magnify more than 100 times.
   C. Only dead or dried specimens may be viewed.
   D. It has limited resolving power and clarity at higher magnifications.

2. Which of the following is *NOT* part of an animal cell?

   A. cell wall **C.** lysosomes
   B. cell membrane **D.** ribosomes

3. What is the main function of the mitochondria in cells?

   A. storage and secretion **C.** cellular respiration
   B. intracellular digestion **D.** cell reproduction

Use the following information to answer questions 4 and 5.

A cellophane bag containing a solution of starch in water is submerged in a beaker of iodine dissolved in water. The cellophane bag is semipermeable and allows both water and iodine molecules to pass through but blocks the larger starch molecules.

4. When iodine is mixed with a starch solution, the iodine turns dark blue. Which of the following will occur in the experiment described above?

   A. The solution in the beaker will show the first evidence of blue color.
   B. The solution in the bag will show the first evidence of blue color.
   C. The blue color will appear both in the bag and in the beaker.
   D. The blue color will not be seen at all in either the bag or the beaker because the cellophane is semipermeable.

5. In the experiment, the bag swells with time. What is the main reason for this behavior?

   A. The starch particles inside the bag clump together.
   B. Water molecules move from the beaker into the bag by osmosis.
   C. Iodine molecules move from the beaker into the bag by diffusion.
   D. Iodine and starch molecules react to form a new molecule that is much larger.

6. A blood cell is placed into a solution that is isotonic relative to the concentration of dissolved substances in the cell. What will happen to the blood cell?

   A. The blood cell will swell and perhaps burst.
   B. The blood cell will shrink and perhaps collapse.
   C. The blood cell will remain the same size, since no water from the isotonic solution can enter the cell.
   D. The blood cell will remain the same size, since water diffuses in and out of the cell at equal rates.

7. Which compounds below provide the most concentrated energy source for the body and are often stored in the body for energy reserves?

   A. amino acids
   B. lipids
   C. nucleic acids
   D. proteins

8. Which of the following is *NOT* characteristic of enzymes?

   A. Enzymes lower the energy needed for a reaction to occur.
   B. Any specific enzyme is capable of speeding up reactions involving many different kinds of compounds of differing structures.
   C. After the enzyme has done its job in speeding the rate of a reaction, it remains unchanged and can take part in a reaction again.
   D. Enzymes help weaken the bonds in the compounds on which they work.

9. In making comparisons between DNA and RNA, which of the following is *NOT* true?

   A. Most DNA consists of double strands of nucleotides, while most RNA consists of single strands of nucleotides.
   B. DNA is found mainly in the nucleus of the cell while RNA is found in both the cell nucleus and cytoplasm.
   C. Both RNA and DNA contain the nitrogen bases cytosine, guanine, and adenine.
   D. The nitrogen base thymine is found only in RNA and the base uracil is found only in DNA.

10. Relative to protein synthesis, which statement below is *FALSE?*

   A. Transfer RNA and messenger RNA have the same structure but differ in function because they are found in different parts of the cell.
   B. The DNA molecule uncoils during this process.
   C. Proteins are synthesized on the ribosomes outside the nucleus.
   D. The protein synthesis mechanism is important in maintaining genetic continuity.

11. Which of the following is *TRUE* in the photosynthesis process?

   A. It involves the absorption of the green wavelengths of sunlight by chlorophyll.
   B. It results in the production of oxygen and glucose from carbon dioxide and water.
   C. It includes so called "dark reactions" which can only take place in total darkness.
   D. It takes place in special plant organelles called cristae.

12. In multicellular animals and plants, many different kinds of tissues and organs are present. The cells within these different tissues are also unique and they can perform their own specialized functions. Which of the following best explains how cells become specialized?

   A. At the time of fertilization, the specialized cells are already present and are ready to perform their unique functions.
   B. At the time of fertilization, there are three basic kinds of cells that later become differentiated into other kinds of specialized cells.
   C. After fertilization, the single cell undergoes repeated divisions and newly formed cells eventually develop into different kinds of tissues and cells.
   D. After fertilization, the cell divides and with each cell division, a different DNA code in each cell determines the structure and function of the cell.

13. Which of the following is *NOT* an example of a type of animal tissue?

   A. bone tissue
   B. nerve tissue
   C. muscle tissue
   D. vascular tissue

14. Listed below are steps in cell respiration.

1. ADP + energy → ATP
2. Glucose molecules are broken down to pyruvic acid and energy is produced.
3. Energy from the high energy molecules is released in small units to all parts of the cell.

In what order do these steps occur in the process of cell respiration?

A. 1, 3, 2
B. 3, 1, 2
C. 2, 1, 3
D. 3, 2, 1

15. Listed below are stages found in the process of cell division in body cells.

1. metaphase
2. telophase
3. prophase
4. anaphase

What is the correct sequence of these stages in mitosis?

A. 3, 1, 4, 2
B. 3, 4, 2, 1
C. 4, 3, 1, 2
D. 3, 1, 2, 4

16. Which statement below about the anatomical characteristics and functions of a paramecium is *FALSE*?

A. Food enters the organism through the gullet.
B. The contractile vacuole helps absorb water from the environment to aid cell functions.
C. A paramecium can move forward or backward using the short cilia that cover its body.
D. There are two nuclei in the paramecium, one that controls respiration and another that controls reproduction.

17. Protozoans are classified according to their method of

A. reproduction.
B. locomotion.
C. gathering food.
D. adaptation to the environment.

18. Below is a description of a particular protist.

> This protist reproduces asexually by mitosis. It contains chloroplasts and has a spot of red pigment which helps the organism detect light. The organism can be either autotrophic or heterotrophic depending upon whether or not light is available.

From the above description, this protist belongs to which phylum?

A. Sarcodines
B. Dinoflagellates
C. Green algae
D. Euglenophytes

19. Below is a list of terms related to the levels of cell organization in multicellular organisms.

1. tissue   2. organs   3. cells   4. systems

What is the best sequence of these terms from simplest to most complex?

A. 3, 2, 1, 4
B. 3, 1, 2, 4
C. 3, 1, 4, 2
D. 3, 2, 4, 1

20. Which part of the brain controls thinking and reasoning?

A. cerebral cortex
B. cerebellum
C. medulla oblongata
D. brain stem

21. Which of the following statements about protists is *NOT TRUE*?

A. They are all made up of cells that have a nucleus.
B. They are all able to make their own food.
C. Most are made up of single cells.
D. They all live in wet or moist environments.

22. What characteristic is common of both living cells and viruses?

A. a cell membrane
B. ribosomes
C. cytoplasm
D. DNA or RNA

23. Monerans, protists, and fungi are very important to humans within the environment. Which statement below about these organisms and their benefit to humans is *FALSE*?

A. Fungi and bacteria are the most important decomposers and help return raw materials to the environment.
B. All of these kingdoms have members that can cause disease or illness in humans.
C. Some algae produce antibiotics and others produce vitamins, enzymes, and alcohols.
D. Some monerans are the only organisms capable of converting nitrogen from the air into important nitrogen-containing chemical compounds.

24. Monerans as a group demonstrate four major kinds of reproduction, three of them sexual and one asexual. Which kind of reproduction listed below is classified as asexual?

A. conjunction
B. fission
C. transduction
D. transformation

25. Below are listed some criteria scientists could use in classifying plants.

1. vascular or nonvascular
2. mobile or nonmobile
3. prokaryotic or eukaryotic
4. cell wall or no cell wall
5. produce seeds or do not produce seeds
6. photosynthetic or nonphotosynthetic

Which two of these criteria are most commonly used to group or classify plants?

A. 1 and 3
B. 1 and 5
C. 3 and 4
D. 2 and 6

26. In grouping plants by their characteristics, which plant below is *MOST* similar to mosses?

A. liverworts
B. ferns
C. horsetails
D. ginkoes

27. Which is *NOT* a trait that is shared by all members of the plant kingdom?

A. the presence of xylem and phloem
B. multicellular
C. ability to undergo photosynthesis
D. the presence of a cell wall around the cell membrane

28. Land plants and green algae are similar in all of the following ways *EXCEPT*

A. they both contain cellulose in their cell walls.
B. they both have alternation of generations in their life cycles.
C. they both contain chlorophyll.
D. they both have a protective layer around their spores and gametes to keep them from drying out.

29. All of the following adaptations could help plants live more effectively in a hot, dry environment *EXCEPT*

A. large, flat leaves.
B. roots which go deep underground.
C. reduced number of stomata.
D. a thick, waxy cuticle on the leaves.

30. Which statement below about various plant structures and their functions is *TRUE*?

A. Water and minerals enter a plant through its stem.
B. The phloem carries dissolved food from the roots to other parts of the plant.
C. Carbon dioxide from the atmosphere enters the plant through stomata in the leaf.
D. Root tip cells give off a basic substance during cell metabolism which help dissolve minerals in the soil.

31. Below are listed some flower structures along with the function of that structure. Which function and structure are *NOT* correctly matched?

A. anther--produces pollen
B. ovule--becomes a seed after the egg is fertilized
C. style--protects the flower bud
D. stigma--traps pollen grains

32. Flowering plants make up almost 85 percent of all the plants found on earth. The success of flowering plants can be at least partially attributable to all of the following *EXCEPT*

A. the transport of sperm in flowering plants is not dependent on being carried by water.
B. pollination in flowering plants is aided by various insects, buds, and wind.
C. flowering plants have developed various methods of pollination.
D. flowering plants are primarily monoploid which makes reproduction easier.

33. In what phylum are more than 75 percent of all animal species found?

A. Arthropoda
B. Annelida
C. Chordata
D. Echinodermata

34. Below are stages found in most metamorphosis.

1. pupa   2. egg   3. adult   4. larva

Which sequence of terms indicated below best describes the process of complete metamorphosis?

A. 2, 4, 1, 3
B. 2, 1, 4, 3
C. 1, 4, 3, 2
D. 4, 1, 2, 3

35. Below are statements about reproduction in animals. Which statement is *FALSE*?

A. Sexual reproduction involves the union of two sets of DNA.
B. Gametes are produced from diploid cells through the process of meiosis.
C. External fertilization requires the production of a large number of gametes and the presence of water.
D. Hermaphrodites, which have both ovaries and testes, usually are able to fertilize themselves.

36. A citizen, concerned about the effects of pollution on our forests, made the following claims:

1. The sulfur dioxide produced by burning coal and oil causes water loss in plants and destroys the chloroplasts.
2. The ozone from high temperature burning and automobile exhaust enters the leaves where it destroys enzymes and reduces photosynthesis.
3. The high concentrations of carbon dioxide from the burning of fossil fuels enter the leaves and interfere with the ability of plants to produce much needed oxygen.
4. The refining of aluminum ores produces fluorides which tend to reduce leaf size and tree height, and the weakened trees are less able to fight off damaging insects.

Which of the above claims is most likely to be *FALSE*?

A. 1
B. 2
C. 3
D. 4

37. What is a major criterion developed many years ago that is still used today for separating animals in the phylum Chordata into different subphyla?

A. sexual or asexual reproduction
B. backbone or no backbone
C. live in water or on land
D. one body opening or more than one body opening

38. Which of the following characteristics is *NOT* consistent with placement into the animal kingdom?

A. nutrition primarily ingestive with digestion occurring in an internal cavity
B. eukaryotic cells containing plastids
C. motility by contractile fibers
D. development of sensory-neuromotor systems

39. Below are some terms used in classifying living things:

1. phylum
2. kingdom
3. species
4. order
5. genus
6. class
7. family

Which of the following is the proper sequence of these terms in classification from the broadest category to the most specific?

A. 2, 1, 4, 6, 5, 3, 7
B. 1, 2, 7, 5, 3, 4, 6
C. 2, 1, 7, 4, 6, 5, 3
D. 2, 1, 6, 4, 7, 5, 3

40. In considering the digestive system in humans. all of the following are true *EXCEPT*

A. most water absorption takes place in the large intestine.
B. most food absorption takes place in the small intestine through fingerlike projections called villi.
C. bile from the gall bladder emulsifies fats and helps speed up the later enzyme action on the fats.
D. the pancreas releases carbonic acid which helps the pancreatic enzymes work more effectively.

41. Which animal below has an open circulatory system rather than a closed circulatory system?

A. an earthworm
B. a grasshopper
C. a fish
D. a salamander

42. Which body system plays the major role in protecting the body from disease?

A. respiratory
B. excretory
C. circulatory
D. digestive

43. Which of the following is *NOT* a hormone?

A. insulin
B. lymph
C. epinephrine
D. estrogen

44. Which statement about chromosomes is *FALSE*?

A. Chromosomes occur in pairs in all types of cells.
B. Different kinds of species possess differing numbers of chromosomes.
C. Chromosomes contain genes which control the inheritance of traits.
D. The phenomenon of crossing over between chromosomes can provide new combinations of alleles in the sex cells.

45. All of the following concepts were part of Gregor Johann Mendel's research on inheritance *EXCEPT*

A. the law of dominance.
B. the principles of probability.
C. the existence of sex-linked traits.
D. the concept of independent assortment.

46. In a kind of pea plant, the allele for yellow (Y) is dominant over the allele for green (y). Similarly, the allele for round shape (R) is dominant over the allele for wrinkled shape (r). If a purebread round, yellow plant is crossed with a purebread wrinkled, green plant, what would be the phenotypic ratios in the F_2 generation?

A. 9 round-yellow, 3 wrinkled-green, 3 round-green, 1 wrinkled-yellow
B. 9 round-yellow, 3 wrinkled-yellow, 3 round-green, 1 wrinkled-green
C. 3 round-yellow, 1 wrinkled-green
D. All plants would be round and yellow.

47. Four people are hidden in the next room. A researcher, after studying these people, determines their probable sex chromosome makeup. The genotypes are as follows: XY, XX, XO, XXY.

Using this information, how many of the people in the next room would be male?

A. 1
B. 2
C. 3
D. 4

48. Two closely related species occupy the same environment. Species S reproduces sexually and species A reproduces asexually. If the environment changes over time, what are the chances of survival for the two species?

A. about the same for both species
B. greater for species A
C. greater for species S
D. almost zero for both species

49. Which of the following experimental designs would be best for determining the effectiveness of a vaccine in preventing a bacterial infection in humans?

A. Expose 50 humans to the disease and then inoculate all of them with the vaccine.
B. Expose 50 humans to the disease and then inoculate 25 of them with the vaccine.
C. Inoculate 25 humans with the vaccine and 25 with sterile saline and then expose all 50 to the disease.
D. Inoculate 25 humans with the vaccine and 25 with sterile saline and then expose only those inoculated with the vaccine to the disease.

50. A man with blood genotype AB married a woman with blood genotype BO. Below are listed some possible blood genotypes.

1. AB	4. AO
2. AA	5. BO
3. BB	6. OO

Which of the blood genotypes above would be possible for the first child born to this couple?

A. 1, 2, 3, and 4
B. 1, 3, 4, and 5
C. 1, 3, and 5
D. Any of the above would be possible.

51. Which of the following procedures would be the best to use in developing seeds for a dwarf plant from a normal plant?

A. Continually prune the normal plants as they grow and use their seeds. Repeat this process until you get dwarf plants.
B. Grow the normal plants but deny them some nutrients so they do not grow as tall. Obtain their seeds and continue this process.
C. Grow the normal plants, but only allow them half as much sunlight. Take their seeds and continue this process.
D. Grow the normal plants and keep the seeds only from the smallest plants. Plant these seeds and continue the procedure for several generations.

52. Temperature changes in an environment influence the ecology. Which statement about this relationship is *FALSE*?

A. Temperature changes can lead to reduced food supply.
B. Temperature changes usually affect life in the water more than they do life on land.
C. Temperature changes can cause animals to migrate.
D. Temperature changes are often responsible for the beginnings of certain biological processes.

53. In an ecosystem, which of the following is a consumer that feeds only on producers?

A. a carnivore
B. an omnivore
C. a herbivore
D. a second-order consumer

54. A biological model that is designed to show all the possible feeding relationships in an ecosystem is called

A. a food chain.
B. a food web.
C. an energy pyramid.
D. a biomass diagram.

55. Which of the following might be the best possible treatment for a person who has a mild sickle-cell condition?

A. Give injections of the missing enzyme to help the body function normally.
B. Prescribe a special diet which contains no galactose.
C. Prescribe drugs that help the hemoglobin hold more oxygen.
D. Prescribe that the amino acid valine be taken orally each day to compensate for its deficiency.

56. Which of the following reagents should be used in testing for the presence of simple sugars?

A. bromthymol blue
B. biuret reagent
C. Benedict's solution
D. Lugol's solution

57. When making a wet mount for observing onion skin cells under a microscope, what would be the best technique for staining?

A. Place a drop of stain on the dry slide before making the mount, spread the stain with a piece of paper towel, and let it dry before making the mount.
B. Place a drop of stain at the edge of the cover slip and draw the stain in with a piece of paper towel placed on the other side of the cover slip.
C. Place a drop of stain on the cover slip along with a drop of water and then absorb some of the liquid with a piece of paper towel. Turn the cover slip over and place it on top of the piece of onion skin.
D. Add a drop of stain directly on top of the onion skin to be observed. Then put a well-moistened cover slip on top of the sample.

58. In the human circulatory system, blood is pumped to the lungs from the right ventricle through the

A. pulmonary vein.
B. aorta.
C. pulmonary artery.
D. ventricular apex.

59. In a certain community, studies show that an increase in the numbers of species A is followed by a decrease in the numbers of species B. To determine whether or not there is a direct cause and effect relationship between these two events, the most logical first investigative step might be to determine

A. the kind of food eaten by species A.
B. the kind of food eaten by species B.
C. the predators of species A.
D. the effect of possible climate changes on species B.

60. Which of the statements below about the environment is *TRUE*?

A. Adding carbon dioxide to the atmosphere by burning fossil fuels could cause a general cooling effect on the earth.
B. Ozone in the atmosphere helps screen out potentially harmful ultraviolet light.
C. The majority of solar energy that reaches earth's surface is used in the process of photosynthesis.
D. The unburned particulates often produced when burning diesel fuel are a major cause of acid rain.

APPENDIX C

FAMILY INFORMATION/ SOCIOECONOMIC SURVEY

FAMILY INFORMATION

Name: ______________________

Instructions

The following questions about your family will help to determine what things effect your score on the science test. Please read each question carefully. The information will NEVER be shown to the public. Your name is only on this questionnaire so that it can be placed with your science test score. Your name, family information, or science test score will NEVER be made public.

EXAMPLES

4. Which of the categories below most nearly describes your mother's/female guardian's main job? If your mother/female guardian has more than one job, check her main occupation.

(Check only one box)

CLERICAL such as bank teller, bookkeeper, secretary, typist, mail carrier, ticket agent . . . . ☐

6. Which of the following do you have in your home?

		Have	Do Not Have
a.	A specific place for study........................	☐	☐
b.	A daily newspaper.................................	☐	☐

1. **Which of the categories below most nearly describes your father's/male guardian's main job? If your father/male guardian has more than one job, check his main occupation.**

(Check only one box)

	Code
CLERICAL such as bank teller, bookkeeper, secretary, typist, mail carrier, ticket agent	☐ 57
CRAFTSMAN such as baker, automobile mechanic, machinist, painter, plumber, telephone installer, carpenter	☐ 27
FARMER, FARM MANAGER	☐ 28
HOMEMAKER ONLY	☐ .
LABORER such as construction worker, sanitary worker, farm laborer	☐ 7
MANAGER, ADMINISTRATOR such as sales, restaurant, or officer manager, school admin., buyer, govt. official	☐ 68
MILITARY such as career officer, enlisted man	☐ .
OPERATIVE such as meat cutter, assembler, machine operator, welder, taxicab, bus, or truck driver	☐ 19
PROFESSIONAL such as accountant, artist, registered nurse, engineer, librarian, writer, social worker, actor, actress, athlete, politician, but not including school teacher	☐ 59
PROFESSIONAL such as clergyman, dentist, physician, lawyer, scientist, college teacher	☐ 82
PROPRIETOR OR OWNER such as owner of a small business, contractor, restaurant owner	☐ 50
PROTECTIVE SERVICE such as detective, police officer, fire fighter	☐ 38
SALES such as salesperson, advertising or insurance agent, real estate broker	☐ 54
SCHOOL TEACHER such as elementary or secondary	☐ 71
SERVICE such as barber, beautician, practical nurse, private household worker, janitor, waiter	☐ 16
TECHNICAL such as draftsman, medical or dental technician, computer programmer	☐ 61
Never Worked	☐ .
Don't Know	☐ .

2.What was the highest level of education your father/male guardian completed?

(Check only one box)

	Code
Less than high school	☐ 1
High School graduate only	☐ 2
Vocational, trade, or business school after high school	
Less than two years	☐ 3
Two years or more	☐ 3
College	
Less than two years of college	☐ 3
Two or more years of college (including two-year degree)	☐ 3
Completed college (4 or 5 year degree)	☐ 4
Master's degree or equivalent	☐ 5
Ph.D., M.D., or other advanced professional degree	☐ 5
Don't Know	☐ .

3. American families are divided below into three groups according to how much money they make in a year. Check the square which comes closest to the amount of money your family makes in a year.

(Check only one box)

	Code
$19,000 or less	☐ 1
$20,000 to $34,999	☐ 2
$35,000 or more	☐ 3
Don't know	☐ .

4. Which of the categories below most nearly describes your mother's/female guardian's main job? If your mother/female guardian has more than one job, check her main occupation.

(Check only one box)
Code

CLERICAL such as bank teller, bookkeeper, secretary, typist, mail carrier, ticket agent . . . . ☐ 57

CRAFTSMAN such as baker, automobile mechanic, machinist, painter, plumber, telephone installer, carpenter . . . . ☐ 27

FARMER, FARM MANAGER . . . . ☐ 28

HOMEMAKER ONLY . . . . ☐ .

LABORER such as construction worker, sanitary worker, farm laborer . . . . ☐ 7

MANAGER, ADMINISTRATOR such as sales, restaurant, or officer manager, school admin., buyer, govt. official . . . . ☐ 68

MILITARY such as career officer, enlisted man . . . . ☐ .

OPERATIVE such as meat cutter, assembler, machine operator, welder, taxicab, bus, or truck driver . . . . ☐ 19

PROFESSIONAL such as accountant, artist, registered nurse, engineer, librarian, writer, social worker, actor, actress, athlete, politician, but not including school teacher . . . . ☐ 59

PROFESSIONAL such as clergyman, dentist, physician, lawyer, scientist, college teacher . . . . ☐ 82

PROPRIETOR OR OWNER such as owner of a small business, contractor, restaurant owner . . . . ☐ 50

PROTECTIVE SERVICE such as detective, police officer, fire fighter . . . . ☐ 38

SALES such as salesperson, advertising or insurance agent, real estate broker . . . . . ☐ 54

SCHOOL TEACHER such as elementary or secondary . . . . ☐ 71

SERVICE such as barber, beautician, practical nurse, private household worker, janitor, waiter . . . . ☐ 16

TECHNICAL such as draftsman, medical or dental technician, computer programmer . ☐ 61

Never Worked . . . . ☐ .

Don't Know . . . . ☐ .

5.What was the biggest level of education your mother/female guardian completed?

(Check only one box)
Code

Less than high school . . . . ☐ 1

High School graduate only . . . . ☐ 2

Vocational, trade, or business school after high school

Less than two years . . . . ☐ 3

Two years or more . . . . ☐ 3

College

Less than two years of college . . . . ☐ 3

Two or more years of college
(including two-year degree) . . . . ☐ 3

Completed college (4 or 5 year degree) . . . . ☐ 4

Master's degree or equivalent . . . . ☐ 5

Ph.D., M.D., or other advanced professional degree . . . . ☐ 5

Don't Know . . . . ☐ .

6. Which of the following do you have in your home?

		Have 2	Do Not Have 1
a.	A specific place for study	☐	☐
b.	A daily newspaper	☐	☐
c.	Encyclopedia or other reference books	☐	☐
d.	Typewriter	☐	☐
e.	Electric dishwasher	☐	☐
f.	Two or more cars or trucks that run	☐	☐
g.	More than 50 books	☐	☐
h.	A room of your own	☐	☐
i.	Pocket calculator	☐	☐
j.	Color TV	☐	☐
k.	Computer	☐	☐
l.	Video tape recorder (VCR)	☐	☐
m.	Compact disc (CD) player	☐	☐

Personal Information

1. What is your gender? (circle one letter)

   A. MALE   B. FEMALE

2. What is your age? __________ years

3. Which of the following best describes your racial or ethnic identification? (circle one)

   A. AMERICAN INDIAN   D. WHITE
   B. ASIAN   E. HISPANIC
   C. BLACK   F. OTHER (specify) ____________

4. What is your current Grade Point Average (GPA) on a 4.0 scale? _____

5. Please circle the number of semesters of each science class and the grade that your received in the class below.

Science Class	Semester (circle all that apply)	Grade (circle one per semester)				
BIOLOGY	First	A	B	C	D	E
	Second	A	B	C	D	E
	Third	A	B	C	D	E
	Fourth	A	B	C	D	E
CHEMISTRY	First	A	B	C	D	E
	Second	A	B	C	D	E
	Third	A	B	C	D	E
	Fourth	A	B	C	D	E
PHYSICS	First	A	B	C	D	E
	Second	A	B	C	D	E
	Third	A	B	C	D	E
	Fourth	A	B	C	D	E
GENERAL SCIENCE	First	A	B	C	D	E
	Second	A	B	C	D	E
	Third	A	B	C	D	E
	Fourth	A	B	C	D	E
AGRISCIENCE and NATURAL RESOURCES	First	A	B	C	D	E
	Second	A	B	C	D	E
	Third	A	B	C	D	E
	Fourth	A	B	C	D	E
OTHER SCIENCE CLASS ___________	First	A	B	C	D	E
	Second	A	B	C	D	E
	Third	A	B	C	D	E
	Fourth	A	B	C	D	E

APPENDIX D

OBJECTIVE 1
SUPPLEMENTARY TABLES

Table 34

Science credits completed

Science Credits	Frequency	Percent
0.5	1	0.6
1.0	15	9.6
1.5	6	3.8
2.0	40	25.6
2.5	14	9.0
3.0	32	20.5
3.5	15	9.6
4.0	16	10.3
4.5	8	5.1
5.0	6	3.8
5.5	2	1.3
6.0	1	0.6
Total	156	100.0

Table 35

Agriscience and natural resources credits completed

ANR Credits	Frequency	Percent
0.5	5	10.2
1.0	25	51.0
1.5	1	2.0
2.0	11	22.4
2.5	1	2.0
3.0	5	10.2
3.5	1	2.0
Total	49	100.0

APPENDIX E

FIRST COVER LETTER

Agricultural & Extension Education

Michigan State University
410 Agriculture Hall
East Lansing, Michigan 48824 - 1039
(517) 355 - 6580

FAX (517) 353 - 4981

April 14, 1992

John Doe
Maple Grove High School
123 Main Street
Maple Grove, MI 41234

Dear John:

Secondary agricultural education programs in Michigan have experienced drastic changes over the past several years. Currently, many programs are restructuring to become agriscience and natural resources programs. Part of this restructuring process includes the adoption of the Michigan Agriscience and Natural Resources Curriculum.

As a member of the agricultural education profession in Michigan, your use of, and opinions about the curriculum is important. Your name has been randomly selected from all agriscience and natural resources teachers in Michigan. Because you are one of a select group of teachers chosen to complete this questionnaire, the return of your completed questionnaire is very important.

You may be assured of complete confidentiality. The questionnaire has an identification number for mailing purposes only. This is so that we may check your name off of the mailing list when your questionnaire is returned. Your name will never be placed on the questionnaire.

The results of this questionnaire will be shared with the officers and members of the Michigan Association of Agriscience Educators, the Michigan Horticulture Teachers Association, and the Michigan Department of Education. Please return your completed questionnaire by **April 30, 1992** in the enclosed self-addressed stamped envelope.

Thank you for your assistance.

Sincerely,

Jack Elliot
Assistant Professor

Sincerely,

Jim Connors
Graduate Assistant

APPENDIX F

PERCEPTIONS OF THE MICHIGAN AGRISCIENCE AND NATURAL RESOURCES CURRICULUM TEACHER SURVEY

Perceptions of the Michigan Agriscience and Natural Resources Curriculum

Teacher Survey

Department of Agricultural and Extension Education
Michigan State University

Perceptions of the Michigan Agriscience and Natural Resources Curriculum

Background

Michigan agricultural education programs are in the process of restructuring to agriscience and natural resources (ANR) programs. During this time of change it is important to determine teachers' perceptions of the Michigan Agriscience and Natural Resources (ANR) Curriculum. This survey is designed to determine the amount of curriculum that is currently being taught, and teachers' perceptions of agriscience education.

Directions

Answer each question as accurately as you can. Many questions can be answered by circling the item that best describes your opinion or situation. Other questions will require a written answer. All answers will be kept completely confidential.

Example #1

Please read each statement carefully. If the statement describes content that is not taught in your agriscience and natural resources courses, please circle "NO." If the statement describes content that is taught in your courses, please circle "YES." (circle one response)

NO YES 1. Analyze water problems, existing and potential.

Example #2

Please indicate the extent to which you agree or disagree with each of the following statements. (Circle one response)

SD D ? A SA 1. More students would enroll in agriculture if an agriscience and natural resources curriculum was offered in my school.

AGRISCIENCE AND NATURAL RESOURCES CURRICULUM CONTENT

Please read each statement carefully. If the statement describes content that is not currently taught in your agriscience and natural resources courses, please circle "NO." If the statement describes content that is taught in your courses, please circle "YES." (circle one response)

NO YES	1.	Analyze the interrelationships between natural resources and Michigan agricultural production.
NO YES	2.	Examine the conservation of natural resources.
NO YES	3.	Discuss the reuse of recoverable natural resources.
NO YES	4.	Analyze the economic importance of the agricultural and natural resources sectors in Michigan.
NO YES	5.	Analyze the interrelationships of Michigan agriculture, natural resources, and society.
NO YES	6.	Analyze the interrelationships between agriculture, natural resources, and the government.
NO YES	7.	Analyze how human life depends on plants.
NO YES	8.	Diagram the structures of a plant cell.
NO YES	9.	Identify plant parts including seeds, root, leaves, etc.
NO YES	10.	Examine the process of photosynthesis.
NO YES	11.	Examine the process of respiration.
NO YES	12.	Examine the process of transpiration.
NO YES	13.	Examine the process of translocation.
NO YES	14.	List the six requirements for plant growth.
NO YES	15.	Diagram the process of mitosis.
NO YES	16.	Examine asexual (vegetative) propagation.
NO YES	17.	Distinguish between acidity, alkalinity, pH, and cation exchange.
NO YES	18.	Analyze soil texture and its importance to soil tilth.
NO YES	19.	Describe field capacity, saturation, and wilting point
NO YES	20.	Analyze the concept of water holding capacity and water infiltration of different soils.
NO YES	21.	Examine the functions of macronutrients and micronutrients in plant growth.
NO YES	22.	Analyze the sources of each of the primary elements (N,P,K).

Please read each statement carefully. If the statement describes content that is not currently taught in your agriscience and natural resources courses, please circle "NO." If the statement describes content that is taught in your courses, please circle "YES." (circle one response)

NO YES	23.	Analyze plant nutrient deficiencies by using a deficiency test.
NO YES	24.	Analyze the role of pests in agriculture.
NO YES	25.	Diagram the life cycles of pests.
NO YES	26.	Examine biological control of pests.
NO YES	27.	Examine cultural and chemical control of pests.
NO YES	28.	Examine the term "binomial nomenclature."
NO YES	29.	Describe the concept of the five kingdoms.
NO YES	30.	Define the terms "genus," "species," and "sub-species."
NO YES	31.	Define evolution.
NO YES	32.	Define genetic variability and natural selection.
NO YES	33.	Examine the importance of animal domestication.
NO YES	34.	Identify the major sources of animal protein in the world.
NO YES	35.	Discuss the use of performance modifiers in animal agriculture.
NO YES	36.	Examine the use of terms for direction and position in the vertebrate body.
NO YES	37.	Explain glandular functions including secretion and excretion.
NO YES	38.	Classify the function of specific glands as endocrine or exocrine.
NO YES	39.	Identify both plant and animal cells.
NO YES	40.	Identify muscle, blood, nerve, and adipose cells.
NO YES	41.	Identify the components of the vertebrate skeletal system.
NO YES	42.	Define the terms, comparative anatomy, homology, and analogy.
NO YES	43.	Discuss the functions of the anatomical structures and compare them to similar structures in other animals.
NO YES	44.	Describe the functions of the components of the digestive system.
NO YES	45.	Compare the functions and location of the digestive organs of man, poultry, horses, cows, and swine.
NO YES	46.	Label six major organs found in the reproductive tract of farm animals and humans.

Please read each statement carefully. If the statement describes content that is not currently taught in your agriscience and natural resources courses, please circle "NO." If the statement describes content that is taught in your courses, please circle "YES." (circle one response)

NO YES 47. Describe general metabolic and physiological changes resulting from castration.

NO YES 48. Examine the role of hormones in the body systems.

NO YES 49. Describe and understand the term "endocrinology."

NO YES 50. Define terms related to hormone influence such as "receptor cells, negative feedback, endocrine gland, and homeostasis."

NO YES 51. Examine the importance of hormones to body functions.

NO YES 52. Describe the major organs found in the animal reproductive tract.

NO YES 53. Diagram an animal sperm and ovum, and identify all major parts.

NO YES 54. Examine the steps of mitosis and miosis.

NO YES 55. Compare the gestation length, time of ovulation, and length of estrus for four domestic species of economic importance.

NO YES 56. Describe the process of fertilization in animals.

NO YES 57. Examine the transmission of genes through meiotic division.

NO YES 58. Examine the act of mating and conception through implantation of the embryo (blastocyst) in the uterus.

NO YES 59. Define the terms chromosome, nucleic acids, DNA, and RNA.

NO YES 60. Define the terms haploid, diploid, and segregation.

NO YES 61. Define the terms phenotype, genotype, homozygous, heterozygous, allele, gene, dominant, and recessive.

NO YES 62. Define "parturition."

NO YES 63. Examine the six classes of nutrients.

NO YES 64. Identify organs that breakdown carbohydrates, fats, and proteins.

NO YES 65. Examine the different vitamins and their functions.

NO YES 66. Examine microbial digestion including synthesis of amino acids.

NO YES 67. Examine feed digestion and absorption.

NO YES 68. Describe the digestive systems in ruminants and non-ruminants.

NO YES 69. Understand the concepts of body temperature, heart rate, and respiration in animal health.

NO YES 70. Explain the methods of control for internal and external parasites.

ATTITUDES ABOUT AGRISCIENCE AND NATURAL RESOURCES

Your attitude about the term "agriscience" is important to this research study. On the next page you will find the term "agriscience," followed by thirteen pairs of descriptive adjectives. Please make your judgements by placing your check-mark (✓) in the appropriate space based on what these terms mean TO YOU.

Example #3

FFA

If you feel that the concept is very closely related to one end of the scale, you should place your check-mark (✓) as follows:

OLD:_✓_:___:___:___:___:___:___:NEW

If you feel that the concept is closely related to one or the other end of the scale (but not extremely), you should place your check-mark (✓) as follows:

OLD:___:_✓_:___:___:___:___:___:NEW

If the concept seems only slightly related to one side as opposed to the other side (but is not really neutral), then you should place your check-mark (✓) as follows:

OLD:___:___:_✓_:___:___:___:___:NEW

If you consider the concept to be neutral on the scale, both sides of the scale equally associated with the concept, or if the scale is completely irrelevant, then you should place your check-mark (✓) in the middle space:

OLD:___:___:___:_✓_:___:___:___:NEW

AGRISCIENCE

(Place one check-mark (✓) for each pair of terms)

INDISPENSABLE: ___:___:___:___:___:___:___ :DISPENSABLE

GOOD: ___:___:___:___:___:___:___ :BAD

UNIMPORTANT: ___:___:___:___:___:___:___ :IMPORTANT

EFFECTIVE: ___:___:___:___:___:___:___ :INEFFECTIVE

EXCITING: ___:___:___:___:___:___:___ :BORING

OLD: ___:___:___:___:___:___:___ :NEW

DYNAMIC: ___:___:___:___:___:___:___ :STATIC

INNOVATIVE: ___:___:___:___:___:___:___ :ARCHAIC

NECESSARY: ___:___:___:___:___:___:___ :UNNECESSARY

ESSENTIAL: ___:___:___:___:___:___:___ :UNESSENTIAL

DOUBTFUL: ___:___:___:___:___:___:___ :SURE

UNWANTED: ___:___:___:___:___:___:___ :WANTED

WORTHLESS: ___:___:___:___:___:___:___ :VALUABLE

PERCEPTIONS OF AGRISCIENCE AND NATURAL RESOURCES

Please indicate the extent to which you agree or disagree with each of the following statements.

Response	Key
Strongly Disagree	SD
Disagree	D
Undecided	?
Agree	A
Strongly Agree	SA

(circle one response)

SD D ? A SA	1.	An agriscience and natural resources program in high school will give students a solid base for a career in agriculture and natural resources.
SD D ? A SA	2.	An agriscience and natural resources course should be recommended to all high school students.
SD D ? A SA	3.	High school science credit should be awarded for agriscience and natural resources courses.
SD D ? A SA	4.	My community supports the concept of agriscience and natural resources.
SD D ? A SA	5.	Teaching an agriscience and natural resources curriculum enables me to more effectively meet the needs of my students.
SD D ? A SA	6.	An agriscience and natural resources curriculum attracts a diverse group of students.
SD D ? A SA	7.	I am a supporter of the change to agriscience and natural resources programs.
SD D ? A SA	8.	I believe that traditional production agriculture programs are better than agriscience and natural resources programs.
SD D ? A SA	9.	There is evidence to support the change to an agriscience and natural resources based curriculum.
SD D ? A SA	10.	An agriscience and natural resources program is appropriate for my community.
SD D ? A SA	11.	Agriscience and natural resources programs should be placed in the science department of high schools.

AGRISCIENCE CURRICULUM KNOWLEDGE

Please read each of the following statements. Circle "F" if the statement is false, and "T" if the statement is true.

F T 1. There are four basic core units in the Michigan Agriscience and Natural Resources Curriculum (ANR).

F T 2. There are 11 advanced/specialized modules in the Michigan ANR Curriculum.

F T 3. The Michigan ANR Curriculum is cross-referenced with the State Science Objectives for Secondary Students as specified by the Michigan Department of Education.

F T 4. The Michigan ANR Curriculum can be purchased from the Department of Agricultural and Extension Education (AEE) at MSU.

F T 5. The title and contents of the Michigan ANR Curriculum were selected by MSU teacher educators in agriculture, MSU agricultural professors, and Michigan Department of Education staff.

F T 6. All agricultural and horticultural programs in Michigan must complete the restructuring process to become ANR programs by 1993.

F T 7. It is recommended that students who complete an ANR course that uses the Michigan ANR Curriculum should receive science credit towards graduation.

F T 8. Students who complete certain advanced/ specialized courses will be eligible to receive advanced placement credits towards a Bachelors degree at Michigan State University.

F T 9. Hours of scientific-technical updating that teachers receive towards qualification to teach the new curriculum are currently being recorded by the Department of Ag. and Ext. Education at MSU.

F T 10. Comprehensive high school ANR programs must teach three of the four basic core units of the Michigan ANR Curriculum.

PERSONAL INFORMATION

1. What is your gender? (circle one letter)

   A. MALE
   B. FEMALE

2. What is your age? _____years

3. How long have you taught? _____years

4. Which of the following best describes your racial or ethnic identification? (circle one letter)

   A. AMERICAN INDIAN
   B. ASIAN
   C. BLACK
   D. WHITE
   E. HISPANIC
   F. OTHER - SPECIFY __________

5. How would you characterize the location of your school? (circle one letter)

   A. RURAL
   B. TOWN
   C. SUBURBAN
   D. URBAN

6. Has your agricultural education program completed the restructuring process to become an agriscience and natural resources program? (circle one letter)

   A. NO
   B. YES

7. How many hours, of the 86 required for qualification to teach the new curriculum, do you have completed?

   ____________hrs.

8. Are you certified to teach science? (circle one letter)

   A. NO
   B. YES

9. Have you assembled a restructuring committee? (circle one letter)

A. NO → **Please skip to question # 12.**

B. YES

10. If yes, have they met? (circle one letter)

A. NO → **Please skip to question # 12.**

B. YES

11. How many times has the committee met?

__________ times

12. Please use the space below and on the back for any additional comments that you may have.

APPENDIX G

POSTCARD REMINDER

Dear John:

Last week you were mailed a Michigan Agriscience and Natural Resources Curriculum survey. If you have already completed and returned the survey, please accept our sincere thanks. If not, please do so as soon as possible.

The return of your completed survey is important in order to determine teachers' perceptions of the Michigan ANR Curriculum. The opinions of Michigan teachers will be used to improve future curriculum development activities. If by some chance you did not receive the survey, or it got misplaced, you will receive another survey within the next two weeks.

Sincerely,
Jack Elliot

APPENDIX H

SECOND COVER LETTER

Agricultural & Extension Education

Michigan State University
410 Agriculture Hall
East Lansing, Michigan 48824 - 1039
(517) 355 - 6580

FAX (517) 353 - 4981

May 5, 1992

John Doe
Maple Grove High School
123 Main Street
Maple Grove, MI 41234

Dear John:

About three weeks ago you should have received a questionnaire asking for your perceptions of the Michigan Agriscience and Natural Resources Curriculum. As of today, I have not received your completed questionnaire. If you have already returned the survey I would like to thank you.

Your perceptions about the Michigan Agriscience and Natural Resources Curriculum are of vital importance. The opinions and comments that you make will help assist future curriculum development activities.

In case you misplaced the first questionnaire, I have enclosed another one for your convenience. Please take a few minutes to complete and return it in the enclosed self addressed stamped envelope. Your cooperation will be greatly appreciated.

Sincerely,

Jack Elliot
Assistant Professor

Cordially,

Jim Connors
Graduate Assistant

APPENDIX I

THIRD COVER LETTER

Agricultural & Extension Education

Michigan State University
410 Agriculture Hall
East Lansing, Michigan 48824 - 1039
(517) 355 - 6580

FAX (517) 353 - 4981

May 19, 1992

John Doe
Maple Grove High School
123 Main Street
Maple Grove, MI 41234

Dear John:

I am writing to you regarding the questionnaire that you have received on your perceptions of the Michigan Agriscience and Natural Resources Curriculum. I have not received your completed questionnaire. If you have returned the questionnaire, please disregard this letter.

The large number of Michigan agriscience and natural resources teachers who have returned the questionnaire is encouraging. However, in order to accurately describe teachers' perceptions and opinions about the Michigan Agriscience and Natural Resources Curriculum we need you to complete and return your questionnaire.

The information you supply will be used by teacher educators and Department of Education staff to improve curriculum development activities. The usefulness of the results depends on obtaining the perceptions of all agriscience and natural resources teachers in Michigan.

In case our other correspondence did not reach you, a replacement questionnaire is enclosed. I urge you to complete the questionnaire and return it in the enclosed envelope as soon as possible.

Your contribution to the success of this study will be greatly appreciated.

Sincerely,

Jack Elliot,
Assistant Professor

APPENDIX J

FOURTH COVER LETTER

Agricultural & Extension Education

Michigan State University
410 Agriculture Hall
East Lansing, Michigan 48824 - 1039
(517) 355 - 6580

FAX (517) 353 - 4981

June 17, 1992

John Doe
Maple Grove High School
123 Main Street
Maple Grove, MI 41234

Dear John:

Over the past several months you should have received three questionnaires from me in the mail. The questionnaires are asking for your perceptions of the Michigan Agriscience and Natural Resources Curriculum. As an agriscience and natural resources teacher your perceptions, opinions, and attitudes about the Michigan Agriscience and Natural Resources Curriculum are very important.

You are one of only 20 Michigan agriscience and natural resources teachers who have not returned their questionnaires. If the results of this study are to be valid and useful for future curriculum development projects, **we must have your completed questionnaire**.

If you have already returned the questionnaire please disregard this letter. We have enclosed another questionnaire in case you misplaced the earlier ones. Please take 10 minutes to read and complete the questionnaire. A self addressed stamped envelope has been enclosed for your convenience.

Your cooperation in this research project is greatly appreciated. The information you provide will be analyzed and presented to agricultural education professionals at Michigan State University and the State Department of Education. Thanks for taking the time to complete and return this questionnaire.

Sincerely,

Jack Elliot
Assistant Professor

APPENDIX K

OBJECTIVES 2-5
SUPPLEMENTARY TABLES

Table 36

Analyze the interrelationships between natural resources and Michigan agricultural production

Response	Frequency	Percent
No	34	29.1
Yes	83	70.9
Total	117	100.0

Table 37

Examine the conservation of natural resources

Response	Frequency	Percent
No	19	16.1
Yes	99	83.9
Total	119	100.0

Table 38

Discuss the reuse of recoverable natural resources

Response	Frequency	Percent
No	26	22.0
Yes	92	78.0
Total	118	100.0

Table 39

<u>Analyze the economic importance of the agricultural and natural resources sectors in Michigan</u>

Response	Frequency	Percent
No	28	23.7
Yes	90	76.3
Total	118	100.0

Table 40

<u>Analyze the interrelationships of Michigan agriculture, natural resources, and society</u>

Response	Frequency	Percent
No	24	20.3
Yes	94	79.7
Total	118	100.0

Table 41

<u>Analyze the interrelationships between agriculture, natural resources, and the government</u>

Response	Frequency	Percent
No	44	37.6
Yes	73	62.4
Total	117	100.0

Table 42

Analyze how human life depends on plants

Response	Frequency	Percent
No	8	6.8
Yes	110	93.2
Total	118	100.0

Table 43

Diagram the structures of a plant cell

Response	Frequency	Percent
No	27	22.9
Yes	91	77.1
Total	118	100.0

Table 44

Identify plant parts including seeds, root, leaves, etc.

Response	Frequency	Percent
No	9	7.6
Yes	109	92.4
Total	118	100.0

Table 45

Examine the process of photosynthesis

Response	Frequency	Percent
No	6	5.1
Yes	112	94.9
Total	118	100.0

Table 46

Examine the process of respiration

Response	Frequency	Percent
No	12	10.2
Yes	106	89.8
Total	118	100.0

Table 47

Examine the process of transpiration

Response	Frequency	Percent
No	13	11.0
Yes	105	89.0
Total	118	100.0

Table 48

Examine the process of translocation

Response	Frequency	Percent
No	26	22.4
Yes	90	77.6
Total	116	100.0

Table 49

List the six requirements for plant growth

Response	Frequency	Percent
No	13	11.0
Yes	105	89.0
Total	118	100.0

Table 50

Diagram the process of mitosis

Response	Frequency	Percent
No	55	46.6
Yes	63	53.4
Total	118	100.0

Table 51

Examine asexual (vegetative) propagation

Response	Frequency	Percent
No	16	13.6
Yes	102	86.4
Total	118	100.0

Table 52

Distinguish between acidity, alkalinity, pH, and cation exchange

Response	Frequency	Percent
No	21	17.8
Yes	97	82.2
Total	118	100.0

Table 53

Analyze soil texture and its importance to soil tilth

Response	Frequency	Percent
No	16	13.6
Yes	102	86.4
Total	118	100.0

Table 54

Describe field capacity, saturation, and wilting point

Response	Frequency	Percent
No	36	30.5
Yes	82	69.5
Total	118	100.0

Table 55

Analyze the concept of water holding capacity and water infiltration of different soils

Response	Frequency	Percent
No	15	12.7
Yes	103	87.3
Total	118	100.0

Table 56

Examine the functions of macronutrients and micronutrients in plant growth

Response	Frequency	Percent
No	15	12.7
Yes	103	87.3
Total	118	100.0

Table 57

Analyze the sources of each of the primary elements (N,P,K)

Response	Frequency	Percent
No	20	16.9
Yes	98	83.1
Total	118	100.0

Table 58

Analyze plant nutrient deficiencies by using a deficiency test

Response	Frequency	Percent
No	65	56.0
Yes	51	44.0
Total	116	100.0

Table 59

Analyze the role of pests in agriculture

Response	Frequency	Percent
No	10	8.5
Yes	107	91.5
Total	117	100.0

Table 60

Diagram the life cycles of pests

Response	Frequency	Percent
No	31	27.0
Yes	84	73.0
Total	115	100.0

Table 61

Examine biological control of pests

Response	Frequency	Percent
No	10	8.5
Yes	107	91.5
Total	117	100.0

Table 62

Examine cultural and chemical control of pests

Response	Frequency	Percent
No	7	6.0
Yes	109	94.0
Total	116	100.0

Table 63

<u>Examine the term "binomial nomenclature</u>

Response	Frequency	Percent
No	38	32.5
Yes	79	67.5
Total	117	100.0

Table 64

<u>Describe the concept of the five kingdoms</u>

Response	Frequency	Percent
No	43	37.4
Yes	72	62.6
Total	115	100.0

Table 65

<u>Define the terms "genus," "species," and sub-species"</u>

Response	Frequency	Percent
No	20	17.1
Yes	97	82.9
Total	117	100.0

Table 66

Define evolution

Response	Frequency	Percent
No	54	46.2
Yes	63	53.8
Total	117	100.0

Table 67

Define genetic variability and natural selection

Response	Frequency	Percent
No	35	29.9
Yes	82	70.1
Total	117	100.0

Table 68

Examine the importance of animal domestication

Response	Frequency	Percent
No	40	34.2
Yes	77	65.8
Total	117	100.0

Table 69

Identify the major sources of animal protein in the world

Response	Frequency	Percent
No	40	34.2
Yes	77	65.8
Total	117	100.0

Table 70

Discuss the use of performance modifiers in animal agriculture

Response	Frequency	Percent
No	54	46.6
Yes	62	53.4
Total	116	100.0

Table 71

Examine the use of terms for direction and position in the vertebrate body

Response	Frequency	Percent
No	76	66.1
Yes	39	33.9
Total	115	100.0

Table 72

Explain glandular functions including secretion and excretion

Response	Frequency	Percent
No	56	48.3
Yes	60	51.7
Total	116	100.0

Table 73

Classify the function of specific glands as endocrine or exocrine

Response	Frequency	Percent
No	70	60.3
Yes	46	39.7
Total	116	100.0

Table 74

Identify both plant and animal cells

Response	Frequency	Percent
No	39	33.6
Yes	77	66.4
Total	116	100.0

Table 75

Identify muscle, blood, nerve, and adipose cells

Response	Frequency	Percent
No	66	56.9
Yes	50	43.1
Total	116	100.0

Table 76

Identify the components of the vertebrate skeletal system

Response	Frequency	Percent
No	57	49.1
Yes	59	50.9
Total	116	100.0

Table 77

Define the terms, comparative anatomy, homology, and analogy

Response	Frequency	Percent
No	87	75.0
Yes	29	25.0
Total	116	100.0

Table 78

Discuss the functions of the anatomical structures and compare them to similar structures in other animals

Response	Frequency	Percent
No	54	46.6
Yes	62	53.4
Total	116	100.0

Table 79

Describe the functions of the components of the digestive system

Response	Frequency	Percent
No	32	27.4
Yes	85	72.6
Total	117	100.0

Table 80

Compare the functions and location of the digestive organs of man, poultry, horses, cows, and swine

Response	Frequency	Percent
No	34	29.3
Yes	82	70.7
Total	116	100.0

Table 81

<u>Label six major organs found in the reproductive tract of farm animals and humans</u>

Response	Frequency	Percent
No	39	33.3
Yes	78	66.7
Total	117	100.0

Table 82

<u>Describe general metabolic and physiological changes resulting from castration</u>

Response	Frequency	Percent
No	46	39.7
Yes	70	60.3
Total	116	100.0

Table 83

<u>Examine the role of hormones in the body systems</u>

Response	Frequency	Percent
No	41	35.0
Yes	76	65.0
Total	117	100.0

Table 84

Describe and understand the term "endocrinology"

Response	Frequency	Percent
No	62	53.4
Yes	54	46.6
Total	116	100.0

Table 85

Define terms related to hormone influence such as "receptor cells, negative feedback, endocrine gland, and homeostasis"

Response	Frequency	Percent
No	81	69.8
Yes	35	30.2
Total	116	100.0

Table 86

Examine the importance of hormones to body functions

Response	Frequency	Percent
No	41	35.0
Yes	76	65.0
Total	117	100.0

Table 87

Describe the major organs found in the animal reproductive tract

Response	Frequency	Percent
No	36	30.8
Yes	81	69.2
Total	117	100.0

Table 88

Diagram an animal sperm and ovum, and identify all major parts

Response	Frequency	Percent
No	52	44.8
Yes	64	55.2
Total	116	100.0

Table 89

Examine the steps of mitosis and miosis

Response	Frequency	Percent
No	55	47.4
Yes	61	52.6
Total	116	100.0

Table 90

Compare the gestation length, time of ovulation, and length of estrus for four domestic species of economic importance

Response	Frequency	Percent
No	35	29.9
Yes	82	70.1
Total	117	100.0

Table 91

Describe the process of fertilization in animals

Response	Frequency	Percent
No	31	26.5
Yes	86	73.5
Total	117	100.0

Table 92

Examine the transmission of genes through meiotic division

Response	Frequency	Percent
No	62	53.4
Yes	54	46.6
Total	116	100.0

Table 93

Examine the act of mating and conception through implantation of the embryo (blastocyst) in the uterus

Response	Frequency	Percent
No	52	44.8
Yes	64	55.2
Total	116	100.0

Table 94

Define the terms chromosome, nucleic acids, DNA, and RNA

Response	Frequency	Percent
No	52	44.4
Yes	65	55.6
Total	117	100.0

Table 95

Define the terms haploid, diploid, and segregation

Response	Frequency	Percent
No	68	58.6
Yes	48	41.4
Total	116	100.0

Table 96

Define the terms phenotype, genotype, homozygous, heterozygous, allele, gene, dominant, and recessive

Response	Frequency	Percent
No	42	36.2
Yes	74	63.8
Total	116	100.0

Table 97

Define "parturition"

Response	Frequency	Percent
No	38	32.5
Yes	79	67.5
Total	117	100.0

Table 98

Examine the six classes of nutrients

Response	Frequency	Percent
No	35	29.9
Yes	82	70.1
Total	117	100.0

Table 99

Identify organs that breakdown carbohydrates, fats, and proteins

Response	Frequency	Percent
No	37	31.6
Yes	80	68.4
Total	117	100.0

Table 100

Examine the different vitamins and their functions

Response	Frequency	Percent
No	40	34.2
Yes	77	65.8
Total	117	100.0

Table 101

Examine microbial digestion including synthesis of amino acids

Response	Frequency	Percent
No	57	48.7
Yes	60	51.3
Total	117	100.0

Table 102

Examine feed digestion and absorption

Response	Frequency	Percent
No	37	31.6
Yes	80	68.4
Total	117	100.0

Table 103

Describe the digestive systems in ruminants and non-ruminants

Response	Frequency	Percent
No	34	29.1
Yes	83	70.9
Total	117	100.0

Table 104

Understand the concepts of body temperature, heart rate, and respiration in animal health

Response	Frequency	Percent
No	44	37.6
Yes	73	62.4
Total	117	100.0

Table 105

Explain the methods of control for internal and external parasites

Response	Frequency	Percent
No	40	34.5
Yes	76	65.5
Total	116	100.0

Table 106

Semantic differentiation scale - indispensable/dispensable

Response	Frequency	Percent
Very strongly negative	1	0.8
Strongly negative	3	2.5
Slightly negative	6	5.1
Neutral	21	17.8
Slightly positive	16	13.6
Strongly positive	32	27.1
Very strongly positive	39	33.1
Total	118	100.0

Table 107

Semantic differentiation scale - bad/good

Response	Frequency	Percent
Very strongly negative	0	0.0
Strongly negative	0	0.0
Slightly negative	1	0.9
Neutral	10	8.5
Slightly positive	10	8.5
Strongly positive	38	32.5
Very strongly positive	58	49.6
Total	117	100.0

Table 108

Semantic differentiation scale - unimportant/important

Response	Frequency	Percent
Very strongly negative	0	0.0
Strongly negative	2	1.7
Slightly negative	3	2.5
Neutral	4	3.4
Slightly positive	17	14.4
Strongly positive	38	32.2
Very strongly positive	54	45.8
Total	118	100.0

Table 109

Semantic differentiation scale - ineffective/effective

Response	Frequency	Percent
Very strongly negative	0	0.0
Strongly negative	5	4.2
Slightly negative	5	4.2
Neutral	13	11.0
Slightly positive	16	13.6
Strongly positive	47	39.8
Very strongly positive	32	27.1
Total	118	100.0

Table 110

Semantic differentiation scale - boring/exciting

Response	Frequency	Percent
Very strongly negative	0	0.0
Strongly negative	3	2.5
Slightly negative	1	0.8
Neutral	19	16.1
Slightly positive	22	18.6
Strongly positive	44	37.3
Very strongly positive	29	24.6
Total	118	100.0

Table 111

Semantic differentiation scale - old/new

Response	Frequency	Percent
Very strongly negative	1	0.9
Strongly negative	4	3.4
Slightly negative	4	3.4
Neutral	21	17.9
Slightly positive	21	17.9
Strongly positive	43	36.8
Very strongly positive	23	19.7
Total	117	100.0

Table 112

Semantic differentiation scale - static/dynamic

Response	Frequency	Percent
Very strongly negative	0	0.0
Strongly negative	3	2.5
Slightly negative	3	2.5
Neutral	15	12.7
Slightly positive	21	17.8
Strongly positive	50	42.4
Very strongly positive	26	22.0
Total	118	100.0

Table 113

Semantic differentiation scale - archaic/innovative

Response	Frequency	Percent
Very strongly negative	0	0.0
Strongly negative	0	0.0
Slightly negative	3	2.5
Neutral	18	15.3
Slightly positive	26	22.0
Strongly positive	40	33.9
Very strongly positive	31	26.3
Total	118	100.0

Table 114

Semantic differentiation scale - unnecessary/necessary

Response	Frequency	Percent
Very strongly negative	1	0.8
Strongly negative	2	1.7
Slightly negative	4	3.4
Neutral	8	6.8
Slightly positive	20	16.9
Strongly positive	34	28.8
Very strongly positive	49	41.5
Total	118	100.0

Table 115

Semantic differentiation scale - unessential/essential

Response	Frequency	Percent
Very strongly negative	0	0.0
Strongly negative	2	1.7
Slightly negative	2	1.7
Neutral	14	11.9
Slightly positive	20	16.9
Strongly positive	36	30.5
Very strongly positive	44	37.3
Total	118	100.0

Table 116

Semantic differentiation scale - doubtful/sure

Response	Frequency	Percent
Very strongly negative	0	0.0
Strongly negative	4	3.4
Slightly negative	5	4.3
Neutral	19	16.4
Slightly positive	22	19.0
Strongly positive	39	33.6
Very strongly positive	27	23.3
Total	116	100.0

Table 117

Semantic differentiation scale - unwanted/wanted

Response	Frequency	Percent
Very strongly negative	1	0.9
Strongly negative	5	4.3
Slightly negative	7	6.0
Neutral	18	15.5
Slightly positive	22	19.0
Strongly positive	32	27.6
Very strongly positive	31	26.7
Total	116	100.0

Table 118

Semantic differentiation scale - worthless/valuable

Response	Frequency	Percent
Very strongly negative	1	0.9
Strongly negative	2	1.7
Slightly negative	4	3.4
Neutral	10	8.5
Slightly positive	12	10.3
Strongly positive	41	35.0
Very strongly positive	47	40.2
Total	117	100.0

Table 119

An agriscience and natural resources program in high school will give students a solid base for a career in agriculture and natural resources

Response	Frequency	Percent
Strongly disagree	1	0.8
Disagree	2	1.7
Undecided	1	0.8
Agree	62	52.1
Strongly agree	53	44.5
Total	119	100.0

Table 120

An agriscience and natural resources course should be recommended to all high school students

Response	Frequency	Percent
Strongly disagree	3	2.5
Disagree	13	10.9
Undecided	9	7.6
Agree	60	50.4
Strongly agree	34	28.6
Total	119	100.0

Table 121

High school science credit should be awarded for agriscience and natural resources courses

Response	Frequency	Percent
Strongly disagree	0	0.0
Disagree	0	0.0
Undecided	2	1.7
Agree	28	23.5
Strongly agree	89	74.8
Total	119	100.0

Table 122

My community supports the concept of agriscience and natural resources

Response	Frequency	Percent
Strongly disagree	0	0.0
Disagree	4	3.4
Undecided	22	18.5
Agree	49	41.2
Strongly agree	44	37.0
Total	119	100.0

Table 123

Teaching an agriscience and natural resources curriculum enables me to more effectively meet the needs of my students

Response	Frequency	Percent
Strongly disagree	1	0.9
Disagree	5	4.3
Undecided	19	16.4
Agree	53	45.7
Strongly agree	38	32.8
Total	116	100.0

Table 124

An agriscience and natural resources curriculum attracts a diverse group of students

Response	Frequency	Percent
Strongly disagree	2	1.7
Disagree	12	10.1
Undecided	12	10.1
Agree	57	47.9
Strongly agree	36	30.3
Total	119	100.0

Table 125

I am a supporter of the change to agriscience and natural resources programs

Response	Frequency	Percent
Strongly disagree	2	1.7
Disagree	3	2.5
Undecided	12	10.2
Agree	43	36.4
Strongly agree	58	49.2
Total	118	100.0

Table 126

I believe that traditional production agriculture programs are better than agriscience and natural resources programs

Response	Frequency	Percent
Strongly disagree	31	26.1
Disagree	59	49.6
Undecided	23	19.3
Agree	3	2.5
Strongly agree	3	2.5
Total	119	100.0

Table 127

<u>There is evidence to support the change to an agriscience and natural resources based curriculum</u>

Response	Frequency	Percent
Strongly disagree	0	0.0
Disagree	3	2.6
Undecided	17	14.5
Agree	61	52.1
Strongly agree	36	30.8
Total	117	100.0

Table 128

<u>An agriscience and natural resources program is appropriate for my community</u>

Response	Frequency	Percent
Strongly disagree	0	0.0
Disagree	4	3.4
Undecided	10	8.5
Agree	59	50.4
Strongly agree	44	37.6
Total	117	100.0

Table 129

Agriscience and natural resources programs should be placed in the science department of high schools

Response	Frequency	Percent
Strongly disagree	4	3.4
Disagree	10	8.5
Undecided	9	7.7
Agree	54	46.2
Strongly agree	40	34.2
Total	117	100.0

Table 130

There are four basic core units in the Michigan Agriscience and Natural Resources Curriculum (ANR)

Response	Frequency	Percent
Incorrect	0	0.0
Correct	114	100.0
Total	114	100.0

Table 131

<u>There are 11 advanced/specialized modules in the Michigan ANR Curriculum</u>

Response	Frequency	Percent
Incorrect	19	19.0
Correct	81	81.0
Total	100	100.0

Table 132

<u>The Michigan ANR Curriculum is cross-referenced with the State Science Objectives for Secondary Students as specified by the Michigan Department of Education</u>

Response	Frequency	Percent
Incorrect	6	5.5
Correct	104	94.5
Total	110	100.0

Table 133

The Michigan ANR Curriculum can be purchased from the Department of Agricultural and Extension Education (AEE) at MSU

Response	Frequency	Percent
Incorrect	92	82.1
Correct	20	17.9
Total	102	100.0

Table 134

The title and contents of the Michigan ANR Curriculum were selected by MSU teacher educators in agriculture, MSU agricultural professors, and Michigan Department of Education Staff

Response	Frequency	Percent
Incorrect	86	78.2
Correct	24	21.8
Total	110	100.0

Table 135

<u>All agricultural and horticultural programs in Michigan must complete the restructuring process to become ANR programs by 1993</u>

Response	Frequency	Percent
Incorrect	5	4.5
Correct	106	95.5
Total	111	100.0

Table 136

<u>It is recommended that students who complete an ANR course that uses the Michigan ANR Curriculum should receive science credit towards graduation</u>

Response	Frequency	Percent
Incorrect	4	3.5
Correct	109	96.5
Total	113	100.0

Table 137

Students who complete certain advanced/specialized courses will be eligible to receive advanced placement credits towards a Bachelors degree at Michigan State University

Response	Frequency	Percent
Incorrect	25	22.9
Correct	84	77.1
Total	109	100.0

Table 138

Hours of scientific-technical updating that teachers receive towards qualification to teach the new curriculum are currently being recorded by the Department of Ag. and Ext. Education at MSU

Response	Frequency	Percent
Incorrect	96	85.7
Correct	16	14.3
Total	112	100.0

Table 139

Comprehensive high school ANR programs must teach three of the four basic core units of the Michigan ANR Curriculum

Response	Frequency	Percent
Incorrect	61	58.7
Correct	43	41.3
Total	104	100.0

Table 140

Age of Respondents

Age	Frequency	Percent
23	2	1.7
24	1	0.9
26	2	1.7
27	3	2.6
28	1	0.9
29	3	2.6
30	3	2.6
31	2	1.7
32	4	3.4
33	4	3.4
34	2	1.7
35	8	6.9
36	3	2.6
37	4	3.4
38	7	6.0
39	5	4.3
40	6	5.2
41	2	1.7
42	5	4.3
43	6	5.2
44	1	0.9
45	6	5.2
46	7	6.0
47	2	1.7
48	3	2.6
49	2	1.7
50	3	2.6
51	2	1.7
52	2	1.7
53	6	5.2
54	4	3.4
55	2	1.7
56	1	0.9
57	1	0.9
60	1	0.9
Total	116	100.0

Table 141

<u>Years of teaching by respondents</u>

Years	Frequency	Percent
1	3	2.6
2	7	6.0
3	2	1.7
4	3	2.6
5	4	3.4
6	6	5.2
7	5	4.3
8	3	2.6
9	1	0.9
10	3	2.6
11	2	1.7
12	6	5.2
13	4	3.4
14	6	5.2
15	6	5.2
16	5	4.3
17	5	4.3
18	5	4.3
19	2	1.7
20	4	3.4
21	3	2.6
22	4	3.4
23	4	3.4
24	3	2.6
25	2	1.7
26	1	0.9
27	4	3.4
28	5	4.3
29	2	1.7
31	2	1.7
32	3	2.6
35	1	0.9
Total	116	100.0

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