FUTURE AGRICULTURAL SYSTEMS COMPETENCIES OF BEGINNING TEXAS AGRICULTURAL SCIENCE TEACHERS AS DETERMINED BY AGRICULTURAL EDUCATION PROFESSIONALS AND ADMINISTRATORS OF AGRICULTURAL EDUCATION PROGRAMS: A DELPHI STUDY

A Dissertation

by

TIMOTHY DEE ROCKA

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

August 2003

Major Subject: Agricultural Education

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Approved as to the style and content by:

Gary Briers (Chair of Committee)	Glen Shinn (Member)
Julie Harlin (Member)	Richard Cummins (Member)
John Hoyle (Member)	Glen Shinn (Head of Department)

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ABSTRACT

Future Agricultural Systems Competencies of Beginning Texas Agricultural Science Teachers as Determined by Agricultural Education Professionals and Administrators of Agricultural Education Programs: A Delphi Study. (August 2003)

Timothy Dee Rocka, B.S., Stephen F. Austin State University;

M.S., Stephen F. Austin State University

Chair of Advisory Committee: Dr. Gary Briers

It has always been the initiative of agricultural education to provide our American society with the educational “needs of the day” (Meyer, 1999). As our nation and state enters a new era, it is fitting for an examination of the future needs of agricultural education teachers. In Texas, the State Board of Educator Certification (SBEC) currently has no assessment of the agricultural systems knowledge of agricultural education teaching candidates. This study examines the future agricultural systems competencies of beginning agricultural education teachers. Two groups, agricultural education professionals and administrators of agricultural education programs, were asked “what the future agricultural systems competencies of beginning agricultural science teachers should be.”

Two independent panels, the first composed of eleven (11) educators and the second composed of twelve (12) school administrators, were identified to serve as experts. A three-round Delphi was used to collect the data. Each

round allowed the expert panelists to converge to a consensus of agreement that identified future competencies for beginning agricultural science teachers. Panelists were asked to provide competencies associated with the five powerful and fundamental conceptual areas of biological, physical, social, informational, and other integrative science which underpin agricultural education (Paul, 1995).

The study revealed a three-fourths consensus with one-hundred (100) future competencies necessary for beginning Texas agricultural science teachers. Among these competencies twenty-three (23) were associated with the biological sciences, twenty-seven (27) were associated with the physical sciences, twenty-five (25) were associated with the social sciences, twenty (20) were associated with the informational sciences, and five (5) were associated with other integrative sciences.

The study found seventeen (17) “highly recommended” topics and six (6) “recommended” topics related to the future agricultural systems competencies identified by the expert panelists. Cooper and Layard (2001) reveal that our future society will be much more technologically and sociologically advanced requiring teacher preparation institutions and state agencies associated with teacher preparation to develop new, innovative programs to better prepare tomorrow’s educator. This study recommends that new agricultural systems standards be developed to adequately prepare future beginning agricultural science teachers.

DEDICATION

This dissertation is dedicated to my family – Kim, Courtney, Colten, and Caylee. Words can't express the deep appreciation I have as the father and husband of my family. The process of obtaining an advanced degree is grueling and requires much personal sacrifice. I could have never achieved this endeavor without their love, support, and encouragement. I would especially like to thank my wife, Kim. Your commitment to me is amazing.

To my mother, Joyce: I am the person I am because of the loving and caring environment that you provided to me as a child and young man. Thanks for your support! To my late father Carlton Delano Rocka: the man who taught me the true meaning of leadership. He once said "son you know that you are a leader when others call on you to lead." To my brothers and sisters; Carl Jr., Danny, Freda, and Belinda; thanks for your caring nature throughout my life.

To my brother-in-law and closest friend Doug; I think we have done most everything together; from teaching to playing golf. I will always think of you as my little brother, and wish you the best at Illinois State. To my in-laws Glenn and Barbra Morrish; thank you for your love and support. Every time Kim and I moved from one location to the other, you guys were there to help. Finally, I would like to thank God for giving me the talents and abilities to fulfill this journey of my life. This is the beginning of a new chapter in my life. Without God's grace none of this would have been possible.

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To Dr. Dick Cummins: I express my appreciation of bringing it all together. Having knowledge and wisdom can accomplish much. Dr. Cummins taught me that once you have become an educated person you are never allowed to make a mistake.

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CHAPTER I

INTRODUCTION

The discipline of agricultural education is evolving as our society moves forward from an industrial-manufacturing economy to a knowledge economy. The purpose and intent of agricultural education has always been to meet the educational needs of the day (Meyer, 1999). State teacher credentialing agencies struggle to keep pace with the current demands of teacher preparation and education. More often than not, current teacher education programs are offering inadequate teacher preparation and training programs (National Center for Educational Statistics (NCES), 1999). Presently, there is no subject matter assessment for Texas candidates of agricultural science teacher certification; therefore, the agricultural systems competencies of agricultural science teachers are defined by each individual teacher education institution causing a large degree of variation in teacher training (State Board of Educator Certification (SBEC), 2002).

Currently, there is no content assessment of agricultural science teacher candidate's knowledge of agricultural systems. Agricultural systems competencies are defined as agricultural science topics that are technical or scientific in nature. In the past, state teacher credentialing agencies have required completion of specific course credit before individuals were

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This dissertation follows the style and format of the *Journal of Agricultural Education.*

recommended for certification in agricultural science. Because agricultural education has evolved to meet the needs of society, future competencies must be investigated to allow the discipline to keep pace. Many states have moved to a results-based teacher education model with little specific direction related to the technical knowledge necessary to teach the subject matter content. Most recommending institutions of agricultural science require the completion of courses similar to what was required in the past. Bruening, Scanlon, and Hodes (2001) explain these past course requirements as the remains of an older production-manufacturing era of society. It is evident that the purpose and scope of contemporary agricultural science has shifted away from the production model (National Council for Agricultural Education (NCAE), 1999). It is the purpose of this study to investigate the future agricultural systems competencies necessary for beginning agricultural science teachers at the secondary education level.

Significance of the Study

As our society changes, so must its educational institutions and the knowledge which they deliver. A history of agricultural education reveals that the discipline has been evolutionary in its change process. This study asks questions related to how and why agricultural education has evolved to its present state. Are the competencies of beginning agricultural science teachers adequate for contemporary and future educational need? Our society is and

has been going through a radical change from an industrial era to an informational era (Drucker, 1992). No longer is there a need for exclusively teaching production agricultural techniques but new skills and knowledge necessary for success in a rapidly changing society. Because agricultural education is a knowledge-driven discipline, it is of great significance that an in-depth understanding of current and future competencies of beginning agricultural science teachers be gained.

Statement of the Problem

It has long been the primary objective of the discipline of agricultural education to supply its clientele with educational needs which are technologically advanced, economically efficient, and sociologically necessary. It is the purpose of this study to examine one facet of the discipline of agricultural education which related to the preparation of beginning agricultural science teachers for secondary education programs in the state of Texas. Society has become more urban as our nation's population shifts from rural regions to larger metropolitan areas (Murdock et al, 2002). Students of agricultural science and technology have a more diverse background today than ever before. Our society demands a more sophisticated set of occupational skill as compared to the past.

As society changes, beginning agricultural science teachers are required to develop and maintain a different set of skills from which to teach. Teacher

education programs lag behind in preparing beginning teachers with the knowledge and skills required. If agricultural education is to survive and meet the educational needs of the day, future competencies of beginning agricultural science and technology teachers must be identified.

Purpose of the Study

The purpose of this study was to identify the competencies needed by beginning agricultural science teachers. With the use of a Delphi technique, expert educators and school administrators in the discipline of agricultural education were able to identify the necessary competencies as they relate to each of the associated powerful and fundamental concepts which underpin agricultural education. The specific objectives of the study were as follows: (a) identify the competencies of beginning agricultural science teachers needed for the future as determined by educators of agricultural science and technology, teacher educators, and school administrators, (b) determine a consensus of competencies between the responses of school administrators and educators, and (c) formulate recommendations to be utilized for the future planning of teacher preparation.

Research Questions

The following research questions were addressed in this study:

1. What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by expert agricultural education professionals?
2. What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by expert administrators of agricultural education programs?
3. What are the future agricultural systems competencies of beginning Texas agricultural science teachers that are a consensus between expert agricultural education professionals and expert administrators of agricultural education programs?

Definition of Terms

Agricultural Education: the instructional delivery of agriculturally related information.

Agricultural Systems: technical areas associated with the teaching of agricultural education. Included are the scientific of biology, physics, sociology, information technology, and other integrative sciences.

Biological Science: the scientific study of living things which include animals, plants, and other living organisms. Included are biology, botany, zoology, and animal science.

Consensus: the agreement level of like responses at seventy-five percent or greater on a given topic or competency among expert panelists.

Informational Science: the scientific study of knowledge or intelligence as related to society. Included are computer technology, data management, and records retrieval and archival.

Other Integrative Science: the scientific approach of incorporating areas in relationship to one another. Examples include management systems, and data management decision making.

Powerful and Fundamental Concept: an idea, principle, or thought, especially a generalized idea of a thing or of a class of things. An abstract or generic idea generalized from particular instances.

Physical Science: the scientific study of natural science which includes non living material. Included are physics, chemistry, and astronomy.

Social Science: the scientific study of human society and the interpersonal relationships of people. Include are sociology, anthropology, and psychology.

Teacher Quality: a measurement of a teacher's ability to deliver adequate instruction at the appropriate level to enhance student learning.

Assumption

This study assumed that: (1) each panelist was an expert in the field of agricultural science and technology, (2) each respondent's responses were truthful and provided in good faith. It is assumed that the Delphi method is a valid research method for determining future competencies of beginning agricultural science teachers as related to each of the five powerful and fundamental concepts that underpin agricultural education.

Limitations

The limitations of this study will be within the scope of the sample of expert panelists that who were identified and nominated to participate in the study. The size of each of the expert panelists will limit the reliability of the study. It has been determined that a minimum of thirteen (13) expert panelists are needed in each group to gain a reliability of .90 (Dalkey, 1967, Helmer, 1967).

Organization of the Study

Organized in five chapters, this study reports research from the statement of the problem to recommendations for future study. Chapter I introduces the problem and the purpose of the study as well as establishing research questions, definitions of terms, assumptions, and limitations of the study.

Chapter II provides a comprehensive review of literature which surveys a history of agricultural education's foundation, teacher competencies, teacher quality, future trends of a rapidly changing society, powerful and fundamental concepts associated with agricultural education, and the reinventing of agricultural education. An explanation of the methodology utilized in this study is outlined in Chapter III; also, procedures for instrument development procedures, sample selection, data collection, and data analysis are described. Findings and analysis of data are presented in Chapter IV. Chapter V serves

as the final chapter which summarizes the study and offers conclusions and recommendations for practice and for further study.

CHAPTER II

REVIEW OF LITERATURE

Introduction

The discipline of agricultural education is evolving as our society moves forward from an industrial-manufacturing economy to a knowledge economy. The purpose and intent of agricultural education has always been to meet the educational needs of the day (Meyer, 1999). State teacher credentialing agencies struggle to keep pace with the current demands of teacher preparation and education. More often than not, current teacher education programs are offering inadequate teacher preparation and training programs (NCES, 1999). Presently, there is no subject matter assessment for Texas candidates of agricultural science teacher certification; therefore, the agricultural systems competencies of agricultural science teachers are defined by each individual teacher education institution, causing a large degree of variation in teacher training (SBEC, 2002).

Currently, there is no content assessment of agricultural science teacher candidate's knowledge of agricultural systems knowledge. Agricultural systems competencies are defined as agricultural science topics that are technical or scientific in nature. In the past, state teacher credentialing agencies have required completion of specific course credit before individuals were recommended for certification in agricultural science. Because agricultural education has evolved to meet the needs of society, future competencies must

be investigated to allow the discipline to keep pace. Many states have moved to a results-based teacher education model with little specific direction related to the technical knowledge necessary to teach the subject matter content. Most recommending institutions of agricultural science in Texas require the completion of courses similar to what was required in the past. Bruening, Scanlon, and Hodes (2001) explain that these past course requirements are the remains of an older production-manufacturing era of society. It is evident that the purpose and scope of contemporary agricultural science has shifted from the production model to a service model (NCAE, 1999). It is the purpose of this study to investigate the future agricultural systems competencies necessary for beginning agricultural science teachers at the secondary education level.

Historical Perspective

As agricultural education enters the new millennium, many new challenges must be confronted and overcome. According to Herren and Hillison (1996), the past reveals that agricultural education was created as a means of providing sound scientific technical training to its clientele. This is evident at all levels of agricultural education, ranging from secondary education to adult education, as well as international agricultural development. It is apparent that the strength of our nation was conceived in its ability to maintain a self-sustaining food supply. This becomes obvious as one investigates the condition of third world countries that intensely struggle to feed themselves and

maintain a viable economy. This study assumes the importance of agricultural education as significant, and attempts to discover new and innovative ways to meet the demands of its contemporary clientele.

In order for us to understand the future needs of agricultural science, a comprehensive understanding of the past is necessary. Agricultural education has been an integral component of the exponential growth of our American economy for more than one hundred years. This contribution is evident in the present day food and fiber production and manufacturing systems currently used. No longer do the vast majority of Americans reside on a farm, many reside in an urban environment and for those that do reside in rural America, most do not produce agricultural commodities. Formal education in agriculture largely began with the passage of the Morrill Land Grant Act in 1862. Justin Morrill and others understood that the United States' economy needed to build a solid infrastructure which included a strong agricultural and industrial base (Meyer, 1999). From this foundation, other industries and businesses began to flourish. The original intent of the Morrill Act was to meet the educational needs of the day (Meyer, 1999). Many scholars believe that the American college and university system is superior to other educational systems in the world. Because of the inclusion of agricultural education in the development of our nation's foundation, our nation's economy has grown to an economic powerhouse.

It wasn't until 1917 when Congress passed the Smith-Hughes Act that agricultural education was officially available to public schools nationwide. Before Smith-Hughes, schools that maintained agricultural education programs did so with limited funding and resources. Other governmental legislation did exist in various locations as a means of supporting agricultural education at the secondary education level. In the early 1900s Congressional District-Agricultural Schools were founded in Alabama, Georgia, and Virginia (Hillison, 1998). The primary function of these schools was to teach basic agricultural education and home economics education. Other federal resources were later made available with the Nelson Amendment attached to the Agricultural Appropriations Bill of 1907 (Hillison, 1987). This amendment was designed to aid states in providing instructors of agricultural and mechanical arts.

The Smith-Hughes Act served as a catalyst to allow agricultural education to reach a critical mass population. The specific details related to the competencies of agricultural education teachers were left to be decided by the pioneer teacher educators of the day. Many of the agricultural education teacher educators themselves had little or no formal training in the discipline. Because of the establishment of the land grant college system, there did exist a strengthening body of agricultural scientists. The decision of who would become the first generation of secondary level agricultural education teachers was raged between the agricultural scientist and many others. According to Hillison, "some wanted to convert nature-study teachers, others wanted to

convert science teachers, some wanted to take the best farmers and make teachers out of them while others wanted to use colleges of agriculture graduates as teachers" (1987, p. 11). Those who wanted a scientific curriculum with a common pedagogical methodology won the debate. The obvious place to turn to was the land grant college system, as it had an existing scientific base from which educational programming could be derived.

This was a pivotal point in the history of agricultural education. When comparing agricultural education to other disciplines in career education, an obvious distinction exists. Today, many career education teacher preparation programs such trades and industrial education, health science technology, and marketing education, require several years of work-related experience in lieu of technical or scientific course work as part of the credentialing process. In contrast, agricultural educators typically are required to have a bachelor's degree in a scientific agricultural field with specific pedagogical training. Until recently, many state education agencies required very specific credit hour requirements for agricultural education pre-service students. Texas requires that each recommending institution certify a candidate's knowledge of agricultural systems based on college course credit hours. It appears that the distinction of work experience verses course credit comes from the remittance of the agricultural scientist influence on teacher education.

Teacher Competency

There have been a multitude of studies performed related to agricultural education teacher professional development competencies; however, there is little research related to technical competencies of beginning agricultural teachers. Currently, teacher credentialing agencies assume that technical competencies of beginning teachers are gained by satisfying the requirements of a bachelor's degree in a scientific field related to agriculture. This creates a unique dilemma for non-agricultural degreed individuals seeking agricultural education certification. Because the discipline of agricultural education is confronted with a shortage of certified teachers, it behooves the discipline to accommodate both the secondary schools in need of teachers and non-agricultural degreed agricultural education teacher candidates (Camp, 2000). Because teacher quality is of paramount concern to teacher preparation, there must exist as a check and balance of agricultural systems competencies with the supply of qualified beginning agricultural teachers.

In order to determine the foundational technical competencies of agricultural science, it is necessary to investigate what essentials are required to teach agricultural science. The grand theoretical base of teaching is founded in the concept that teachers must be knowledgeable of the subject content they are teaching in order to successfully teach the content to others (Camp, 2001). It is from this theory base that teacher preparation programs have evolved. Bartlett (2002) identifies traditional courses from academic

institutions, distance courses, work experience, and professional development as four areas in which postsecondary career and technology teachers gain technical preparation. Because agricultural education technical competencies have changed dramatically in the past, it is safe to assume that technical competencies of the future will continue to change.

Teacher Quality

Teacher quality is not a new concern; it has been a concern from the very beginning of formalized education. In the 1750s, Benjamin Franklin labored over the notion of who could serve as a competent schoolmaster (Robison, 1911). And yet even today research reveals that there is a public distrust and general lack of confidence that public school teachers are prepared for the job (National Center for Educational Statistics, (NCES), 1999). It is therefore equally important that beginning agricultural educators obtain appropriate and relevant agricultural systems competencies before being recommended for certification. The basic tenet of teaching is grounded in the theory that a teacher's knowledge of the subject matter in which he or she is teaching must be mastered before the teacher can effectively teach the content (Camp, 2001). This foundational concept is so obvious, yet so commonly overlooked in the development and evaluation stages of teacher education. As highlighted in the US Department of Education's study "What Matters Most: Teaching for America's Future," schools across our nation employ teachers

who are unprepared to teach their subject matter content (National Commission on Teaching and America's Future (NCTAF), 1996).

Teacher quality must be measured by student performance. Poor student results are inevitable when poorly qualified teachers deliver the instruction. A missing link between student performance and teacher performance can be found within teacher preparation; however, teacher preparation programs cannot be expected to transform just anyone into a highly qualified teacher (NCES, 1999). Teacher education programs must first recruit those individuals who are suited for the rigors of teaching. The basic tenet that teachers must know their content before they can teach it cannot be secured by adding more content courses to a prescribed degree plan. Ballou and Podgursky (1997) raise important issues in their discussion of ways in which to attract "brighter," more capable individuals into the teaching pool. According to the researchers' logic, lengthening formal training does not necessarily equate to higher teacher quality. It is important to note, however, the other side of the debate; that is, in addition to talent and subject matter knowledge, prospective teachers must also be trained to teach children (NCTAF, 1996). Some suggest that teachers are born not made; this is the basic tenet of Donald O. Clifton founder of the Gallup organization. However, research has found that individuals who have experienced quality teaching are more likely to become quality teachers themselves (NCTAF, 1996).

Teacher knowledge and skill is the single largest factor that impacts student performance (Erickson, 2002). Teaching quality is an ongoing process that requires continuous growth and development of a teacher's knowledge and skills. Because the subject matter of agricultural education is based on scientific fundamentals, a complete shift in teacher knowledge is unnecessary; however, because our society has changed rapidly, it is vitally important for agricultural educators to keep pace with current innovations within the discipline. Our society revolves around the need and use of knowledge. Because agricultural education curriculum is a reflection of current technological need, beginning teachers of agricultural education must continuously develop professionally.

Agricultural Education Reinvented

The National Council for Agricultural Education (1999) conducted a comprehensive review and strategic plan for agricultural education, which produced several initiatives and the publication *The Reinventing of Agricultural Education for the Year 2020.* The initiatives were derived from a diverse group of stakeholders and called for a fundamental change in the direction of agricultural education. The mission of the study focuses primarily on the career preparation of students with emphasis on making students aware of global agricultural systems, food and fiber systems, and natural resources systems that are related to agriculture. Because of this shift in focus of agricultural

education as defined by the National Council for Agricultural Education (NCAE, 1999), it is necessary to conduct research to determine the appropriate future agricultural systems competencies for beginning teachers of agricultural education.

The Reinventing of Agricultural Education prescribes four specific goals; (1) to develop an abundance of highly motivated, well-educated teachers in all disciplines, pre-kindergarten through adult, providing agriculture, food, fiber, and natural resources systems education; (2) to provide all students access to seamless. Lifelong instruction in agriculture, food, fiber, and natural resources systems through a wide variety of delivery methods and educational settings; (3) to insure that all students are conversationally literate in agriculture, food, fiber, and natural resources systems, and (4) to encourage partnerships and strategic alliances that ensure a continuous presence of education in and about agriculture, food, fiber and natural resources systems. These four goals include the enrichment of teacher education to prepare all beginning teachers with the necessary competencies to insure learning opportunities for a diverse student clientele. As a means of satisfying the goals and objectives of the Reinventing of Agricultural Education recommendations, government agencies in charge of credentialing beginning agricultural education teachers must consider the restructuring of teacher education programs. Research related to the agricultural systems competencies of beginning agricultural education teachers

at the secondary education level must be conducted as to allow for higher quality of beginning teacher candidates.

Futuring

Futuring is defined by Hoyle (1995, p. 20) as “the act of seeing and feeling alternative futures that are either in the near, middle, or far future.” An understanding of future possibilities or alternative is necessary to establish direction and leadership to agricultural education. Figure 1 depicts the three essential elements of making visions happen, which include a vision statement, mission statement, and goal statement. Each of these three elements insures that the futuring vision is communicated to all stakeholders within a community (Hoyle, 1995).

The future agricultural systems competencies of beginning agricultural educators must coincide with the future needs of our community and society. What is known about the future of our society? Many believe it will become more intellectually advanced, global in nature, culturally diverse, massive in number, older in population, environmentally complex, and more technologically advanced (Pritchett, 1997). It is estimated that 80% of the technologies needed to solve the complexities of a growing world population by 2050 have not been created or conceived (Hoyle, 1995). The future will require new, innovative approaches to teaching agricultural science using much different information.

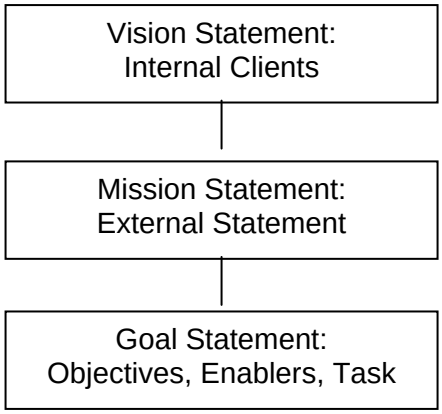

Figure 1. The Three Essential Elements for Making Visions Happen (Hoyle, p. 21, 1995).

As each of these critical attributes is examined, it becomes apparent how interrelated each is to the other. The introduction of new information in our society is at a record high. Not only are we discovering new information at a rapid pace, with the aid of information technology, old information is being archived and being made readily accessible (Pritchett, 1997). Another critical component related to the information age in which we live is to whom information is available. Half a century ago, much of the same data and documentation did exist; however, access to the information was limited because of physical barriers. How much paper or data could a single person physically manage fifty years ago? Information technology has mandated a new way of managing data and information.

Information technology is serving as the catalyst for change in our society. America's population is changing: (1) in size from 275 million in the

year 2000 to 349 million in the year 250; (2) in diversity large increases in the number of persons classified as non-Hispanic will remain constant over the fifty years, however all other minority groups will group by one-third; and (3) in age, American life expectancy will rise from 79 in the year 2000 to 86 by the year 2050, respectively (Day, 1996). Population shifts are occurring within the United States as people gravitate to urban regions. Increased technology has provided efficiency in food and fiber production, human health services, and basic education, which attribute to the shifts within the population. What challenges does our society face in the future? In the US, the life expectancy will rise from 79 to 86 years of age by year 2050 with the number of over 65 years of age doubling by 2060 (Day, 1996). This older population will require additional resources beyond what are currently available. According the US Census Bureau, our nation is expected to become a minority-majority by the year 2060 (Day, 1996). The 2000 US Census reveals that the birth rate is growing rapidly in the Hispanic American, African American, and Asian American ethnic groups and is remaining constant in the Caucasian ethnic group. Immigration to the US is yet another contributor to both the expected increases in population and diversity. Our educational system, including agricultural education will be strained to meet the demands of a larger, more diverse student body (NCES, 1999).

The increase in population will demand a food and fiber production system of equal proportion; however, because of a more informed consumer,

future agriculturists will certainly have greater environmental demands. The era of high-input production agriculture is rapidly ending as consumers learn more about the risk associated with chemical agriculture (D. Creech, personal communication, June 10, 1999). It is apparent that new solutions will come from the high science of biotechnology and genetic engineering. New breakthroughs such as pest resistance crops are the wave of the future; however, to date, high science has not always been embraced by society. This was apparent with the introduction of BST (Bovine somatotropin) in the early 1990s. This hormone is used to increase the milk production of dairy cattle. Consumers were fearful of the effects that BST milk might have on young children. It is apparent that a lack of available information provided to the consumer about high science caused a rejection of biotechnological technique (H. W. Ladewig, personal communication, October 8, 2001). Today, BST is widely accepted. Agricultural education will need to provide a communications channel by which the common public gains understanding of high science, known as high touch. High touch is nothing more than the ability to gain comprehension of a very complex concept with little or no complex training. This is achieved by melting down the complexity into very commonly understood concepts (P. E. Peters, personal communication, November 14, 2001). The catalyst for high touch will be the use of information technology.

Concepts and Schemata

Concepts and schemata act as the fundamental basis by which humans categorize and file into memory stimuli presented. Just think of the entire stimulus that confronts the average person on an average day. The bombardment of daily information on our brains would cause our mental functioning to come to a complete stop without some means of sorting and categorizing information. According to Howard (1987) the human brain would go into distress if there was no means by which to categorize such a massive amount of stimulus. So, what is stimulus? Howard says that stimulus is everything that the human senses come into contact with. This includes all contact made with each of the five senses of sight, hearing, smell, touch, and taste, and he believes that this is the core of learning. Others, such as John Dewey (1938), advocate similar explanations of learning and cognition. It is important to understand that the very basis of learning is derived from the stimulus with which we come into contact. This explains why two learners who are involved in the same class with the same teacher may learn differently and derive different concepts for a given lesson. Howard (1987) further states that there are no two learners alike.

The only way in which humans can make sense of the world is by the use of a categorizing protocol. As soon as a human comes into contact with a stimulus, i.e. smell, sound, or visual image, that person begins a process of associating it with what is already know (Howard, 1987). The information

already known is stored in a human's long term memory which is formed over the course of a lifetime of understandings and formulates a person's conceptualization. There is a multitude of influences which shape what exist in a person's conceptualization, and that which does exist as long term memory is how all new information is further understood. This is one reason that past experience is so very important in critical thinking (Paul, 1995). Our society demands that public officials have a depth of experience in a variety of areas before becoming a community leader. Although experience alone is not a guarantee of future success, it has been accepted as a major criterion for predicting a person's behavior. Long term memory and conceptualization is also referred to as a paradigm by Covey (1990). A paradigm is a mental map of what is conceptualized in the human mind; human understanding is delineated through paradigmatic thought. This phenomenon can explain why there are so many different approaches to a given problem among different people. This also explains why organizational cultures differ in philosophy. Our society accepts the fundamental fact of differentiation among human understanding. Conceptually speaking, people have systems in place by which every exposure of life is categorized and processed, and as people grow conceptually, they began to differ a great deal.

Powerful and Fundamental Concepts

As a part of the grand theoretical base of a teacher's content knowledge, there are many underlying powerful and fundamental concepts that serve as the underpinning of the discipline of agricultural education (Paul, 1995). Agricultural education is grounded in several powerful and fundamental scientific concepts and principles. Because agricultural education was founded and conceived in science, there exists a logical connection between the discipline and biological science, physical science, social science, informational science and other integrative sciences (Akers, 2001; Binkley & Tulloch, 1981; Connors, 1998; Frantz, 1997; Graham & Garton, 2001; NCAE, 1999; Paul, 1995; Pritchett, 1997; Rojewski, 2002). Biological science includes the collective study of living things. Physical science in composed of chemistry, physics, astronomy, and mathematics. Social science involves the relationships between man and the world. Informational science is identified as a study of knowledge and intelligence. Other integrative sciences include those areas of modern science which utilize several scientific strands. These identified areas of science serve as powerful and fundamental concepts which are foundational principle to agricultural education's body of knowledge. Collectively, many different scientific disciplines are drawn upon to formulate the discipline agricultural education. A powerful and fundamental concepts serves as the core intelligence of study. This study will attempt to identify the competencies of beginning teachers as related to each of the powerful and

fundamental concepts of biological, physical, social, informational, and other integrative sciences.

Methodology

This study was conducted using the Delphi technique. Delphi has long been associated with gathering expert opinion in a systematic way (Strauss & Zeigler,1975). The name Delphi comes from the Greek Oracle in which religious prophecies were forecast. Although this process is far from being a religious experience, it has been widely accepted as an appropriate means of drawing consensus on items that have little historic data or about which little is known. The Rand Corporation first developed “Project Delphi” in the 1940s for the US Air Force as a method for military experts to plan for defense strategies against military attack (Sackman, 1974). The pioneers of the techniques, Helmer and Rescher (1959), describe Delphi as a means of interrogating select expert individuals to gather information and opinion.

The Delphi technique allows each participant an equal opportunity to respond with a certain degree of anonymity. Because there is never a face to face group meeting, less dominant personalities have a greater opportunity to express their individual concerns and thoughts. Delphi also provides the researcher with an abundance of information about the research questions as each participant is considered an expert in the field, and each is typically highly committed to the outcome of the study.

Summary

In conclusion, the changing demands of society will dictate the path in which agricultural education precedes. The focus and intent of this study was to solicit expert opinion about the needed competencies of beginning agricultural science teachers and describe the future dramatic affect facing university teacher preparation programs. Historically, agricultural education was created in an effort to provide knowledge to individuals in local communities; this dissemination of knowledge in turn was used to positively influence the local economy and quality of life. Our democratic society functions best with the continuous input of new knowledge and innovation. This study attempted to determine the necessary competencies associated with future agricultural systems technical competencies of agricultural education. Although the future can't be fully predicted, researchers must attempt to address possible trends and directions as a means of better preparing future educators.

CHAPTER III

METHODOLOGY

The focus of this study was to answer three major questions:

1. What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by expert agricultural education professionals?
2. What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by expert administrators of agricultural education programs?
3. What are the future agricultural systems competencies of beginning Texas agricultural science teachers that are a consensus between expert agricultural education professionals and expert administrators of agricultural education programs?

Research Design

This study focused on determining the future competencies necessary for a beginning agricultural science teacher in Texas. It was determined that the best means of collecting the necessary information would be obtained by utilizing the Delphi technique. Delphi has long been associated with future forecasting. It works well “for determining the consensus of a group of experts in a given field with regard to some issues” (Chizari, 1990, p. 42). Delphi allows the development of consensus on issues without bring participants in face to

face contact. At the initiation of the Delphi technique, the panelists will typically have opposing opinions and differentiated ideas related to the research questions; however, it is expected that consensus can be reached and obtained after the panel converges on the issues being studied.

The number of rounds necessary for a Delphi study can be predetermined; however, the researcher can allow the panelists' consensus to be the true determiner for the study's completion (Brooks, 1972). Others advocate that the number of rounds should never be predetermined, that the number should be based purely on the necessity required to reach group consensus.

Methodology

Sample

The panel of experts was divided into two independent groups. An existing purposeful sample of educators was nominated by the State Board of Educator Certification (SBEC) to serve on the agricultural science and technology standards committee, which is composed of agricultural science and technology teachers, university teacher education staff, and Texas Education Agency field service staff. A second group of innovative public school administrators composed of superintendents, campus principals, and directors of career and technology education was identified and nominated to serve as expert panels. Each of these two independent groups functioned independently

of each other as each group identified the future competencies of beginning Texas agricultural science teachers. The first-round Delphi instrument was the same for each group; however, the formulation of all subsequent instruments was determined solely from the initial responses of each group. The initial round-one instrument provided opportunity for qualitative input regarding each major powerful and fundamental concept associated with the study.

Data Collection Procedure

Research instruments were disseminated and responses collected via conventional mail.

1. Round-one instrument. The first round instrument was developed using the powerful and fundamental concepts associated with agricultural science which includes biological, physical, social, informational, and other integrative sciences (see Appendix A).
2. Two panels of experts- one of innovative educators and another of administrators- were identified and nominated from staff at the State Board of Educator Certification, Texas Education Agency, and the Department of Agricultural Education at Texas A&M University.
3. Two round-two instruments were developed from the responses to the first. The second-round instruments were developed independently of each other one using round-one responses for administrators and the other using round-one responses for educators (see Appendix B). Two

panels were asked to rank their responses using a 1-6 scale Likert type scale (see Appendix B).

4. Two round-three instruments were developed from the responses of the round-two instruments respectively, again keeping the two group's responses separate (see Appendix C).

Instrumentation

The research instrument was designed to utilize the Delphi Technique. Delphi has long been associated with gathering expert opinion in a systematic way (Strauss & Zeigler,1975). The Rand Corporation first developed "Project Delphi" in the 1940s for the US Air Force as a method for military experts to plan for defense strategies against military attack (Sackman, 1974). The pioneers of the techniques, Helmer and Rescher (1959), describe Delphi as a means of interrogating select expert individuals to gather information and opinion.

Data Analysis

The analysis of this study has been done using qualitative descriptive research techniques to determine each of the future competencies identified for a beginning Texas agricultural science teacher. A three-fourths agreement level with a rating of five (5) or six (6) among the expert panel was used to determine if a response reached consensus within the respective group.

Demographical data were collected and the statistical package for social science (SPSS) computer software program was utilized as the primary data analysis tool.

The study was conducted by gathering data from two groups of experts that were composed of expert agricultural education professional and expert school administrators, each of whom has exhibited innovation and creativity within the discipline. The expert agricultural education professional group was composed of agricultural science teachers and university teacher educators. The expert administrator group was composed of public school principals, superintendents and directors of career and technology education. Each panel had a maximum of fifteen participants with the final amount as eleven for the educators group and twelve for the administrators group. In an attempt to mirror the demographic representation of the agricultural science community, each panel represented both large and small institutions as well as urban and rural.

A three-round Delphi was issued to collect the data. The first-round questionnaire was composed of the five powerful and fundamental concepts which ground agricultural education. The five powerful and fundamental concepts are composed of every strand of true science which includes the biological sciences, physical sciences, social sciences, informational sciences, and other integrative sciences. The objective of the first-round questionnaire

was to identify the future agricultural systems competencies of a beginning teacher associated with each of the five powerful and fundamental concepts. The questionnaire was mailed to both expert panel groups. Panelists were given a two week window of time in which to respond to the first questionnaire. A follow-up letter was mailed to each participant who had not responded in a reasonable amount of time. A follow-up letter was sent to all non-respondents with the intention of gaining a 100% participation rate of response.

The second-round questionnaire contained the identified competencies from the first-round questionnaire. The format of the second-round questionnaire used a 1 to 6 scale (Likert) to further refine the panelist experts' opinion. Panelists were given a one week time frame in which to respond to the second questionnaire. A follow-up letter was sent within a reasonable time to insure each panelist an opportunity to respond.

The third-round Delphi questionnaire was formatted in the same manner as the second-round questionnaire. The purpose and intent of the third-round was to further refine the responses identified in the second-round questionnaire. A dichotomous Yes or No response instrument was used. A follow-up letter was sent to provide any non-respondents an opportunity to respond. There was a consensus reached with the uses of the third-round questionnaire; therefore, the researcher determined that an additional fourth-round questionnaire did not need to be administered.

The data collected were analyzed using the Statistical Package for Social Science (SPSS). Descriptive statistics were used with the rounds-two, and round-three responses; frequency, mean, mode, and median were measured. The face, content, and construct validity of the questionnaires were determined by three (3) experts within the Department of Agricultural Education at Texas A&M University.

Selection of Panel

A panel of thirty-five (35) experts was identified to participate in the study. The experts were individuals nominated and selected form three primary sources: the Texas Education Agency (TEA), State Board of Educator Certification (SBEC), and Texas A&M University, Department of Agricultural Education Graduate Faculty. Individuals nominated to the panel had to have a combination of characteristics which included experience in agricultural education at the secondary level, agricultural education experience at the higher education level, or experience as an administrator who has supervised agricultural education programs.

In tandem with this study, the SBEC implemented a committee of agricultural education professionals and school administrators to aid in the development in a new set of standards for agricultural science and technology. Fifteen (15) of the individuals who served on the SBEC committee were invited to serve as expert panelists for this study. Other outstanding public school

administrators who had experience supervising agricultural education programs were identified by both State Staff at the Texas Education Agency and from faculty at Texas A&M University, Department of Agricultural Education. A total of 35 experts were identified and invited to participate in the study. The initial invitation outlined the timeline and other details of the study to provide participants a sufficient amount of information to enable them to determine if they could commit to the study. The panel was divided into two independent groups: administrators of agricultural science programs (ADM), and agricultural education professionals (EDU). Table one (1) reveals the expert panels' demographic representation by expert group.

Table 1
Panel of Experts by Group Representation

Independent Group	Number of Experts Contacted to Participate	Number of Experts Consented to Participate
Agricultural Education Professionals (EDU)	16	11
Administrators of Agricultural Education Programs (ADM)	19	12

Demographics of Panel

A consent form was sent to each panelist with the invitation letter which served as the panel's agreement to participate in the study. It was decided *a priori* that only the panelists who returned the consent form would be sent a

round one (R1) instrument. The consent form not only served as an agreement for each panelist, but also as a data collection instrument to gain demographic information about each expert as it requested each panelist's age range, gender, professional experience, highest level of education completed, and current employment position. The panel of expert's demographic information is revealed in Table 2.

The age range distribution reveals that there was a wide range of ages. The age ranges of 31 to 40, 41 to 50, and 51 to 60 each had 7 or 8 experts, making these ranges even in the number of panelists. There was only one panelist in the 21 to 30 age range. There were 21 male experts and 2 female experts. The panel had a high level of public school teaching experience with 95.7% of the experts having taught public school. Nearly half of the panel (n=12) had experience as a public school administrator. More than two-thirds (n=16) of the panel had university teaching experience, and three panelists reported they had other professional experience. The panel appeared to be highly educated with 15 reporting to have obtained a master's degree and 8 panelists reported having a doctoral degree. Current employment of the panel was reported as 5 agricultural science teachers, 12 public school administrators, 5 university teacher educators, and 1 other professional employment (see Table 2).

Table 2
Demographical Information of Expert Panels

Characteristic		Number of EDU Experts	Number of ADM Experts
Age Range			
	21 to 30	-	1
	31 to 40	7	-
	41 to 50	3	5
	51 to 60	1	6
Gender			
	Female	2	-
	Male	9	12
Experience			
	Public School Teaching	10	12
	Public School Administration		12
	University Level Teaching	5	11
	Other Professional Experience	3	-
Education Level			
	Master's Degree	6	9
	Doctoral Degree	5	3
Employment			
	Agricultural Science Teacher	5	-
	Public School Administrator	-	12
	University Teacher Educator	5	-
	Other Employment	1	-

Instrumentation

The round-one instrument followed a layout design similar to one used by Dobbin (1999). An open-ended instrument consisting of five questions was developed as round-one (R1). The R1 questionnaire was designed around the five powerful and fundamental conceptual areas that serve as the underpinning for agricultural science and technology. The five areas were determined from a review of the literature of agricultural education. As a part of the grand theoretical base of a teacher's content knowledge, there are many underlying

powerful and fundamental concepts that serve as the underpinning of the discipline of agricultural education (Paul, 1995). Because agricultural education was founded and conceived in science, there exists a logical connection between the discipline and biological science, physical science, social science, informational science and other integrative sciences. The panelists were asked to identify competencies associated with each of the five conceptual areas. The five questions included on the R1 instrument were;

1. Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the biological sciences.
2. Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the physical sciences
3. Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the social sciences
4. Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the informational sciences
5. Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the other integrative sciences

Responses from round-one led to the panelists being separated into two groups as educators and administrators. The round-two instruments were developed "group specific," which yielded one instrument for the educators and one for the administrators. Similarly, the round-three instruments were developed using the responses of the respective group, i.e. administrators and educators with their responses analyzed independent of each other. Figure 2 provides an example of a typical Delphi research method.

Validity and Reliability

Validity

The questions for the initial R1 instrument were validated for content as to the appropriateness of each question for the study by faculty and staff in the Department of Agricultural Education at Texas A&M University. The group compared the questions to the SBEC developed standards for agricultural science and technology (AS&T) to determine appropriateness and usefulness to the study. During the summer of 2002, SBEC formulated the committee for AS&T with the intent to update the standards for AS&T beginning teacher assessment. The combination of input from both groups strengthens the validity of the R1 Delphi questionnaire.

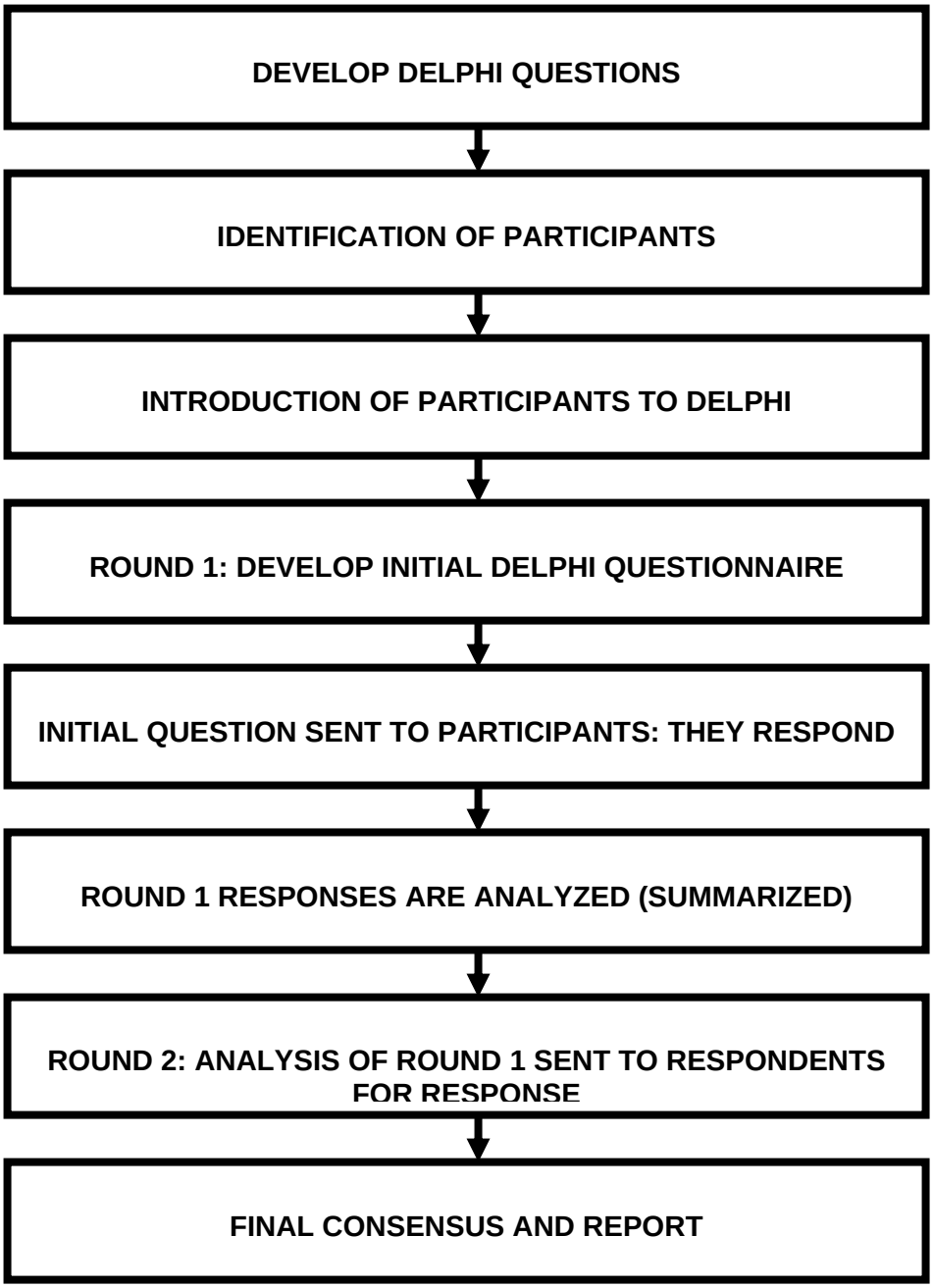

Figure 2. The Delphi Process as Defined by Ulschack, (1983).

Reliability

Researchers who commonly use the Delphi technique have determined that a group size of thirteen is sufficient in determining process reliability (Buriak & Shinn, 1993, Dalkey, 1967, Helmer, 1967). The size of the nominated and invited panel for this udy was 35 experts with 23 agreeing to commit to participate in the study. This number of expert participants places this study within the acceptable participant range recommendations for the Delphi research technique. However, two separate panels emerged. One combined eleven (11) participants and the other, twelve (12).

Pilot Test

To enhance the validity of the instrument an initial pilot test of the instrument was provided to educators and administrators in the Department of Agricultural Education and Brenham Independent School District. Face validity and content validity were determined by use of a pilot. These individuals were asked to make corrections, change questions and make other suggestions as to improve the instrument. The pilot took place in October, 2002 and following its completion, the researcher made necessary revisions and corrections to the instrument.

Data Collection

After the completion of the pilot test, invitations were mailed on October 25, 2002, to selected experts. Expert panelists were asked to complete an enclosed consent form, confirm their personal information listed on the data information sheet, and return the form and the sheet in the self addressed stamped envelope. The information listed on the data information sheet was initially taken from the directory for agricultural science teachers and the Texas Education Agency's website. The pre-collected contact data served to expedite the data collection process.

Round-One

The R1 instrument was finalized in early October, 2003 (see Appendix 1). The first instrument was sent by US mail on October 31, 2002 to each of the expert panelists at the address provided on the data information sheet. Accompanying the R1 instrument was a cover letter (see Appendix 1) which explained the focus and intent of the instrument. It was the researcher's desire to emphasize to the panelist, the needed for identifying future competencies of beginning agricultural science teachers. The researcher explained to the experts that it was realized that not every expert had full expertise in every conceptual area; therefore, the experts were asked to complete those conceptual areas in which they felt most confident. The R1 instrument was designed to extract an assortment of knowledge from the diversity represented

on the expert panel by asking five open-ended questions. There was one question for each of the five identified powerful and fundamental conceptual areas. A definition of each conceptual area was provided to stimulate the experts' responses.

Panelists were given two weeks in which to respond to the R1 instrument with a deadline date of November 15, 2002. A second invitation, data sheet and a R1 instrument was sent by US mail to all non-respondents of the first invitation to participate in the study (see Appendix 1). It was explained that an opportunity was still available to participate, and the second invitation allowed the researcher to send additional follow-up invitations to experts that had wrong address information. This second invitation gave the details the study's timeline (see Appendix 1). As the November 15th deadline approached, the researcher sent out a second reminder postcard to all non-respondents (see Appendix 1). The timeline was extended to allow a sufficient number of R1 instruments to be collected. In late November 2002 a total of 17- eight (8) EDU and nine (9) ADM- R1 instruments had been collected, which was a sufficient number of responses to analyze the data (see Table 3). The responses collected in the R1 instrument were analyzed and some adjustments were made by the researcher as necessary. The responses of the administrators were separated from the educators. These two sets of data were used independently to develop the round-two (R2) instrument.

Table 3
Number of Each Group's Respondents by Delphi Round

Independent Group	Round	Number of Experts Responded	Response Rate
EDU (n=11)	One	8	72.7%
	Two	9	81.8%
	Three	8	72.7%
ADM (n=12)	One	9	75.0%
	Two	11	91.6%
	Three	11	91.6%

Round-Two

The round-two (R2) instrument was developed into two independent instruments that were group specific, one for educators (EDU) and the other for administrators (ADM) to achieve the necessary results of research question three (see Appendix 2). Each R2 instrument was developed from the respective responses of the R1 instrument in the form of a list of competencies from each conceptual area. The researcher made adjustments as necessary to each of the competencies provided by the panel on the R1 instrument.

R2 was sent on January 3, 2003, to the 23 experts who agreed to participate in the study. A cover letter was sent which explained that the original timeline had been extended, and gave a brief description of the remaining anticipated timeline with a due date of January 24, 2003 (see Appendix 2). After the due date passed, a follow-up reminder postcard was sent to all non-respondents (see Appendix 2).

The R2 instrument focused on determining the level of agreement among the panel by asking them to rate each competency listed on the R2 instrument. A Likert type scale was used with a rating range of 1 to 6: one (1) Strongly Disagree, two (2) Disagree, three (3) Somewhat Disagree, four (4) Somewhat Agree, five (5) Agree, and six (6) Strongly Agree. The instrument again was structured around each conceptual area which underpins agricultural education with a definition of each conceptual area provided. Also, two additional columns were provided; the first asked for the experts' comments and the latter asked if the competency should be moved to another conceptual area. The comments were useful to the researcher in gaining a better understanding of why an expert rated a given competency at a given level. Although a few experts requested to move some competencies to other conceptual areas, there was not enough of a consensus to do so. The 75% consensus techniques recommended by Linstone et al. (1975), was used to determine the competencies that would be combined in the R3 instrument.

Round-Three

The round-three (R3) instruments were developed from the responses of each respective group. Again two independent instruments were developed from the data collected in the R2 instruments, one for educators (EDU) and one for administrators (ADM) (see Appendix 3). The R3 instruments were sent to each respective expert on February 21, 2003, with a due date of March 7, 2003.

A cover letter was sent which explained that the R3 instrument would be the last round as the researcher believed that a consensus could be reached with the third round instrument (see Appendix 3). Experts were also informed that an analysis of the final results from R3 would be sent to them for their review. All non-respondents were sent a follow-up reminder postcard on March 17, 2003 (see Appendix 3).

The R3 instruments were developed from the responses to the R2 instruments. Those competencies that were rated a five (5) or a six (6) on the R2 instruments by 75% or more by the respondents were used to develop the R3 instruments. As a result of using a 75% level of agreement for each competency, the R2 EDU instrument lost four (4) competencies and the R2 ADM instrument lost two (2) competencies. Each of the remaining competencies was listed on the R3 instrument (see Appendix 3). On the R3 instrument, experts were asked to rate their level of agreement using a dichotomous scale of Yes or No. A response of Yes meant that the expert did agree that a given competency was needed by a BAST, and a response of No meant that the expert did not agree that a given competency was needed by a BAST. The R3 instruments again provide a column for additional comments. The R3 instrument was divided by conceptual area with a definition provided.

Analysis of Data

To facilitate analysis of the data, a random number code was used by the researcher. The code was assigned by the computer as each expert's personal information was entered into Microsoft Access®. The code was used to track the instruments received and for follow-up communication.

Round one, two, and three responses were converted to numeric data and entered into the Statistical Package for Social Science (SPSS) using an IBM laptop computer.

CHAPTER IV

FINDINGS

The purpose of this study was to determine the future agricultural systems competencies needed by beginning agricultural science teachers. To achieve this objective, three specific research questions have been developed:

1. What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by expert agricultural education professionals?
2. What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by expert administrators of agricultural education programs?
3. What are the future agricultural systems competencies of beginning Texas agricultural science teachers that are a consensus between expert agricultural education professionals and expert administrators of agricultural education programs?

This chapter will focus on presenting the findings of a three-round Delphi research technique used to determine the future agricultural systems competencies of beginning agricultural science teachers.

Round-One

The round-one (R1) instrument was developed with five primary questions (see Appendix 1). Each open-ended question asked the panel to identify agricultural systems competencies for beginning agricultural science teacher within five conceptual concepts areas. These areas were determined to be powerful and fundamental and underpin the discipline of agricultural education (Akers, 2001; Binkley & Tulloch, 1981; Connors, 1998; Frantz, 1997; Graham & Garton, 2001; NCAE, 1999; Paul, 1995; Pritchett, 1997; Rojewski, 2002). The five conceptual areas were operationally defined as biological science, physical science, social science, informational science, and other integrative science. A definition of each conceptual area was provided on the R1 instrument. A series of five open-ended questions were developed, one for each conceptual area. The response of each question was edited and analyzed by the researcher for further instrument development. Eight (8) EDU experts and nine (9) ADM experts responded to R1 out of the eleven (11) and twelve (12) that agreed to participate in the study, respectively.

Conceptual Area I: Biological Science

The first R1 open-ended question dealt with the conceptual area of biological science and twenty-four (24) competencies for the EDU group and twenty-five (25) competencies for the ADM group. Duplicate and redundant

responses were combined. Table 4 reveals the responses of each group for the R1 biological science conceptual area.

Table 4
Response from Round One (R1) by Group
Conceptual Area I: Biological Science

Group	Competency
EDU	Basic animal anatomy. Basic animal behaviors. Basic animal environments. Animal feeds, feeding, and nutrition. Plant structures and growth. Genetics; plant and animal. Genetics engineering. Entomology. Aquaculture. Cloning. Food safety. Animal reproduction. Animal systems, digestive, respiratory, circulatory, and nervous. Breeds and types of livestock, and non-livestock farm animals. An understanding of artificial Insemination, cloning, embryo transfer. Plant growth and structure. Bio-security in agricultural systems. Basic understanding of DNA mapping for ID purposes. Tissue culture and other mass cloning techniques. Plants and soil science. Selection of livestock. Plant identification. Anatomy and physiology of animals. Anatomy and physiology of plants.
ADM	Anatomy of animals-how life is sustained; cell growth Plant and animal reproduction. The future role of genetics in the production of plants and animals. Global impact of biological science.

Table 4 Continued

Group	Competency
	The economics of higher level production through improved biology.
	Biotechnology and its future in our society.
	Animal anatomy and physiology.
	Animal genetics and reproduction.
	Food and fiber production.
	Environmental knowledge.
	Breeds of livestock.
	Broad based knowledge of specialty animals- canine, avian, tropical fish: Applicable in urban environment.
	Plants and soil science.
	Entomology.
	Agricultural biotechnology
	Environmental and natural resources systems.
	Animal physiology systems; cardiovascular, nervous.
	Animal health and nutritional resources.
	Agricultural chemicals.
	Microbiology.
	Skeletal systems.
	Animal nutrition.
	Animal health and parasites.
	Artificial Insemination/Embryo Transfer.
	Horticulture/Floriculture.

Conceptual Area II: Physical Science

The second R1 open-ended question dealt with the conceptual area of physical science and yielded twenty-three (23) competencies for the EDU group and twenty-six (26) competencies for the ADM group. Duplicate and redundant responses were combined. Table 5 reveals the responses of each group for the physical science conceptual area.

Table 5
Response from Round One (R1) by Group
Conceptual Area II: Physical Science

Group	Competency
EDU	Basic principles of engines. Basic principles of electricity. Basic principles of power and hand tools. Basic principles of shop safety. Basic principles of motors. Basic principles of plumbing. Basic principles of metal fabrication. Basic principles of wood fabrication. Basic principles of concrete. Global positioning satellite technology. Understanding of natural resources that are beginning to shrink. Knowledge and understanding of GMO. Water rights and water conservation. Alternative fuel and their sources. Food production as derived from nutrients. Structure and composition of the atmosphere. Global climate. Acid pollution. Groundwater. Water quality. Soil structures. Soil types and classes. Climate and weather patterns.
ADM	Soil science; formations and types. Plant science; Fertilizers, minerals, inorganic and organic. Earth science; Weather conditions/planning seasons. Feed rations/ feed additives. Welding; gas and electrical. Basic engineering physics for shop projects. Chemical properties associated with plant and animal production. The influence of weather on production agriculture. Modern technology used to influence weather. Physical concepts associated with power systems.

Table 5 Continued

Group	Competency
	Physical concepts associated with moon phases and climatology. Environmental issues facing our future generations. Global warming and its effect on agriculture. The interaction of the physical environment with basic living organisms. Water requirements of plants. Soil classification systems. Inorganic and organic fertilizers. The development of consumer products. General physic; Industrial, engineering, and manufacturing concepts. Soil structures. Soil textures. Photosynthesis. Soil profiles. Soil classes. Electricity; Basic terms and principals. Engines and power supplies; internal combustion engines.

Conceptual Area III: Social Science

The third R1 open-ended question dealt with the conceptual area of social science and yielded sixteen (16) competencies for the EDU group and twenty-four (24) competencies for the ADM group. Duplicate and redundant responses were combined. Table 6 reveals the responses of each group for the social science conceptual area.

Table 6
Response from Round One (R1) by Group
Conceptual Area III: Social Science

Group	Competency
EDU	Working with adverse individuals and groups. Individual social skills. Community relations. Learning styles. Ethics. Leadership and leadership styles. Human behavior. Types of communication. Personal hygiene. Cultural diversity and the way it influences food production and consumption. Governmental intervention, local and foreign that affect agricultural production and consumption. Policies and politics of agricultural production. Ethical concerns related to food production. Career preparation. Manners and etiquette. Character education.
ADM	History of agriculture. Impact and structure of local governments. FFA activities; career development events. Community organizations; the impact of booster clubs and major shows. Governmental programs available for agriculture. The functions of government, how it works and the political process. Global affairs that effect agriculture. The economics of agriculture; NAFTA, world trading, the stock market, and commodity market. Concepts associated with moving from dependence to independence to interdependence. Understanding of emotional connections between individual, and how they shape relationships. Concepts associated with being a leader. How leaders function and how they operate. The role of citizenship in our society. Principles of parliamentary law. Principles of democracy and how we keep it. Team work and team building. Characteristics of effective leadership.

Table 6 Continued

Group	Competency
ADM	Proper etiquette. Organizational structure and function. Employer and employee responsibilities. Interpersonal communications skills. Social skills and self discipline. Learning styles. Learning abilities. Employment characteristics.

Conceptual Area IV: Informational Science

The fourth R1 open-ended question dealt with the conceptual area of informational science and yielded nine (9) competencies for the EDU group and seventeen (17) competencies for the ADM group. Duplicate and redundant responses were combined. Table 7 reveals the responses of each group for the informational science conceptual area.

Table 7
Response from Round One (R1) by Group
Conceptual Area IV: Informational Science

Group	Competency
EDU	Basic recordkeeping. Budgeting. Development and use of data bases. Ability to access information in ways to solve daily problems and issues. Problem solving skills. Goal setting skills. Information technology skills. Internet, email and other electronic communication skills. Computer application skills related to agricultural education.

Table 7 Continued

Group	Competency
ADM	Computer technology in recordkeeping Use of global positioning satellite systems Public speaking. How information is gathered. Ethics and how they impact our society. The concept of data application and its use in problem solving. How knowledge is used in organizations Concepts of effective leadership Ethics in the workplace Resume writing, interviewing The integration of technology education with agricultural engineering. The integration of business curriculum with agricultural communications. Recordkeeping skills Brain research; how different students learn. The use of information technology in agriculture. Ways to integrate the internet and email to communicate. Understanding data collection and the interpretation of data

Conceptual Area V: Other Integrative Science

The fifth R1 open-ended question dealt with the conceptual area of other integrative science and yielded four (4) competencies for the EDU group and ten (10) competencies for the ADM group. Duplicate and redundant responses were combined. Table 8 reveals the responses of each group for the other integrative science conceptual area.

Table 8
Response from Round One (R1) by Group
Conceptual Area V: Other Integrative Science

Group	Competency
EDU	Managerial skills. Time management. Goal setting. The integration of many areas of agriculture.
ADM	The impact of chemistry. Soft skill development. Advertising and marketing of agricultural products. Concepts associated with problem solving. Relationships between basic academic and agricultural science. Concepts connected to scientific research. Aquaculture, food science and wildlife; basic knowledge of how theses areas integrate. Integrating areas of agricultural sciences with industrial licensure and certification. The development of an agricultural science fair. The importance of cooperation, respect, and trust as related to students.

Round-Two

Two round-two (R2) instruments were developed from the responses of the R1 instrument with each instrument having been developed from the respective group of educator panelists (EDU) and administrator panelists (ADM) responses (see Appendix 2). The responses from the EDU group were used to develop an EDU panelist specific R2 instrument, and the responses form the ADM group were used to develop an ADM panelist specific R2

instrument. The R2 instruments listed the identified competencies derived from the five opened-ended, conceptually based questions of the R1 instrument.

The R2 instruments were structured in a manner that grouped the identified competencies provided from R1 into the five conceptual areas of biological science, physical science, social science, informational science, and other integrative science. Both instruments used a rating scale that ranged from 1 to 6: one (1) Strongly Disagree, two (2) Disagree, three (3) Somewhat Disagree, four (4) Somewhat Agree, five (5) Agree, and six (6) Strongly Agree, to measure the level of agreement that an identified competency was a future skill for beginning agricultural science teachers. The R2 instruments provided a column for the participants to make comments, and if the participants believed that a competency should be placed within a different conceptual area, a column was provided for the panelists to respond respectively. The R2 instruments also provide a section which allowed panelists to add additional competencies to any of the five conceptual areas should they feel that additional competencies be identified that were not identified in the R1 instrument. Nine (9) EDU experts and eleven (11) ADM experts responded to R2 out of the eleven (11) and twelve (12) that agreed to participate in the study, respectively.

EDU Group Responses to R2

The R2 instrument for the EDU group provided seventy-eight (78) identified competencies within the five conceptual areas. The biological conceptual area contained twenty-four (24) competencies, the physical science conceptual area contained twenty-three (23) competencies, the social science conceptual area contained sixteen (16) competencies, the informational science conceptual area contained nine (9) competencies, and the other integrative science conceptual area contained four (4) competencies.

It was decided *a priori* by the researcher that any competency yielding a rating of 5 (five) or 6 (six) by 75% within the EDU panel would be considered as having reached consensus by the EDU group. Table 9 reveals the responses of the EDU group to the R2 instrument. A consensus was reached on a total of forty-five (45) competencies. Consensus for twelve (12) competencies was reached in the biological conceptual area, eleven (11) competencies of the physical science conceptual area, thirteen (13) competencies of the social science conceptual area, eight (8) competencies of the informational science conceptual area, and one (1) competency of the other integrative science conceptual area.

Table 9
Educator (EDU) Group Percentage of Agreement for Round-Two (R2) Competency

Agricultural System	Competency	% of Agreement
Biological Science	Basic animal anatomy.	88.9%
	Basic animal behaviors.	77.8%
	Basic animal environments.	77.8%
	Animal feeds, feeding, and nutrition.	77.8%
	Plant structures and growth.	88.9%
	Genetics; plant and animal.	66.7%
	Genetics engineering.	44.4%
	Entomology.	55.6%
	Aquaculture.	22.2%
	Cloning.	22.2%
	Food safety.	55.6%
	Animal reproduction.	77.8%
	Animal systems, digestive, respiratory, circulatory, and nervous.	77.8%
	Breeds and types of livestock, and non-livestock farm animals.	88.9%
	An understanding of artificial Insemination, cloning, embryo transfer.	44.4%
	Plant growth and structure.	88.9%
	Bio-security in agricultural systems.	33.3%
	Basic understanding of DNA mapping for ID purposes.	33.3%
	Tissue culture and other mass cloning techniques.	33.3%
	Plants and soil science.	88.9%
	Selection of livestock.	88.9%
	Plant identification.	55.6%
	Anatomy and physiology of animals	77.8%
	Anatomy and physiology of plants	66.7%
Physical Science	Basic principles of engines.	88.9%
	Basic principles of electricity.	88.9%
	Basic principles of power and hand tools.	88.9%
	Basic principles of shop safety.	100.0%
	Basic principles of motors.	88.9%
	Basic principles of plumbing.	55.6%
	Basic principles of metal fabrication.	77.8%
	Basic principles of wood fabrication.	66.7%
	Basic principles of concrete.	66.7%
	Global positioning satellite technology	44.4%

Table 9 Continued

Agricultural System	Competency	% of Agreement
	Understanding of natural resources that are beginning to shrink.	66.7%
	Knowledge and understanding of GMO.	55.6%
	Water rights and water conservation.	88.9%
	Alternative fuel and their sources.	55.6%
	Food production as derived from nutrients.	44.4%
	Structure and composition of the atmosphere.	33.3%
	Global climate.	22.2%
	Acid pollution.	33.3%
	Groundwater.	66.7%
	Water quality.	88.9%
	Soil structures.	88.9%
	Soil types and classes.	88.9%
	Climate and weather patterns.	33.3%
	Environmental studies related to agriculture.	66.7%
	Plant growth.	88.9%
Social Science	Working with adverse individuals and groups.	88.9%
	Individual social skills.	88.9%
	Community relations.	100.0%
	Learning styles.	88.9%
	Ethics.	100.0%
	Leadership and leadership styles.	100.0%
	Human behavior.	77.8%
	Types of communication.	100.0%
	Personal hygiene.	88.9%
	Cultural diversity and the way it influences food production and consumption.	77.8%
	Governmental intervention, local and foreign that affect agricultural production and consumption.	55.6%
	Policies and politics of agricultural production	44.4%
	Ethical concerns related to food production.	55.6%
	Career preparation.	100.0%
	Manners and etiquette.	88.9%
	Character education.	88.9%
Informational Science	Basic recordkeeping.	100.0%
	Budgeting.	100.0%
	Development and use of data bases.	66.7%
	Ability to access information in ways to solve daily problems and issues.	88.9%

Table 9 Continued

Agricultural System	Competency	% of Agreement
	Problem solving skills.	100.0%
	Goal setting skills.	100.0%
	Information technology skills.	88.9%
	Internet, email and other electronic communication skills.	100.0%
	Computer application skills related to agricultural education.	88.9%
Other Integrative Science	Managerial skills.	66.7%
	Time management.	100.0%
	Goal setting.	66.7%
	The integration of many areas of agriculture.	66.7%

ADM Group Responses to R2

The R2 instrument for the ADM group provided one hundred and two (102) identified competencies within the five conceptual areas. The biological conceptual area contained twenty-five (25) competencies, the physical science conceptual area contained twenty-six (26) competencies, the social science conceptual area contained twenty-four (24) competencies, the informational science conceptual area contained seventeen (17) competencies, and the other integrative science conceptual area contained ten (10) competencies.

It was decided *a priori* by the researcher that any competency which yielded a 75% or greater consensus among the ADM panel with a rating of 5 (five) or 6 (six) would be considered as having reached consensus by the entire ADM group. Table 10 reveals the responses of the ADM group to the R2

instrument. A consensus was reached on a total of sixty-one (61) competencies. Consensus for twelve (12) competencies was reached in the biological conceptual area, seventeen (17) competencies of the physical science conceptual area, fourteen (14) competencies of the social science conceptual area, fourteen (14) competencies of the informational science conceptual area, and four (4) competencies of the other integrative science conceptual area.

Table 10
Administrator (ADM) Group Percentage of Agreement for Round-Two (R2) Competency

Agricultural System	Competency	% of Agreement
Biological Science	Anatomy of animals-how life is sustained; cell growth	90.9%
	Plant and animal reproduction.	90.9%
	The future role of genetics in the production of plants and animals.	81.8%
	Global impact of biological science.	45.5%
	The economics of higher level production through improved biology.	36.3%
	Biotechnology and its future in our society.	45.5%
	Animal anatomy and physiology.	90.9%
	Animal genetics and reproduction.	81.8%
	Food and fiber production.	72.7%
	Environmental knowledge.	72.7%
	Breeds of livestock.	81.8%
	Broad based knowledge of specialty animals-canine, avian, tropical fish: Applicable in urban environment.	36.3%
	Plants and soil science.	100.0%
	Entomology.	72.7%
	Agricultural biotechnology	81.8%
	Environmental and natural resources systems.	72.7%

Table 10 Continued

Agricultural System	Competency	% of Agreement
	Animal physiology systems; cardiovascular, nervous.	54.5%
	Animal health and nutritional resources.	90.9%
	Agricultural chemicals.	72.7%
	Microbiology.	54.5%
	Skeletal systems.	72.7%
	Animal nutrition.	100.0%
	Animal health and parasites.	100.0%
	Artificial Insemination/Embryo Transfer	72.7%
	Horticulture/Floriculture	81.8
Physical Science	Soil Science; formations and types.	90.9%
	Plant Science; fertilizers, minerals, inorganic and organic.	100.0%
	Earth Science; Weather conditions/planning seasons.	72.7%
	Feed rations/ feed additives.	100.0%
	Welding; gas and electrical.	100.0%
	Basic engineering physics for shop projects.	90.9%
	Chemical properties associated with plant and animal production.	81.8%
	The influence of weather on production agriculture.	81.8%
	Modern technology used to influence weather.	27.3%
	Physical concepts associated with power systems.	72.7%
	Physical concepts associated with moon phases and climatology.	36.3%
	Environmental issues facing our future generations.	63.6%
	Global warming and its effect on agriculture.	54.5%
	The interaction of the physical environment with basic living organisms.	72.7%
	Water requirements of plants.	100.0%
	Soil classification systems.	81.8%
	Inorganic and organic fertilizers.	90.9%
	The development of consumer products.	81.8%
	General physic; Industrial, engineering, and manufacturing concepts.	45.4%

Table 10 Continued

Agricultural System	Competency	% of Agreement
	Soil structures.	72.7%
	Photosynthesis.	90.9%
	Soil profiles.	81.8%
	Soil classes.	81.8%
	Electricity; basic terms and principals.	90.9%
	Engines and power supplies; internal combustion engines.	90.9%
Social Science	History of agriculture.	81.8%
	Impact and structure of local governments.	63.6%
	FFA activities; career development events.	90.9%
	Community organizations; the impact of booster clubs and major shows.	54.5%
	Governmental programs available for agriculture.	63.6%
	The functions of government, how it works and the political process.	63.6%
	Global affairs that effect agriculture.	81.8%
	The economics of agriculture; NAFTA, world trading, the stock market, and commodity market.	72.7%
	Concepts associated with moving from dependence to independence to interdependence.	63.6%
	Understanding of emotional connections between individual, and how they shape relationships.	45.5%
	Concepts associated with being a leader. How leaders function and how they operate.	90.9%
	The role of citizenship in our society.	81.8%
	Principles of parliamentary law.	100.0%
	Principles of democracy and how we keep it.	72.7%
	Team work and team building.	90.9%
	Characteristics of effective leadership.	90.9%
	Proper etiquette.	72.7%
	Organizational structure and function.	63.6%
	Employer and employee responsibilities.	81.8%
	Interpersonal communications skills.	100.0%
	Social skills and self discipline.	90.9%
	Learning styles.	81.8%
	Learning abilities.	81.8%

Table 10 Continued

	Employment characteristics.	90.9%
Informational Science	Use of global positioning satellite systems.	81.8%
	Public speaking.	90.9%
	How information is gathered.	90.9%
	Ethics and how they impact our society.	90.9%
	The concept of data application and its use in problem solving.	81.8%
	How knowledge is used in organizations.	81.8%
	Concepts of effective leadership.	81.8%
	Ethics in the workplace.	90.9%
	Resume writing, interviewing.	90.9%
	The integration of technology education with agricultural engineering.	72.7%
	The integration of business curriculum with agricultural communications.	72.7%
	Recordkeeping skills.	90.9%
	Brain research; how different students learn.	63.6%
	The use of information technology in agriculture.	81.8%
	Ways to integrate the internet and email to communicate.	81.8%
	Understanding data collection and the interpretation of data.	81.8%
Other Integrative Science	The impact of chemistry.	63.6%
	Soft skill development.	63.6%
	Advertising and marketing of agricultural products.	81.8%
	Concepts associated with problem solving.	81.8%
	Relationships between basic academic and agricultural science.	90.9%
	Concepts connected to scientific research.	72.7%
	Aquaculture, food science and wildlife; basic knowledge of how theses areas integrate.	72.7%
	Integrating areas of agricultural sciences with industrial licensure and certification.	72.7%
	The development of an agricultural science fair.	54.5%
	The importance of cooperation, respect, and trust as related to students.	81.8%

Round-Three

The two round-three (R3) instruments were developed from the responses of the R2 instruments with each instrument developed from the responses of the educators (EDU) and administrator (ADM) groups respectively. The responses from the R2-EDU instrument were used to develop an EDU group specific R3 instrument, and the responses form the R2-ADM instrument were used to develop an ADM group specific R3 instrument.

The R3 instruments was structured in a similar manner as R2, which again grouped the identified competencies into the five conceptual areas of biological science, physical science, social science, informational science, and other integrative science. Both instruments used a dichotomous rating scale of Yes or No to measure the level of agreement of each competency identified. The R3 instruments also provided a column for the participants' comments. Eight (8) EDU experts and eleven (11) ADM experts responded to R3 out of the eleven (11) and twelve (12) that agreed to participate in the study, respectively.

EDU Group Responses to R3

The R3 instrument for the EDU group provided forty-five (45) competencies within the five conceptual areas. The biological conceptual area contained twelve (12) competencies, the physical science conceptual area contained eleven (11) competencies, the social science conceptual area contained thirteen (13) competencies, the informational science conceptual

area contained eight (8) competencies, and the other integrative science conceptual area contained one (1) competency.

It was decided *a priori* by the researcher that any competency which yielded a 75% or greater Yes rating among the EDU panel would be considered having reached a consensus by the EDU group. Table 11 reveals the responses of the EDU group to the R3 instrument. A consensus was reached on a total of forty-one (41) competencies. Consensus for eleven (11) competencies was reached in the biological conceptual area, ten (10) competencies of the physical science conceptual area, eleven (11) competencies of the social science conceptual area, eight (8) competencies of the informational science conceptual area, and one (1) competency of the other integrative science conceptual area.

Table 11
Educator (EDU) Group Percentage of Agreement for Round-Three (R3) Competency

Agricultural System	Competency	% of Agreement
Biological Science	Basic animal anatomy.	100.0%
	Basic animal behaviors.	100.0%
	Basic animal environments.	87.5%
	Animal feeds, feeding, and nutrition.	100.0%
	Plant structures and growth.	100.0%
	Animal reproduction.	87.5%
	Animal systems, digestive, respiratory, circulatory, and nervous.	87.5%
	Breeds and types of livestock, and non-livestock farm animals.	100.0%
	Plant growth and structure.	100.0%
	Plants and soil science.	100.0%

Table 11 Continued

Agricultural System	Competency	% of Agreement
	Selection of livestock.	100.0%
	Anatomy and physiology of animals.	75.0%
Physical Science	Basic principles of engines.	100.0%
	Basic principles of electricity.	100.0%
	Basic principles of power and hand tools.	87.5%
	Basic principles of shop safety.	100.0%
	Basic principles of motors.	87.5%
	Basic principles of metal fabrication.	100.0%
	Water rights and water conservation.	62.5%
	Water quality.	87.5%
	Soil structures.	100.0%
	Soil types and classes.	100.0%
	Plant growth.	100.0%
Social Science	Working with adverse individuals and groups.	87.5%
	Individual social skills.	100.0%
	Community relations.	100.0%
	Learning styles.	100.0%
	Ethics.	100.0%
	Leadership and leadership styles.	100.0%
	Human behavior.	75.0%
	Types of communication.	100.0%
	Personal hygiene.	62.5%
	Cultural diversity and the way it influences food production and consumption.	62.5%
	Career preparation.	100.0%
	Manners and etiquette.	87.5%
	Character education.	87.5%
Informational Science	Basic recordkeeping.	100.0%
	Budgeting.	87.5%
	Ability to access information in ways to solve daily problems and issues.	100.0%
	Problem solving skills.	100.0%
	Goal setting skills.	100.0%
	Information technology skills.	100.0%
	Internet, email and other electronic communication skills.	87.5%
	Computer application skills related to agricultural education.	100.0%

Table 11 Continued

Agricultural System	Competency	% of Agreement
Other Integrative Science	Time management.	87.5%

ADM Group Responses to R3

The R3 instrument for the ADM group provided sixty-one (61) competencies within the five conceptual areas. The biological conceptual area contained twelve (12) competencies, the physical science conceptual area contained seventeen (17) competencies, the social science conceptual area contained fourteen (14) competencies, the informational science conceptual area contained fourteen (14) competencies, and the other integrative science conceptual area contained four (4) competencies.

It was decided *a priori* by the researcher that any competency which yielded a 75% or greater Yes rating among the ADM panel would be considered having reached consensus by the ADM group. Table 12 reveals the responses of the ADM group to the R3 instrument. A consensus was reached on a total of fifty-nine (59) competencies. Consensus for twelve (12) competencies was reached in the biological conceptual area, seventeen (17) competencies of the physical science conceptual area, fourteen (14) competencies of the social science conceptual area, twelve (12) competencies

of the informational science conceptual area, and four (4) competencies of the other integrative science conceptual area.

Table 12
Administrator (ADM) Group Percentage of Agreement for Round-Three (R3) Competency

Agricultural System	Competency	% of Agreement
Biological Science	Anatomy of animals-how life is sustained; cell growth	100.0%
	Plant and animal reproduction.	100.0%
	The future role of genetics in the production of plants and animals.	90.9%
	Animal anatomy and physiology.	100.0%
	Animal genetics and reproduction.	100.0%
	Breeds of livestock.	100.0%
	Plants and soil science.	100.0%
	Agricultural biotechnology	90.9%
	Animal health and nutritional resources.	100.0%
	Animal nutrition.	90.9%
	Animal health and parasites.	100.0%
	Horticulture/Floriculture	100.0%
Physical Science	Soil Science; formations and types.	100.0%
	Plant Science; fertilizers, minerals, inorganic and organic.	100.0%
	Feed rations/ feed additives.	100.0%
	Welding; gas and electrical.	100.0%
	Basic engineering physics for shop projects.	90.9%
	Chemical properties associated with plant and animal production.	90.9%
	The influence of weather on production agriculture.	90.9%
	Water requirements of plants.	100.0%
	Soil classification systems.	100.0%
	Inorganic and organic fertilizers.	100.0%
	The development of consumer products.	81.8%
	Soil textures.	100.0%
	Photosynthesis.	100.0%
	Soil profiles.	100.0%
	Soil classes.	90.9%
	Electricity; basic terms and principals.	100.0%

Table 12 Continued

Agricultural System	Competency	% of Agreement
	Engines and power supplies; internal combustion engines.	100.0%
Social Science	History of agriculture.	100.0%
	FFA activities; career development events.	100.0%
	Global affairs that effect agriculture.	81.8%
	Concepts associated with being a leader. How leaders function and how they operate.	90.9%
	The role of citizenship in our society.	100.0%
	Principles of parliamentary law.	100.0%
	Team work and team building.	100.0%
	Characteristics of effective leadership.	100.0%
	Employer and employee responsibilities.	100.0%
	Interpersonal communications skills.	100.0%
	Social skills and self discipline.	100.0%
	Learning styles.	100.0%
	Learning abilities.	100.0%
	Employment characteristics.	100.0%
Informational Science	Computer technology in recordkeeping.	100.0%
	Use of global positioning satellite systems.	72.7%
	Public speaking.	90.9%
	How information is gathered.	100.0%
	Ethics and how they impact our society.	100.0%
	The concept of data application and its use in problem solving.	90.9%
	How knowledge is used in organizations.	72.7%
	Concepts of effective leadership.	100.0%
	Ethics in the workplace.	100.0%
	Resume writing, interviewing.	100.0%
	Recordkeeping skills.	100.0%
	The use of information technology in agriculture.	100.0%
	Ways to integrate the internet and email to communicate.	100.0%
	Understanding data collection and the interpretation of data.	100.0%

Table 12 Continued

Agricultural System	Competency	% of Agreement
Other Integrative Science	Advertising and marketing of agricultural products.	100.0%
	Concepts associated with problem solving.	100.0%
	Relationships between basic academic and agricultural science.	100.0%
	The importance of cooperation, respect, and trust as related to students.	100.0%

Findings Related to Research Question 1

What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by agricultural education professionals?

The beginning Texas agricultural science teacher's future competencies related to the each conceptual area as defined by agricultural education professionals are included in Table 13.

Table 13
Agricultural Systems Competencies Identified by Educator (EDU) Panel Group

Agricultural System	Competency
Biological Science	Basic animal anatomy.
	Basic animal behaviors.
	Basic animal environments.
	Animal feeds, feeding, and nutrition.
	Plant structures and growth.
	Animal reproduction.
	Animal systems, digestive, respiratory, circulatory, nervous.

Table 13 Continued

Agricultural System	Competency
	Breeds and types of livestock, and non-livestock farm animals. Plants and soil science. Selection of livestock. Anatomy and physiology of animals.
Physical Science	Basic principles of engines. Basic principles of electricity. Basic principles of power and hand tools. Basic principles of shop safety. Basic principles of motors. Basic principles of metal fabrication. Water quality. Soil structures. Soil types and classes Plant growth.
Social Science	Working with adverse individuals and groups. Individual social skills. Community relations. Learning styles. Ethics. Leadership and leadership styles. Human behavior. Types of communication. Career preparation. Manners and etiquette. Character education.
Informational Science	Basic recordkeeping. Budgeting. Ability to access information in ways to solve daily problems and issues. Problem solving skills. Goal setting skills. Information technology skills.

Table 13 Continued

Agricultural System	Competency
	Internet, email and other electronic communication skills. Computer application skills related to agricultural education.
Other Integrative Science	Time management.

Findings Related to Research Question 2

What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by administrators of agricultural education programs?

The beginning Texas agricultural science teacher's future competencies related to the each conceptual area as defined by administrators of agricultural education programs are included in Table 14.

Table 14
Agricultural Systems Competencies Identified by Administrators (ADM) Panel Group

Agricultural System	Competency
Biological Science	Anatomy of animals-how life is sustained; cell growth Plant and animal reproduction. The future role of genetics in the production of plants and animals. Animal anatomy and physiology. Animal genetics and reproduction. Breeds of livestock. Plants and soil science.

Table 14 Continued

Agricultural System	Competency
	Agricultural biotechnology. Animal health and nutritional resources. Animal nutrition. Animal health and parasites. Horticulture/Floriculture
Physical Science	Soil Science; formations and types. Plant Science; fertilizers, minerals, inorganic and organic. Feed rations/ feed additives. Welding; gas and electrical. Basic engineering physics for shop projects. Chemical properties associated with plant and animal production. The influence of weather on production agriculture. Water requirements of plants. Soil classification systems. Inorganic and organic fertilizers. The development of consumer products. Soil textures. Photosynthesis. Soil profiles. Soil classes. Electricity; basic terms and principals. Engines and power supplies; internal combustion engines.
Social Science	History of agriculture. FFA activities; career development events. Global affairs that effect agriculture. Concepts associated with being a leader. How leaders function and how they operate. The role of citizenship in our society. Principles of parliamentary law. Team work and team building. Characteristics of effective leadership. Employer and employee responsibilities.

Table 14 Continued

Agricultural System	Competency
	Interpersonal communications skills. Social skills and self discipline. Learning styles. Learning abilities. Employment characteristics.
Informational Science	Computer technology in recordkeeping. Public speaking. How information is gathered. Ethics and how they impact our society. The concept of data application and its use in problem solving. Concepts of effective leadership. Ethics in the workplace. Resume writing, interviewing. Recordkeeping skills. The use of information technology in agriculture. Ways to integrate the internet and email to communicate. Understanding data collection and the interpretation of data.
Other Integrative Science	Advertising and marketing of agricultural products. Concepts associated with problem solving. Relationships between basic academic and agricultural science. The importance of cooperation, respect, and trust as related to students.

Findings Related to Research Question 3

What are the future agricultural systems competencies of beginning Texas agricultural science teachers that are a consensus between agricultural education professionals and administrators of agricultural education programs?

Conceptual Area I: Biological Science

The beginning Texas agricultural science teacher's future competencies related to the biological science conceptual area which are a consensus between administrators of agricultural education programs and agricultural education professionals are included in Table 15.

Table 15
Findings of Each Group's Agricultural Systems Competencies
Conceptual Area I: Biological Science

Agricultural Education Professionals	Administrators of Agricultural Education Programs
Basic animal anatomy.	Anatomy of animals-how life is sustained; cell growth
Basic animal behaviors.	Plant and animal reproduction.
Basic animal environments.	The future role of genetics in the production of plants and animals.
Animal feeds, feeding, and nutrition.	Animal anatomy and physiology.
Plant structures and growth.	Animal genetics and reproduction.
Animal reproduction.	Breeds of livestock.
Animal systems, digestive, respiratory, circulatory, nervous.	Plants and soil science.
Breeds and types of livestock, and non-livestock farm animals.	Agricultural biotechnology
Plants and soil science.	Animal health and nutritional resources.
Selection of livestock.	Animal nutrition.
Anatomy and physiology of animals.	Animal health and parasites.
	Horticulture/Floriculture

Conceptual Area II: Physical Science

The beginning Texas agricultural science teacher's future competencies related to the physical science conceptual area which are a

consensus between administrators of agricultural education programs and agricultural education professionals are included in Table 16.

Table 16
Findings of Each Group's Agricultural Systems Competencies
Conceptual Area II: Physical Science

Agricultural Education Professionals	Administrators of Agricultural Education Programs
Basic principles of engines.	Soil Science; formations and types.
Basic principles of electricity.	Plant Science; fertilizers, minerals, inorganic and organic.
Basic principles of power and hand tools.	Feed rations/ feed additives.
Basic principles of shop safety.	Welding; gas and electrical.
Basic principles of motors.	Basic engineering physics for shop projects.
Basic principles of metal fabrication.	Chemical properties associated with plant and animal production.
Water quality.	The influence of weather on production agriculture.
Soil structures.	Water requirements of plants.
Soil types and classes	Soil classification systems.
Plant growth.	Inorganic and organic fertilizers.
	The development of consumer products.
	Soil textures.
	Photosynthesis.
	Soil profiles.
	Soil classes.
	Electricity; basic terms and principals.
	Engines and power supplies; internal combustion engines.

Conceptual Area III: Social Science

The beginning Texas agricultural science teacher's future competencies related to the social science conceptual area which are a consensus between

administrators of agricultural education programs and agricultural education professionals are included in Table 17.

Table 17
Findings of Each Group's Agricultural Systems Competencies
Conceptual Area III: Social Science

Agricultural Education Professionals	Administrators of Agricultural Education Programs
Working with adverse individuals and groups.	History of agriculture.
Individual social skills.	FFA activities; career development events.
Community relations.	Global affairs that effect agriculture.
Learning styles.	Concepts associated with being a leader.
Ethics.	How leaders function and how they operate.
Leadership and leadership styles.	The role of citizenship in our society.
Human behavior.	Principles of parliamentary law.
Types of communication.	Team work and team building.
Career preparation.	Characteristics of effective leadership.
Manners and etiquette.	Employer and employee responsibilities.
Character education.	Interpersonal communications skills.
	Social skills and self discipline.
	Learning styles.
	Learning abilities.
	Employment characteristics.

Conceptual Area IV: Informational Science

The beginning Texas agricultural science teacher's future competencies related to the informational science conceptual area which are a consensus between administrators of agricultural education programs and agricultural education professionals are included in Table 18.

Table 18
Findings of Each Group's Agricultural Systems Competencies
Conceptual Area IV: Informational Science

Agricultural Education Professionals	Administrators of Agricultural Education Programs
Basic recordkeeping.	Computer technology in recordkeeping.
Budgeting.	Public speaking.
Ability to access information in ways to solve daily problems and issues.	How information is gathered.
Problem solving skills.	Ethics and how they impact our society.
Goal setting skills.	The concept of data application and its use in problem solving.
Information technology skills.	Concepts of effective leadership.
Internet, email and other electronic communication skills.	Ethics in the workplace.
Computer application skills related to agricultural education.	Resume writing, interviewing.
	Recordkeeping skills.
	The use of information technology in agriculture.
	Ways to integrate the internet and email to communicate.
	Understanding data collection and the interpretation of data.

Conceptual Area V: Other Integrative Science

The beginning Texas agricultural science teacher's future competencies related to other integrative science conceptual area which are a consensus between administrators of agricultural education programs and agricultural education professionals are included in Table 19.

Table 19
Findings of Each Group's Agricultural Systems Competencies
Conceptual Area V: Other Integrative Science

Agricultural Education Professionals	Administrators of Agricultural Education Programs
Time management.	Advertising and marketing of agricultural products. Concepts associated with problem solving. Relationships between basic academic and agricultural science. The importance of cooperation, respect, and trust as related to students.

CHAPTER V

SUMMARY, DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

It has long been the primary objective of the discipline of agricultural education to supply its clientele with educational needs which are technologically advanced, economically efficient, and sociologically necessary (Meyer, 1999). It is the purpose of this study to examine one facet of the discipline of agricultural education which related to the preparation of beginning agricultural science teachers for secondary education programs in the state of Texas. Because there is no specific state assessment of the agricultural systems competencies of beginning agricultural science teachers in the state of Texas, it was necessary to research the future agricultural systems or technical competencies needed by beginning agricultural science teachers (SBEC, 2002). The results of this study may be used to assist agricultural education educator preparation institutions in determining the necessary agricultural systems competencies of program completers, and to gain an understanding of the future implication that impact teacher preparation.

This study of future agricultural systems competencies of beginning agricultural science teachers was based on three specific questions:

1. What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by expert agricultural education professionals?

2. What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by expert administrators of agricultural education programs?
3. What are the future agricultural systems competencies of beginning Texas agricultural science teachers that are a consensus between expert agricultural education professionals and expert administrators of agricultural education programs?

Summary of Procedures

This study followed the prescribed research methodology known as the Delphi technique. The Delphi technique was first derived by the tradition of the Greek Oracles who resided at Delphi and forecasted or prophesied future events or occurrences (Sackman, 1974). In our modern era of culture, Delphi has been used to make future prediction of a variety of topics (Strauss et al, 1975). This research method requires the establishment of a panel of experts to yield a consensus response to the specific research questions. To achieve consensus in this study, a three-round Delphi method was used. The panel of experts was composed of thirty-five (35) highly qualified individuals who were identified from the State Board of Educator Certification, the Texas Education Agency, and the faculty of Texas A&M University, Department of Agricultural Education. These individuals possessed either direct experience in agricultural education or management experience of an innovative agricultural education

program. Twenty-three (23) of these individuals agreed to participate in the research project.

The panel was divided into two independent groups, one composed of eleven (11) educational professionals (EDU), and the other composed of twelve (12) administrators of agricultural education programs (ADM). The EDU group panel experts each were employed as agriculture science teachers, teacher educators of agricultural education programs, or professionally related occupations. The ADM group panel experts were employed as school superintendents, campus principals, or directors of career and technology education programs. The panel was subdivided by the researcher out of an interest to determine if differences existed between the two groups. A common generalization made by some scholars (G. Briers, personal communication, May 3, 2002). within the discipline of agricultural education is that school administrators determine the productive outcome of an agricultural education program; mainly because they hire personnel in charge of agricultural science programs (Camp, 2000). The researcher wanted to make some determination as to if administrators would have a different set of criteria from teachers and teacher educators as related to competencies of beginning teachers of agricultural science.

Initially, every panelist was sent the same round-one (R1) instrument with five powerful and fundamental conceptually based questions. This open-ended questionnaire attempted to extract as many individual responses as

possible. The researcher prompted the panelists as to the objective of the study. This was accomplished by providing a cover letter with the round-one instrument which explained that nature of a Delphi study and the use of the five powerful and fundamental concepts related to agricultural education. The letter further explained the role of a panelist in that it was not expected that each panelist fully exhaust the knowledge base related to the science of agriculture, but to yield responses as to the needs of a beginning teacher of agricultural science. Some experts were specifically chosen because of their vast understanding of one or two particular conceptual areas. The cover letter for the round-one instrument explained that an individual expert need not be an expert in all five powerful and fundamental conceptual areas.

The R1 instrument was provide to all twenty-three (23) panelists who gave consent to participate in the study. A cover letter explaining the details of the instrument and five open-ended questions were detailed in the R1 instrument. Each question asked the experts to identify specific competencies for a given powerful and fundamental concept associated with agricultural education. These five powerful and fundamental concepts were determined from a review of the literature as the scientific underpinning of the discipline of agricultural education (Akers, 2001; Binkley & Tulloch, 1981; Connors, 1998; Frantz, 1997; Graham & Garton, 2001; NCAE, 1999; Paul, 1995; Pritchett, 1997; Rojewski, 2002). The five conceptual areas identified were biological science, physical science, social science, informational science, and other

integrative science. The expert panelists were given the opportunity to provide as much of a response as they choose. The R1 instrument also provided the panelists the opportunity to supply additional comments related to their responses.

The round-two (R2) instruments were developed from each of the groups responses which allowed the researcher to keep the two groups responses separate for further analyzes. Because there was a considerable duplication of responses, the researcher converged many of the responses to those identified on the round-two instruments for each respective group.

The two R2 instruments were developed from the respective R1 responses of each group. The instruments provide each group the ability to record their level of agreement with each identified competency. The R2 instruments focused on determining the level of agreement among the panel by asking them to rate each competency listed on the R2 instruments. A Likert type scale was used with a rating range of 1 to 6: one (1) Strongly Disagree, two (2) Disagree, three (3) Somewhat Disagree, four (4) Somewhat Agree, five (5) Agree, and six (6) Strongly Agree. The instruments again were structured around each conceptual area which underpins agricultural education with a definition of each conceptual area provided. Also two additional columns were provided; the first asked for the experts' comments and the later asked if the competency should be moved to another conceptual area. The comments were very useful to the researcher in gaining a better understanding of why an

expert rated a given competency at a given level. Although a few experts requested to move some competencies to other conceptual areas, there was not enough of a consensus among the respective panel to do so. The 75% consensus techniques recommended by Linstone and Turoff (1975) was used in determining the competencies which would be used to develop the round three instruments. The round-three (R3) instruments were developed from the responses of the respective groups with intent to reach a consensus among the group's expert panelists and provide separate responses which could be compared and analyzed. The researcher designed the R3 instruments to yield a dichotomous Yes or No response as to fully identify the competencies of consensus.

The round-three (R3) instruments were developed from the consensus of each respective group. Again two independent instruments were developed from the data collected in the R2 instruments, one for the eleven (11) member expert EDU group and one for the twelve (12) member expert ADM group. A cover letter was sent which explained that the R3 instrument would be the last round as the researcher believed that a consensus could be reached with the third-round instruments. The R3 instruments were developed from the responses of the R2 instrument. Those competencies that were rated a five (5) or a six (6) on the R2 instrument by a 75% or more by the respondents were used to develop the R3 instrument. As a result of using a 75% level of agreement for each competency, the R2 EDU instrument lost four (4)

competencies and the R2 ADM instrument lost two (2) competencies. Each of the remaining competencies was listed on the R3 instrument.

On the R3 instruments, experts were asked to rate their level of agreement of each competency by using a dichotomous scale of Yes or No. A response of “Yes” meant that the expert did agree that a given competency is needed by a beginning agricultural science teacher (BAST), and a response of “No” meant that the expert did not agree that a given competency is needed by a BAST. The R3 instruments were divided by conceptual area with each powerful and fundamental definition provided. The R3 instruments again provide a column for additional comments by a panelist.

Discussion of Research Question 1

What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by agricultural education professionals?

The competencies identified by agricultural education professionals (EDU) represent a combination of basic and fundamental topics associated with modern agriculture. The literature related to futuring reveals that the world will be a much more complex place, both technologically and sociologically (McCaslin & Parks, 2002: NCAE, 1999; Pritchett, 1997). Many of the responses provided by the educator expert panel offer more of the same, and appear to be traditional in scope and nature. This result may have come from

an overbearing culture of low expectations on the behalf of educators as they attempt to offer a basic understanding of agriculture to their respective clientele. The literature reveals that technology, globalization, and advanced communication skill will be necessary in our future society (Rojewski, 2002). It is evident that across the five powerful and fundamental conceptual areas which underpin agricultural education, education professionals were reluctant to completely embrace these future societal changes (See Table 20). The identified competencies from the EDU group appear to be very similar to the competencies which are currently being used by educator preparation programs.

The perplexing question for educator preparation institutions is this: Who changes first, the content specialist within the institution or the standards developed by credentialing agency? Teacher educators are especially concerned about this phenomenon as they attempt to strike a balance between the scientific course content available at their respective institutions and the demands of the state. Because of the variation which exists among teacher preparation institutions (Bartlett, 2002), it is necessary for the state to establish standards which dictate the needs of a beginning teacher of agricultural science with future agricultural systems competencies.

Table 20
Summary of Agricultural Systems Competencies Identified by Educators (EDU)

Agricultural System	Competency
Biological Science	Basic animal anatomy. Basic animal behaviors. Basic animal environments. Animal feeds, feeding, and nutrition. Plant structures and growth. Animal reproduction. Animal systems, digestive, respiratory, circulatory, nervous. Breeds and types of livestock, and non-livestock farm animals. Plants and soil science. Selection of livestock. Anatomy and physiology of animals.
Physical Science	Basic principles of engines. Basic principles of electricity. Basic principles of power and hand tools. Basic principles of shop safety. Basic principles of motors. Basic principles of metal fabrication. Water quality. Soil structures. Soil types and classes Plant growth.
Social Science	Working with adverse individuals and groups. Individual social skills. Community relations. Learning styles. Ethics. Leadership and leadership styles. Human behavior. Types of communication. Career preparation. Manners and etiquette. Character education.

Table 20 Continued

Agricultural System	Competency
Informational Science	Basic recordkeeping. Budgeting. Ability to access information in ways to solve daily problems and issues. Problem solving skills. Goal setting skills. Information technology skills. Internet, email and other electronic communication skills. Computer application skills related to agricultural education.
Other Integrative Science	Time management.

Discussion of Research Question 2

What are the future agricultural systems competencies necessary for beginning Texas agricultural science teachers as defined by administrators of agricultural education programs?

A review of the responses of administrators of agricultural education programs reveals a global nature to their responses. The researcher assumes that this may be a result of the more diverse orientation towards education in which school administers hold. Because administrators of agricultural education programs are more likely to be removed from the daily operations of agricultural education programs, perhaps they are able to be more objective in their respective responses. It appears that within each of the five fundamental and powerful conceptual areas identified, the administrators were more

demanding of future beginning teachers of agricultural science programs (See Table 21).

The results of the administrator group are more closely aligned with the recommendations from Rojewski's (2002) exposure of future societal demands. It can be assumed that our society will only become more complex with a continued need solve the problems associated with an ever growing world population.

Table 21
Summary of Agricultural Systems Competencies Identified by Administrators (ADM)

Agricultural System	Competency
Biological Science	Anatomy of animals-how life is sustained; cell growth Plant and animal reproduction. The future role of genetics in the production of plants and animals. Animal anatomy and physiology. Animal genetics and reproduction. Breeds of livestock. Plants and soil science. Agricultural biotechnology Animal health and nutritional resources. Animal nutrition. Animal health and parasites. Horticulture/Floriculture
Physical Science	Soil Science; formations and types. Plant Science; fertilizers, minerals, inorganic and organic. Feed rations/ feed additives. Welding; gas and electrical. Basic engineering physics for shop projects.

Table 21 Continued

Agricultural System	Competency
	Chemical properties associated with plant and animal production. The influence of weather on production agriculture. Water requirements of plants. Soil classification systems. Inorganic and organic fertilizers. The development of consumer products. Soil textures. Photosynthesis. Soil profiles. Soil classes. Electricity; basic terms and principals. Engines and power supplies; internal combustion engines.
Social Science	History of agriculture. FFA activities; career development events. Global affairs that effect agriculture. Concepts associated with being a leader. How leaders function and how they operate. The role of citizenship in our society. Principles of parliamentary law. Team work and team building. Characteristics of effective leadership. Employer and employee responsibilities. Interpersonal communications skills. Social skills and self discipline. Learning styles. Learning abilities. Employment characteristics.
Informational Science	Computer technology in recordkeeping. Public speaking. How information is gathered. Ethics and how they impact our society. The concept of data application and its use in problem solving. Concepts of effective leadership.

Table 21 Continued

Agricultural System	Competency
	Ethics in the workplace. Resume writing, interviewing. Recordkeeping skills. The use of information technology in agriculture. Ways to integrate the internet and email to communicate. Understanding data collection and the interpretation of data.
Other Integrative Science	Advertising and marketing of agricultural products. Concepts associated with problem solving. Relationships between basic academic and agricultural science. The importance of cooperation, respect, and trust as related to students.

Discussion of Research Question 3

What are the future agricultural systems competencies of beginning Texas agricultural science teachers that are a consensus between agricultural education professionals and administrators of agricultural education programs?

The study results reveal that the combination of the two groups' responses are very comprehensive and collectively work together as complements.

Conceptual Area I: Biological Science

The responses of each of the group reveal a variation between the groups for the biological science conceptual area. It is apparent that for

biological science, each group determined a need for beginning teachers to be competent in the topic of animal science over other topic areas associated with biological science. It appears that the future role of animal agriculture reached a high level of agreement between the groups. The topic of anatomy and physiology, breeds of livestock, feeds, feeding, and animal nutrition, and animal systems were determined as necessary by both groups. Although not as prevalent, the two groups each identified some topics related to basic plant science (see Table 22).

Table 22
Consensus of Each Group's Agricultural Systems Competencies
Conceptual Area I: Biological Science

Agricultural Education Professionals	Administrators of Agricultural Education Programs
Basic animal anatomy.	Anatomy of animals-how life is sustained; cell growth
Basic animal behaviors.	Plant and animal reproduction.
Basic animal environments.	The future role of genetics in the production of plants and animals.
Animal feeds, feeding, and nutrition.	Animal anatomy and physiology.
Plant structures and growth.	Animal genetics and reproduction.
Animal reproduction.	Breeds of livestock.
Animal systems, digestive, respiratory, circulatory, nervous.	Plants and soil science.
Breeds and types of livestock, and non-livestock farm animals.	Agricultural biotechnology
Plants and soil science.	Animal health and nutritional resources.
Selection of livestock.	Animal nutrition.
Anatomy and physiology of animals.	Animal health and parasites.
	Horticulture/Floriculture

Conceptual Area II: Physical Science

The second conceptual area identified competencies associated with physical science and yielded a variety of responses between the two groups. The EDU group identified many topics related to agricultural mechanics, soil science and redundantly identified one competency in plant science. Topic associated with these identified competencies includes mathematical applications, physics, and chemistry. The responses of the ADM group identify a broader variety of competencies associated with physical science that include soil science, plant science, physical properties associated with plant and animal production, and a lesser concentration of agricultural mechanic related competencies (see Table 23).

Table 23
Consensus of Each Group's Agricultural Systems Competencies
Conceptual Area II: Physical Science

Agricultural Education Professionals	Administrators of Agricultural Education Programs
Basic principles of engines.	Soil Science; formations and types.
Basic principles of electricity.	Plant Science; fertilizers, minerals, inorganic and organic.
Basic principles of power and hand tools.	Feed rations/ feed additives.
Basic principles of shop safety.	Welding; gas and electrical.
Basic principles of motors.	Basic engineering physics for shop projects.
Basic principles of metal fabrication.	Chemical properties associated with plant and animal production.
Water quality.	The influence of weather on production agriculture.
Soil structures.	Water requirements of plants.
Soil types and classes	Soil classification systems.

Table 23 Continued

Agricultural Education Professionals	Administrators of Agricultural Education Programs
Plant growth.	Inorganic and organic fertilizers. The development of consumer products. Soil textures. Photosynthesis. Soil profiles. Soil classes. Electricity; basic terms and principals. Engines and power supplies; internal combustion engines.

Conceptual Area III: Social Science

Within the conceptual area of social science, the EDU group identified several competencies associated with practical skill associated with dealing with students, parents and community. Educators apparently realized a need for a beginning agricultural science teacher to understand and teach skill associated to work and general career preparation. The ADM group offered a very global set of competencies associated to organizational structure and leadership. Specific competencies identified by the ADM group for a beginning agricultural science teacher include history of agriculture, FFA, world agriculture, leadership, citizenship, parliamentary rules, work related responsibilities, social skills, and learning abilities. It is assumed by the researcher that the differences associated between the two groups are associated to the orientation each respective group maintains to the educational system and a public school's mission (see Table 24).

Table 24
Consensus of Each Group's Agricultural Systems Competencies
Conceptual Area III: Social Science

Agricultural Education Professionals	Administrators of Agricultural Education Programs
Working with adverse individuals and groups.	History of agriculture.
Individual social skills.	FFA activities; career development events.
Community relations.	Global affairs that effect agriculture.
Learning styles.	Concepts associated with being a leader.
Ethics.	How leaders function and how they operate.
Leadership and leadership styles.	The role of citizenship in our society.
Human behavior.	Principles of parliamentary law.
Types of communication.	Team work and team building.
Career preparation.	Characteristics of effective leadership.
Manners and etiquette.	Employer and employee responsibilities.
Character education.	Interpersonal communications skills.
	Social skills and self discipline.
	Learning styles.
	Learning abilities.
	Employment characteristics.

Conceptual Area IV: Informational Science

Each group identified a diversity of competencies associated with the conceptual areas of informational science. The EDU group identified competencies associated with specific topics related to the recording and retrieving of information. Competency topics included for a beginning agricultural science teacher by the EDU group include recordkeeping, budgeting, information access, problem solving, goal setting, and electronic communication systems. The ADM group identified many similar competencies

within the conceptual area of informational science. Specific competencies include computer recordkeeping, public speaking, information gathering, ethics, leadership, written communication, and electronic communication skills (see Table 25).

Table 25
Consensus of Each Group's Agricultural Systems Competencies
Conceptual Area IV: Informational Science

Agricultural Education Professionals	Administrators of Agricultural Education Programs
Basic recordkeeping.	Computer technology in recordkeeping.
Budgeting.	Public speaking.
Ability to access information in ways to solve daily problems and issues.	How information is gathered.
Problem solving skills.	Ethics and how they impact our society.
Goal setting skills.	The concept of data application and its use in problem solving.
Information technology skills.	Concepts of effective leadership.
Internet, email and other electronic communication skills.	Ethics in the workplace.
Computer application skills related to agricultural education.	Resume writing, interviewing.
	Recordkeeping skills.
	The use of information technology in agriculture.
	Ways to integrate the internet and email to communicate.
	Understanding data collection and the interpretation of data.

Conceptual Area V: Other Integrative Science

The final conceptual area of other integrative science offers the least amount of competencies of any of the five. It is obvious that each group

struggled to offer competencies for this conceptual area. The EDU group identified only one competency of time management for a beginning agricultural science teacher. The ADM group identified four different competencies related to other integrative science which includes marketing and advertising, problem solving, the integration of agriculture to academics, and cooperation and respect. Again the ADM group identified many additional competencies which are more global in nature (see Table 26).

Table 26
Consensus of Each Group's Agricultural Systems Competencies
Conceptual Area V: Other Integrative Science

Agricultural Education Professional	Administrators of Agricultural Education Programs
Time management	Advertising and marketing of agricultural products. Concepts associated with problem solving. Relationships between basic academic and agricultural science. The importance of cooperation, respect, and trust as related to students.

Conclusions

The conclusions of this study are derived and interpreted from the data collected as described in this study. The conclusions of this study are associated with the expert panelists identified, and, therefore, these conclusions are subject to the limitations of this study and can be applied to the state of Texas. The researcher makes the following conclusions:

1 This study found that three-fourths or more of the education professionals (EDU) group experts agreed on forty-one (41) future competencies necessary for beginning Texas agricultural science teachers. Among these competencies eleven (11) were associated with the biological sciences, ten (10) were associated with the physical sciences, eleven (11) were associated with the social sciences, eight (8) were associated with the informational sciences, and one (1) was associated with other integrative sciences.

The future competencies identified by the EDU group represent a traditional approach to beginning teacher preparation. The future needs of our society will be technologically advance and sociologically complex (McCaslin & Parks, 2002). As the researcher compares the results of the EDU group to the future societal trends, it is evident that educators were reluctant to deviate from what is currently in practice. During a SBEC standards committee meeting held in July 2002, which the researcher is a member, the researcher held personal conversations with several of the EDU group members of the committee which related to beginning teacher competencies. The educators communicated their concerns about development of future standards which were too complex or difficult for a beginning teacher. It is the belief of the researcher that the EDU group, which was composed of members of the SBEC standards committee,

maintains low expectations of beginning teachers, and that this is further revealed in the results of the final results of the EDU group's responses. Low expectations for beginning teachers have long been a problem for teacher education programming.

Teacher quality is not a new concern; it has been a concern from the very beginning of formalized education. In the 1750s, Benjamin Franklin labored over the notion of who could serve as a competent schoolmaster (Robison, 1911). And yet even today research reveals that there is a public distrust and general lack of confidence that public school teachers are prepared for the job (NCES, 1999). It is therefore equally important that beginning agricultural science teachers obtain appropriate and relevant agricultural systems competencies before being recommended for certification. The basic tenet of teaching is grounded in the theory of a teacher's knowledge of the subject matter in which he is teaching must be mastered before the teacher can effectively teach the content (Camp, 2001). This foundational concept is so obvious, yet so commonly overlooked in the development and evaluation stages of teacher education. As highlighted in the US Department of Education's study "What Matters Most: Teaching for America's Future," schools across our nation employ teachers who are unprepared to teach their subject matter content (NCTAF, 1996). The results indicate that the educator group

have become ingrained in tradition and unable to incorporate futuristic competencies which mirror societal changes in technology, biotechnology, and sociology.

Teacher knowledge and skill is the single largest factor of student performance (Erickson, 2002). Teaching quality is an ongoing process that requires continuous growth and development of a teacher's knowledge and skills. Because the subject matter of agricultural science is based on scientific fundamentals, a complete shift in teacher knowledge is unnecessary; however, because our society has changed rapidly (Prichett,1997), it is vitally important for agricultural educators to keep pace with current innovations within the discipline. Our democratic society revolves around the need and use of knowledge. Because agricultural education curriculum is a reflection of current technological need and sociological change, agricultural science teacher preparation programs must continuously evolve to keep pace with current and future demands.

2 This study found that three-fourths or more of the administrators of agricultural education programs (ADM) group experts agreed on fifty-nine (59) future competencies necessary for beginning Texas agricultural science teachers. Among these competencies twelve (12) were associated with the biological sciences, seventeen (17)

were associated with the physical sciences, fourteen (14) were associated with the social sciences, twelve (12) were associated with the informational sciences, and four (4) were associated with other integrative sciences.

The future competencies of beginning agricultural science teachers as identified by the ADM group reveal a more global understanding of agricultural systems competencies for beginning teachers. Administrators responded that beginning teacher should posses a more applications orientation to the understanding of agricultural systems that includes information technology, advanced leadership skills, and biotechnical training. The researcher concludes that because administrators have a much broader exposure to education, the ADM group has a natural tendency integrate other areas into agricultural education, and therefore incorporated more complex agricultural systems competencies of beginning teachers.

The National Council for Agricultural Education conducted a comprehensive review and strategic plan for agricultural education, which produced several initiatives and the publication *The Reinventing of Agricultural Education for the Year 2020* (1999). The mission focuses primarily on the career preparation of students with emphasis on making students aware of global agricultural systems, food and fiber systems, and natural resources systems that are

related to agriculture. Because of this shift in focus of agricultural education as defined by the National Council for Agricultural Education (1999), this study was necessary determine the appropriate future agricultural systems competencies for beginning teachers of agricultural education. As a means of satisfying the goals and objectives of the Reinventing of Agricultural Education recommendations, future teacher education programs should be restructured to incorporate many of the recommended competencies associated with the responses of the ADM group.

Futuring is defined by Hoyle (1995, p 20) as “the act of seeing and feeling alternative futures that are either in the near, middle, or far future.” An understanding of future possibilities or alternative is necessary to establish direction and leadership to agricultural education. The future agricultural systems competencies of beginning agricultural educators must coincide with the future needs of our community and society. The future of our society will become more intellectually advanced, global in nature, culturally diverse, massive in number, older in population, environmentally complex, and more technologically advanced (Pritchett, 1997). It is estimated that 80% of the technologies needed to solve the complexities of a growing world population have not been created or conceived (Hoyle,

1995). The future will require new, innovative approaches to teaching agricultural science using much different information.

As each of these critical attributes is examined, it becomes apparent how interrelated each is to the other. The introduction of new information in our society is at a record high. Not only are we discovering new information at a rapid pace, with the aid of information technology, old information is being archived and being made readily accessible (Pritchett, 1997). Information technology has mandated a new way of managing data and information. Information technology is serving as the catalyst for change in our society. The world's population is increasing in size, diversity, and in age. Population shifts are occurring within the United States as people gravitate to urban regions. Increased technology has provided efficiency in food and fiber production, human health services, and basic education, which attribute to the shifts within the population (Day, 1996).

The increase in population will demand a food and fiber production system of equal proportion; however, because of a more informed consumer, future agriculturists will certainly have greater environmental demands. The era of high-input production agriculture is rapidly ending as consumers learn more about the risk associated with chemical agriculture. It is apparent that new solutions will come

from the high science of biotechnology and genetic engineering. New breakthroughs such as pest resistance crops are the wave of the future; however, to date, high science has not always been embraced by society. The catalyst for high touch will be the use of information technology. The demands of our future society must be incorporated into the future competencies of beginning agricultural science teachers. The ADM group has provided an appropriate start.

3 This study found agreement among the education professionals (EDU) experts and the administrators of agricultural education programs (ADM) experts agreed on one-hundred (100) future competencies necessary for beginning Texas agricultural science teachers. Among these competencies twenty-three (23) were associated with the biological sciences, twenty-seven (27) were associated with the physical sciences, twenty-five (25) were associated with the social sciences, twenty (20) were associated with the informational sciences, and five (5) were associated with other integrative sciences.

Collectively, each group identified a vast array of future competencies needed by beginning agricultural science teachers. Because of the diversity of the two groups, a comprehensive blending of responses has yielded appropriate future beginning teacher

competencies. As cited in the literature, our future society will be much more technologically advanced (Pritchett, 1997). Although no one individual can be certain as to the specific changes the future will possess, the consensus of agricultural systems competencies identified by the entire panel of experts should be used to guide the future standards for beginning agricultural science teachers.

As a part of the grand theoretical base of a teacher's content knowledge, there are many underlying powerful and fundamental concepts that serve as the underpinning of the discipline of agricultural education (Paul, 1995). Agricultural education is grounded in several powerful and fundamental scientific concepts and principles. Because agricultural education was founded and conceived in science, there exists a logical connection between the discipline and biological science, physical science, social science, informational science and other integrative sciences (Akers, 2001; Binkley & Tulloch, 1981; Connors, 1998; Frantz, 1997; Graham & Garton, 2001; NCAE, 1999; Paul, 1995; Pritchett, 1997; Rojewski, 2002). Biological science includes the collective study of living things. Physical science in composed of chemistry, physics, astronomy and mathematics. Social science involves the relationships between man and the world. Informational science is identified as a study of knowledge and intelligence. Other integrative

sciences include those areas of modern science which utilize several scientific strands.

These identified areas of science serve as powerful and fundamental concepts which are foundational principle to agricultural education's body of knowledge. Collectively, many different scientific disciplines are drawn upon to formulate the discipline of agricultural education. A powerful and fundamental concept serves as the core intelligence of study. This study attempted to identify the future competencies of beginning teachers as related to each of the powerful and fundamental concepts of biological, physical, social, informational, and other integrative sciences.

The discipline of agricultural education is evolving as our society moves forward from an industrial-manufacturing economy to a knowledge economy. The purpose and intent of agricultural education has always been to meet the educational needs of the day (Meyer, 1999). State teacher credentialing agencies struggle to keep pace with the current demands of teacher preparation and education. More often than not, current teacher education programs are offering inadequate teacher preparation and training programs (NCES, 1999). Presently, there is no subject matter assessment for Texas candidates of agricultural science teacher certification; therefore, the agricultural systems competencies of agricultural science teachers

are defined by each individual teacher education institution, causing a large degree of variation in teacher training (SBEC, 2002).

Currently, there is no content assessment of agricultural science teacher candidate's knowledge of agricultural systems knowledge. Agricultural systems competencies are defined as agricultural science topics that are technical and or scientific in nature. In the past, state teacher credentialing agencies have required completion of specific course credit before individuals were recommended for certification in agricultural science. Because agricultural education has evolved to meet the needs of society, future competencies must be investigated to allow the discipline to keep pace. Many states have moved to a results-based teacher education model with little specific direction related to the technical knowledge necessary to teach the subject matter content. Most recommending institutions of agricultural science require the completion of courses similar to what was required in the past. Bruening, Scanlon, and Hodes (2001) explain that these past course requirements are the remains of an older production-manufacturing era of society. It is evident that the purpose and scope of contemporary agricultural science has shifted away from the production model (NCAE, 1999). It is the purpose of this study to investigate the future agricultural systems competencies

necessary for beginning agricultural science teachers at the secondary education level.

As agricultural education enters the new millennium, many new challenges must be confronted and overcome. According to Herren and Hillison (1996), the past reveals that agricultural education was created as a means of providing sound scientific technical training to its clientele. This is evident at all levels of agricultural education, ranging from secondary education to adult education, as well as international agricultural development. It is apparent that the strength of our nation was conceived in its ability to maintain a self-sustaining food supply. This becomes obvious as one investigates the condition of third world countries that intensely struggle to feed themselves and maintain a viable economy. This study assumes the importance of agricultural education as significant, and attempts to discover new and innovative ways to meet the demands of its contemporary clientele.

In order for us to understand the future needs of agricultural science, a comprehensive understanding of the past is necessary. Agricultural education has been an integral component of the exponential growth of our American economy for more than one-hundred years. Formal education in agriculture largely began with the passage of the Morrill Land Grant Act in 1862. Justin Morrill and

others understood that the United States' economy needed to build a solid infrastructure which included a strong agricultural and industrial base (Meyer, 1999). From this foundation, other industries and businesses began to flourish. The original intent of the Morrill Act was to meet the educational needs of the day (Meyer, 1999). Many scholars believe that the American college and university system is superior to other educational systems in the world. Because of the inclusion of agricultural education in the development of our nation's foundation, our nation's economy has grown to an economic powerhouse.

The decision of who would become the first generation of secondary level agricultural education teachers was raged between the agricultural scientists and many others. According to Hillison, "some wanted to convert nature-study teachers, others wanted to convert science teachers, some wanted to take the best farmers and make teachers out of them while others wanted to use colleges of agriculture graduates as teachers" (1987, p 11). Those who wanted a scientific curriculum with a common pedagogical methodology won the debate. The obvious place to turn to was the land grant college system, as it had an existing scientific base from which educational programming could be derived. This was a pivotal point in the history of agricultural education. When comparing agricultural education to

other disciplines in career education, an obvious distinction exists. Today, many career education teacher preparation programs require several years of work-related experience in lieu of technical or scientific course work as part of the credentialing process. In contrast, agricultural educators typically are required to have a bachelor's degree in a scientific agricultural field with specific pedagogical training. Until recently, many state education agencies required very specific credit hour requirements for agricultural education pre-service students. It appears that the distinction of work experience verses course credit comes from the remittance of the agricultural scientist influence on teacher education.

There have been a multitude of studies performed related to agricultural education teacher professional development competencies; however, there is little research related to technical competencies of beginning agricultural teachers. Currently, teacher credentialing agencies assume that technical competencies of beginning teachers are gained by satisfying the requirements of a bachelor's degree in a scientific field related to agriculture. This creates a unique dilemma for non-agricultural degreed individuals seeking agricultural education certification. Because the discipline of agricultural education is confronted with a shortage of certified teachers, it behooves the discipline to accommodate both the

secondary schools in need of teachers and non-agricultural degreed agricultural education teacher candidates (Camp, 2000). Because teacher quality is of paramount concern to teacher preparation, there must exist as a check and balance of agricultural systems competencies with the supply of qualified beginning agricultural teachers.

In order to determine the foundational technical competencies of agricultural science, it is necessary to investigate what essentials are required to teach agricultural science. The grand theoretical base of teaching is founded in the concept that teachers must be knowledgeable of the subject content they are teaching in order to successfully teach the content to others (Camp, 2001). It is from this theory base that teacher preparation programs have evolved. Bartlett (2002) identifies traditional courses from academic institutions, distance courses, work experience, and professional development as four areas in which postsecondary career and technology teachers gain technical preparation. Because agricultural education technical competencies have changed dramatically in the past it is safe to assume that technical competencies of the future will continue to change.

Recommendations

The findings of this research study reveal the need for several recommendations for the advancement of agricultural science teacher preparation. Cooper and Layard (2001) stated that our future society will be much more technologically and sociologically advanced, therefore requiring teacher preparation institution and state agencies associated with teacher preparation to develop new and innovative programs to better prepare tomorrow's educator.

Following is a listing of specific recommendations for the preparation of future beginning agricultural science teachers (BAST):

1 It is recommended that the results of this study be provided to the State Board of Educator Certification-Standards Development Committee for Agricultural Science and Technology. That the results of this study be used by the committee in the development of the new standards for beginning agricultural science teachers (BAST). To facilitate this recommendation, the concluding competencies from this study have been categorized into the two distinct groupings of "highly recommended" and "recommended". The first grouping of competencies is composed of seventeen (17) "highly recommended" topics that are a consensus between both expert groups (see Table 27). It is the desire of the researcher that the SBEC incorporate each

of these seventeen (17) “highly recommended” topics in the standards for future beginning agricultural science teachers (BAST).

Table 27
Highly Recommended Topics for BAST

Highly Recommended Topic	EDU Agricultural Systems Competency	ADM Agricultural Systems Competency
Anatomy and physiology of animals.	Basic animal anatomy. Anatomy and physiology of animals.	Anatomy of animals-how life is sustained; cell growth. Animal anatomy and physiology.
Breeds of livestock.	Breeds and types of livestock, and non-livestock farm animals.	Breeds of livestock.
Animal nutrition.	Animal feeds, feeding, and nutrition.	Animal health and nutritional resources Animal nutrition.
Animal reproduction.	Animal reproduction.	Animal genetics and reproduction. Plant and animal reproduction.
Soil science.	Soil structures. Soil types and classes.	Soil Science; formations and types. Soil classification systems. Soil textures. Soil profiles. Soil classes.

Table 27 Continued

Highly Recommended Topic	EDU Agricultural Systems Competency	ADM Agricultural Systems Competency
Plant science.	Plant growth.	Plant Science; fertilizers, minerals, inorganic and organic. Chemical properties associated with plant and animal production. Photosynthesis. Inorganic and organic fertilizers.
Agricultural engineering.	Basic principles of electricity. Basic principles of power and hand tools. Basic principles of shop safety. Basic principles of motors. Basic principles of engines. Basic principles of metal fabrication.	Basic engineering physics for shop projects. Welding; gas and electrical. Engines and power supplies; internal combustion engines. Electricity; basic terms and principals.
Water management.	Water quality.	Water requirements of plants.
Leadership skills.	Leadership and leadership styles.	How leaders function and how they operate. Concepts associated with being a leader. Characteristics of effective leadership. FFA activities; career development events. Principles of parliamentary law. Concepts associated with problem solving.

Table 27 Continued

Highly Recommended Topic	EDU Agricultural Systems Competency	ADM Agricultural Systems Competency
Social skills.	Individual social skills. Character education.	Social skills and self discipline.
Community relations.	Community relations. Working with adverse individuals and groups.	The role of citizenship in our society.
Learning styles.	Learning styles.	Learning styles. Learning abilities.
Employment skills.	Ethics. Career preparation. Manners and etiquette. Human behavior.	Employment characteristics. Employer and employee responsibilities Team work and team building.
Communication skills.	Types of communication	Interpersonal communications skills
Data management.	Basic recordkeeping. Budgeting	Computer technology in recordkeeping. Recordkeeping skills. Understanding data collection and the interpretation of data. The concept of data application and its use in problem solving.
Self improvement.	Problem solving skills. Goal setting skills. Time management.	Ethics and how they impact our society. Ethics in the workplace. Concepts of effective leadership. Public speaking. Resume writing, interviewing

Table 27 Continued

Highly Recommended Topic	EDU Agricultural Systems Competency	ADM Agricultural Systems Competency
Information technology.	Ability to access information in ways to solve daily problems and issues. Information technology skills. Internet, email and other electronic communication skills. Computer application skills related to agricultural education.	The use of information technology in agriculture. Ways to integrate the internet and email to communicate. How information is gathered.

The second grouping of competencies is composed of six (6) "recommended" topics that are concluded from one of the two expert groups, and are identified in the literature as an emerging theme which have future implications for agricultural science and technology (see Table 28). Because of the overwhelming presence in the literature for these emerging themes, it is the desire of the researcher that the SBEC incorporate each of these six (6) "recommended" topics in the standards for future beginning agricultural science teachers (BAST).

Table 28
Recommended Topics for BAST

Recommended Topic[a]	Agricultural Systems Competency	Expert Group
The future role of biotechnology in agriculture.	Agricultural biotechnology. The future role of genetics in the production of plants and animals.	ADM
Horticulture and floricultural science.	Horticulture/Floriculture	ADM
Meteorology.	The influence of weather on production agriculture.	ADM
Customer Service.	The development of consumer products. Advertising and marketing of agricultural products.	ADM ADM
World Agriculture.	Global affairs that effect agriculture.	ADM
Integration of agriculture.	Relationships between basic academic and agricultural science.	ADM

Note. [a]Recommended topics have been identified in the literature from Bartlett (2002), Bruening & Scanlon (2001), Connors (1998), Day (1996), Erickson (2002), Findlay (1992), Frantz (1997), Hoyle (1995), Meyer (1998), Mc Caslin (2002), NCAE (1999), Paul (1995), Pritchett (1997), Rojewski (2002), Yeung, et. al (1996).

2 The State Board of Educator Certification (SBEC) should use the results and recommendations of this study to develop new standards for agricultural science and technology teacher certification, and that these new standards should be incorporated into the new TExES assessment instrument used to asses a candidate's knowledge of the subject matter associated with agricultural science and technology.

3 Because of the variation that exists among the educator preparation institutions across the state, it is recommended that Texas agricultural science teacher preparation institutions take the appropriate measures to insure that course content provided to BASTs related to agricultural systems be current, relevant and futuristic in nature, and that the agricultural systems and related technical course content taught at a respective institution include both the “highly recommended” and “recommended” topics for BASTs (see Tables 27 and 28).

Recommendations for Additional Research

Because of the limitations of this study, there are three recommendations for additional research. This study represents an initiation of an entire body of research within the discipline of agricultural education. After a review of the literature, the researcher determined that a void exists in the discipline of agricultural education related to agricultural systems and technical scientific content related to the preparation of beginning Texas secondary agricultural science teachers.

1 The completion of additional studies with a similar format that includes expert panelists from business and industry related to agricultural education. It is assumed that any career preparation program would develop objectives and standards that are closely

aligned to the needs of business and industry; however, through the evolution of agricultural science over the past several decades, the gap between education and industrial demand has widened. With the solicitation of business and industry professionals as part of additional studies, a triangulation of the results of this study could be achieved.

2 Further studies to gain understand of the difference that exists between the responses of educators and administrators of agricultural education programs. The conclusions of this study revealed an obvious difference between the responses of educators and administrators of agricultural education programs. There are many implications that can be assumed from this difference. The research concluded that each of the two groups possessed different responses to a similar set of questions, “what are the competencies needed by beginning agricultural science teachers?” Additional study of these two groups would allow researchers to gain insight of other related interactive effects.

3 Additional study of what other states’ use as their future agricultural systems competencies for beginning agricultural science teachers. Because vocational education is designed to meet the specific educational demands of a local community, it is assumed that the future technical competencies of beginning agricultural teachers of

other states will be different than the needs of Texas. The future demands of technological and sociological advancement are not unique to Texas, but the colloquial demands of career preparation typically are; therefore the implications of these demands on other states' teacher preparation programs should be studied.

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APPENDIX A

ROUND-ONE

October 25, 2002

Dear <firstname>,<lastname>,

You have been nominated to participate in a study to determine the future competencies of beginning agricultural science teachers. The study will be composed of two groups, one with teachers and university faculty, and the other with school administrators. Each group will be composed of approximately fifteen educators. Because of your reputation as an outstanding educator, you have been selected to participate in the administrators group. This study is being conducted for the completion of my doctoral degree in Agricultural Education at Texas A&M University.

The Delphi Techniques will be used to collect your responses. If you are not familiar with this technique, do not worry, the process is very simple and requires minimal time for completion. The study will be composed of four questionnaires each taking approximately thirty minutes to complete. The first questionnaire will ask your opinion of the future competencies of agricultural science teachers. The second questionnaire will be composed from the responses of the first questionnaire. The third and fourth questionnaire will be developed using this same technique. The objective is to refine everyone's responses until a consensus is reached. Your responses will be kept confidential.

There will never be a face to face meeting of the participants. You will not need to travel. All communication and correspondence will be conducted through mail and email. Email will serve as the primary means of communication outside of the questionnaire itself. It is very important that each participant have access to email. The tentative timeline for the study is listed below:

October 31, 2002	First Round Questionnaire Sent
November 15, 2002	First Round Questionnaire Due
November 27, 2002	Second Round Questionnaire Sent
December 6, 2002	Second Round Questionnaire Due
January 2, 2002	Third Round Questionnaire Sent
January 10, 2002	Third Round Questionnaire Due
January 23, 2003	Fourth Round Questionnaire Sent (Only if Needed)
January 31, 2003	Fourth Round Questionnaire Due
February 14, 2003	Preliminary Results Sent to Panelist

Please confirm your acceptance or rejection of participation in this study by sending me the enclosed green colored consent form. Upon receiving your consent form, I will send you the first round questionnaire. Thank you in advance for your willingness to participate in this very important research study. Your contribution to the discipline of Agricultural Education is greatly appreciated.

Sincerely,

Timothy Rocka
Graduate Student

October 25, 2002

Dear <firstname>,<lastname>,

You have been nominated to participate in a study to determine the future competencies of beginning agricultural science teachers. The study will be composed of two groups with approximately fifteen innovative educators. Because of your active membership on the SBEC Standards Committee for Agricultural Science and Technology, you have been selected for this study. This study is being conducted for the completion of my doctoral degree in Agricultural Education at Texas A&M University.

The Delphi Techniques will be used to collect your responses. If you are not familiar with this technique, do not worry, the process is very simple and requires minimal time for completion. The study will be composed of four questionnaires each taking approximately thirty minutes to complete. The first questionnaire will ask your opinion of the future competencies of agricultural science teachers. The second questionnaire will be composed from the responses of the first questionnaire. The third and fourth questionnaire will be developed using this same technique. The objective is to refine everyone's responses until a consensus is reached. Your responses will be kept confidential.

There will never be a face to face meeting of the participants. You will not need to travel. All communication and correspondence will be conducted through mail and email. Email will serve as the primary means of communication outside of the questionnaire itself. It is very important that each participant have access to email. The tentative timeline for the study is listed below:

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Please confirm your acceptance or rejection of participation in this study by sending me the enclosed green colored consent form. Upon receiving your consent form, I will send you the first round questionnaire. Thank you in advance for your willingness to participate in this very important research study. Your contribution to the discipline of Agricultural Education is greatly appreciated.

Sincerely,

Timothy Rocka
Graduate Student

October 25, 2002

Dear Panelist,

Thank you for agreeing to participate in this study to determine the beginning competencies of agricultural science teachers. Please fill out the following descriptive information, as it will be useful in understanding your results.

Directions: Please circle the appropriate response or FILL IN the information in the blank provided. All information will be held in the strictest confidence.

1. What is your age category?
    a. 21 - 30
    b. 31 - 40
    c. 41 - 50
    d. 51 - 60
    e. 61 or older

2. What is your gender?

    a. a. male b. female

3. Professional experience.

    Public School Teaching _____ years
    Public School Administration _____ years
    University Level Teaching _____ years
    Other Professional Experience _____ years

4. What is your highest education level completed?

    a. Bachelor's Degree
    b. Master's Degree
    c. Doctoral Degree
    d. Other: _____

5. Please indicate your current employment position.

    a. Secondary Agricultural Teacher
    b. Pubic School Administrator
    c. Teacher Educator
    d. Other _____

Please sign and date this letter as it will act as you official consent to participate in this study. Please return this form in the enclosed self-addressed stamped envelope.

Signature of panelist date

Agricultural Systems Competencies for Beginning Agricultural Science Teachers
Round-One

Part I: Operational Details

Introduction

The purpose of this study is to identify the future agricultural systems technical competencies needed by beginning agricultural science teachers. An agricultural system competency is defined as a scientific or technical set of knowledge and skills associated with agriculture. Examples may include animal reproduction, irrigation systems, or global positioning satellite (GPS) technology.

Powerful and Fundamental Concepts

You are asked to record responses for each of the five powerful and fundamental conceptual areas identified for Agricultural Science and Technology. Each powerful and fundamental concept has been identified as an area of study within the discipline of Agricultural Education. Your responses should identify the topics within each conceptual area. Please remember that the study is attempting to identify the future competencies needed by a beginning Agricultural Science Teacher for each conceptual area.

Please remember that you do not have to be an expert in every conceptual area on this survey. You may have a great deal of knowledge in only one or two given areas; therefore, you should not feel compelled to complete every area in its entirety. Remember, there will be approximately thirty participants involved in this study who represent a diverse knowledge base of agriculture. The result of this study will represent the collective work of the entire panel of experts. Try to focus on identifying the future competencies of a **beginning** agricultural science teacher who is just entering the classroom.

Scope

Please record your responses in the table below each conceptual statement. You are asked to provide topics associated with each conceptual area with comments that further explain the meaning of your topic. The scope of the topic should equal a typical teaching unit (about one week) in length. This scope follows the current curriculum guides for Agricultural Science and Technology. By no means should you feel it necessary to provide an exhausted list of topics. Please concentrate on the future competencies needed by a BEGINNING TEACHER. If additional space is needed, use additional paper or write on the back of the questionnaire.

Completion

After you have completed the questionnaire, please return it using the self-addressed stamped envelope enclosed. **The deadline for returning the Round-One questionnaire is November 15, 2002.** If you have questions, please contact me at your convenience at trocka@brenhamisd.net or call 979-277-6507.

Thank you in advance for your diligence in completing this questionnaire. I will be in contact with you within a few weeks! Round two will be sent in late November.

Part II: Agricultural Systems Competencies

Conceptual Area I: Biological Science

Definition
Biological Science: the scientific study of living things, which include animals, plants, and other living organisms and can include those things which are closely associated with living organisms.

Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the biological sciences.

Directions: Please record your responses in the table below. If you need additional space, you may use the back of this page.

Biological Science BAST Competencies	Your Comments

Conceptual Area II: Physical Science

Definition
Physical Science: the scientific study of non-living things including physics, chemistry, and astronomy.

Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the physical sciences.

Directions: Please record your responses in the table below. If you need additional space, you may use the back of this page.

Physical Science BAST Competencies	Your Comments

Conceptual Area III: Social Science

Definition
Social Science: the scientific study of human society and the interpersonal relationships of people.

Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the social sciences.

Directions: Please record your responses in the table below. If you need additional space, you may use the back of this page.

Social Science BAST Competencies	Your Comments

Conceptual Area IV: Informational Science

Definition
Informational Science: the scientific study of knowledge and intelligence as related to society.

Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the informational sciences.

Directions: Please record your responses in the table below. If you need additional space, you may use the back of this page.

Informational Science BAST Competencies	Your Comments

Definition
Other Integrative Science: the scientific approach of incorporating areas of relationship to one another.

Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the other integrative sciences.

Directions: Please record your responses in the table below. If you need additional space, you may use the back of this page.

Other Integrative Science BAST Competencies	Your Comments

Dear Expert Panelist,

Thanks for your commitment to the Beginning Agricultural Science Teachers Competency Study. This is just a reminder that the Round-two Questionnaire is due. The deadline for completing the survey is January 24 2002. Please take a moment to complete the instrument and return it as soon as possible. Round-three is schedule to be sent in two weeks.

If you have already sent in Round-Two, please disregard this reminder.
Thanks for your help!

Tim Rocka,
Graduate Student
Texas A&M University

October 31, 2002

Dear <firstname>, <lastname>,

You should have received an invitation letter to participate in a study of future competencies of beginning agricultural science teachers. It was sent October 25, 2002, requesting your participation in the study.

This letter will serve as a follow-up invitation again soliciting your participation. Enclosed you will find a copy of the original invitation, which outlined the study in detail, a consent form, a data sheet, and the round-one questionnaire. Please update the data sheet as necessary, fill-out the consent form, and return both of these items in the enclosed self-addressed stamped envelop along with your completed questionnaire.

If you have received this letter after having already sent in a consent form, please disregard this second notice; however, please do take time to complete the enclosed round-one questionnaire.

It should take approximately thirty minutes to fill-out the enclosed questionnaire. It is due November 15, 2002. Your time and attention to this matter is greatly appreciated. Thank you for your contribution to the advancement of Texas Agricultural Education.

Sincerely,

Tim Rocka
Graduate Student

APPENDIX B

ROUND-TWO

January 3, 2003

Dear Expert Panelist,

I hope you are starting a delightful New Year. Thanks for your contribution to the Round-One Questionnaire of Beginning Agricultural Science Teacher Competencies. Round-One was our greatest challenge as the remaining two questionnaires work to refine your responses. Our timeline has changed. Because of a need for extended time for some, Round-One was not completed until mid-December, and with the Holidays, time has marched forward. My desire is to have this Round-Two Questionnaire completed before the end of January 2003, and sometime shortly after, Round-Three will be sent which will conclude our study.

Enclosed is the Round-Two Questionnaire. Please rate your degree of agreement or disagreement for each of the competencies listed. If you feel that a competency should be moved to another conceptual area, please respond using the move column. If you desire to explain why you rated a specific competency, please write your comments in the column provided. Finally, should you determine that we have left something out, please record any additional competencies you feel appropriate using Part B of each Conceptual Area (if you have no additional competencies, just leave it blank). Please remember that a Round-Three Questionnaire will be sent, which will allow you the opportunity to confirm your ratings.

After completing the questionnaire, please return it in the self addressed stamped envelop enclosed. The Round-Two Questionnaire is due January 24, 2003. Thanks in advance for your assistance in shaping the future of Agricultural Education.

Sincerely,

Tim Rocka,
Graduate Student

Round-Two (ADM)
Conceptual Area I: Biological Science

Definition
Biological Science: the scientific study of living things, which include animals, plants, and other living organisms and can include those things which are closely associated with living organisms.

Part A. Competency Rating

Directions: Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the BIOLOGICAL SCIENCES by recording your degree of agreement or disagreement with each competency as it relates to the conceptual area of BIOLOGICAL SCIENCE using a Scale of 1 to 6(1-strongly disagree to 6-strongly agree). Should you feel that a competency needs to be moved under another conceptual area, please indicate that conceptual area in the move Column.

Rating Scale

1-Strongly Disagree 2-Disagree 3-Somewhat Disagree 4-Somewhat Agree 5-Agree 6-Strongly Agree

No.	Biological Science BAST Competency	Rating Scale	Your Comments	Move to Conceptual Area
1.	Anatomy of Animals-how life is sustained, cell growth	1 2 3 4 5 6		
2.	Plant and Animal Reproduction	1 2 3 4 5 6		
3.	The future role of genetics in the production of plants and animals	1 2 3 4 5 6		
4.	Global impact of Biological Science	1 2 3 4 5 6		

5.	The economics of higher level production through improved biology	1 2 3 4 5 6		
6.	Biotechnology and its future in our society	1 2 3 4 5 6		
7.	Animal Anatomy and Physiology	1 2 3 4 5 6		
8.	Animal genetics and reproduction	1 2 3 4 5 6		
9.	Food and fiber production	1 2 3 4 5 6		
10.	Environmental Knowledge	1 2 3 4 5 6		
11.	Breeds of Livestock	1 2 3 4 5 6		
12.	Broad based knowledge of specialty animals-canine, avian, tropical fish: Applicable in urban environment.	1 2 3 4 5 6		
13.	Plants and Soil Science	1 2 3 4 5 6		
14.	Entomology	1 2 3 4 5 6		
15.	Agricultural Biotechnology	1 2 3 4 5 6		

16.	Environmental and Natural Resources Systems	1 2 3 4 5 6		
17.	Animal Physiology Systems; cardiovascular, nervous.	1 2 3 4 5 6		
18.	Animal health and nutritional resources	1 2 3 4 5 6		
19.	Agricultural Chemicals	1 2 3 4 5 6		
20.	Microbiology	1 2 3 4 5 6		
21.	Skeletal Systems	1 2 3 4 5 6		
22.	Animal Nutrition	1 2 3 4 5 6		
23.	Animal Health and Parasites	1 2 3 4 5 6		
24.	Artificial Insemination/Embryo Transfer	1 2 3 4 5 6		
25.	Horticulture/Floriculture	1 2 3 4 5 6		

Part B. ADDITIONAL COMPETENCIES

Directions: Please identify any additional competencies that you feel should be included under the BIOLOGICAL SCIENCE CONCEPTUAL AREA.

Biological Science BAST Competencies	**Your Comments**

Physical Science: the scientific study of non-living things including physics, chemistry, and astronomy.

Part A. Competency Rating

Directions: Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the PHYSCIAL SCIENCE by recording your degree of agreement or disagreement with each competency as it relates to the conceptual area of PHYSICAL SCIENCE using a Scale of 1 to 6(1-strongly disagree to 6-strongly agree). Should you feel that a competency needs to be moved under another conceptual area, please indicate that conceptual area in the move Column.

Rating Scale

1-Strongly Disagree 2-Disagree 3-Somewhat Disagree 4-Somewhat Agree 5-Agree 6-Strongly Agree

No.	Physical Science BAST Competency	Rating Scale	Your Comments	Move to Conceptual Area
1.	Soil Science; formations and types	1 2 3 4 5 6		
2.	Plant Science; Fertilizers, minerals, inorganic and organic	1 2 3 4 5 6		
3.	Earth Science; Weather conditions/planning seasons	1 2 3 4 5 6		
4.	Feed rations/ feed additives	1 2 3 4 5 6		
5.	Welding; gas and electrical	1 2 3 4 5 6		

6.	Basic engineering physics for shop projects	1 2 3 4 5 6		
7.	Chemical properties associated with plant and animal production	1 2 3 4 5 6		
8.	The influence of weather on production agriculture.	1 2 3 4 5 6		
9.	Modern technology used to influence weather.	1 2 3 4 5 6		
10.	Physical concepts associated with power systems.	1 2 3 4 5 6		
11.	Physical concepts associated with moon phases and climatology.	1 2 3 4 5 6		
12.	Environmental issues facing our future generations.	1 2 3 4 5 6		
13.	Global warming and its effect on agriculture.	1 2 3 4 5 6		
14.	The interaction of the physical environment with basic living organisms.	1 2 3 4 5 6		
15.	Water requirements of plants.	1 2 3 4 5 6		
16.	Soil classification systems.	1 2 3 4 5 6		
17.	Inorganic and organic fertilizers.	1 2 3 4 5 6		

18.	The development of consumer products.	1 2 3 4 5 6		
19.	General physic; Industrial, engineering, and manufacturing concepts.	1 2 3 4 5 6		
20.	Soil Structures	1 2 3 4 5 6		
21.	Soil Textures	1 2 3 4 5 6		
22.	Photosynthesis	1 2 3 4 5 6		
23.	Soil Profiles	1 2 3 4 5 6		
24.	Soil Classes	1 2 3 4 5 6		
25.	Electricity; Basic terms and principals.	1 2 3 4 5 6		
26.	Engines and power supplies; internal combustion engines.	1 2 3 4 5 6		

Part B. ADDITIONAL COMPETENCIES

Directions: Please identify any additional competencies that you feel should be included under the PHYSICAL SCIENCE CONCEPTUAL AREA.

Physical Science BAST Competencies	**Your Comments**

Conceptual Area III: Social Sciences

Social Science: the scientific study of human society and the interpersonal relationships of people.

Part A. Competency Rating

Directions: Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the SOCIAL SCIENCE by recording your degree of agreement or disagreement with each competency as it relates to the conceptual area of SOCIAL SCIENCE using a Scale of 1 to 6(1-strongly disagree to 6-strongly agree). Should you feel that a competency needs to be moved under another conceptual area, please indicate that conceptual area in the move Column.

Rating Scale

1-Strongly Disagree 2-Disagree 3-Somewhat Disagree 4-Somewhat Agree 5-Agree 6-Strongly Agree

No.	Social Science BAST Competency	Rating Scale	Your Comments	Move to Conceptual Area
1.	History of Agriculture	1 2 3 4 5 6		
2.	Impact and Structure of Local Governments	1 2 3 4 5 6		
3.	FFA Activities; Career Development Events	1 2 3 4 5 6		
4.	Community Organizations; The Impact of Booster Clubs and Major Shows	1 2 3 4 5 6		
5.	Governmental programs available for agriculture.	1 2 3 4 5 6		
6.	The functions of government, how it works and the political process.	1 2 3 4 5 6		

7.	Global affairs that effect agriculture.	1 2 3 4 5 6		
8.	The economics of agriculture; NAFTA, World Trading, the Stock Market, and Commodity Market.	1 2 3 4 5 6		
9.	Concepts associated with moving from dependence to independence to interdependence.	1 2 3 4 5 6		
10.	Understanding of emotional connections between individual, and how they shape relationships.	1 2 3 4 5 6		
11.	Concepts associated with being a leader. How leaders function and how they operate.	1 2 3 4 5 6		
12.	The role of citizenship in our society.	1 2 3 4 5 6		
13.	Principles of parliamentary law.	1 2 3 4 5 6		
14.	Principles of Democracy and how we keep it.	1 2 3 4 5 6		
15.	Team work and team building.	1 2 3 4 5 6		
16.	Characteristics of effective Leadership.	1 2 3 4 5 6		
17.	Proper etiquette.	1 2 3 4 5 6		

18.	Organizational structure and function	1 2 3 4 5 6		
19.	Employer and employee responsibilities	1 2 3 4 5 6		
20.	Interpersonal communications skills	1 2 3 4 5 6		
21.	Social skills and self discipline	1 2 3 4 5 6		
22.	Learning Styles	1 2 3 4 5 6		
23.	Learning Abilities	1 2 3 4 5 6		
24.	Employment Characteristics	1 2 3 4 5 6		

Part B. ADDITIONAL COMPETENCIES

Directions: Please identify any additional competencies that you feel should be included under the SOCIAL SCIENCE CONCEPTUAL AREA.

Social Science BAST Competencies	**Your Comments**

Conceptual Area IV: Informational Sciences

Informational Science: the scientific study of knowledge and intelligence as related to society.

Part A. Competency Rating

Directions: Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the INFORMATIONAL SCIENCES by recording your degree of agreement or disagreement with each competency as it relates to the conceptual area of INFORMATIONAL SCIENCE using a Scale of 1 to 6(1-strongly disagree to 6-strongly agree). Should you feel that a competency needs to be moved under another conceptual area, please indicate that conceptual area under the move column.

Rating Scale

1-Strongly Disagree 2-Disagree 3-Somewhat Disagree 4-Somewhat Agree 5-Agree 6-Strongly Agree

No.	Informational Science BAST Competency	Rating Scale	Your Comments	Move to Conceptual Area
1.	Computer Technology in recordkeeping	1 2 3 4 5 6		
2.	Use of Global Positioning Satellite Systems	1 2 3 4 5 6		
3.	Public Speaking.	1 2 3 4 5 6		
4.	How information is gathered.	1 2 3 4 5 6		
5.	Ethics and how they impact our society.	1 2 3 4 5 6		

6.	The concept of data application and its use in problem solving.	1 2 3 4 5 6		
7.	How knowledge is used in organizations	1 2 3 4 5 6		
8.	Concepts of effective leadership	1 2 3 4 5 6		
9.	Ethics in the workplace	1 2 3 4 5 6		
10.	Resume writing, interviewing	1 2 3 4 5 6		
11.	The integration of technology education with Agricultural Engineering.	1 2 3 4 5 6		
12.	The integration of business curriculum with Agricultural Communications.	1 2 3 4 5 6		
13.	Recordkeeping skills	1 2 3 4 5 6		
14.	Brain research; how different students learn.	1 2 3 4 5 6		
15.	The use of information technology in agriculture.	1 2 3 4 5 6		
16.	Ways to integrate the internet and email to communicate.	1 2 3 4 5 6		
17.	Understanding data collection and the interpretation of data	1 2 3 4 5 6		

Part B. ADDITIONAL COMPETENCIES

Directions: Please identify any additional competencies that you feel should be included under the INFORMATIONAL SCIENCE CONCEPTUAL AREA.

Informational Science BAST Competencies	**Your Comments**

Conceptual Area V: Other Integrative Sciences

Other Integrative Science: the scientific approach of incorporating areas of relationship to one another.

Part A. Competency Rating

Directions: Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the OTHER INTEGRATIVE SCIENCE by recording your degree of agreement or disagreement with each competency as it relates to the conceptual area of OTHER INTEGRATIVE SCIENCE using a Scale of 1 to 6(1-strongly disagree to 6-strongly agree). Should you feel that a competency needs to be moved under another conceptual area, please indicate that conceptual area in the move Column.

Rating Scale

1-Strongly Disagree 2-Disagree 3-Somewhat Disagree 4-Somewhat Agree 5-Agree 6-Strongly Agree

No.	Other Integrative Science BAST Competency	Rating Scale	Your Comments	Move to Conceptual Area
1.	The impact of Chemistry	1 2 3 4 5 6		
2.	Soft Skill Development	1 2 3 4 5 6		
3.	Advertising and marketing of agricultural products.	1 2 3 4 5 6		
4.	Concepts associated with problem solving.	1 2 3 4 5 6		
5.	Relationships between basic academic and agricultural science.	1 2 3 4 5 6		

6.	Concepts connected to scientific research.	1 2 3 4 5 6		
7.	Aquaculture, food science and wildlife; basic knowledge of how theses areas integrate.	1 2 3 4 5 6		
8.	Integrating areas of agricultural sciences with industrial licensure and certification.	1 2 3 4 5 6		
9.	The development of an Agricultural Science Fair.	1 2 3 4 5 6		
10.	The importance of cooperation, respect, and trust as related to students.	1 2 3 4 5 6		

Part B. ADDITIONAL COMPETENCIES

Directions: Please identify any additional competencies that you feel should be included under the OTHER INTEGRATIVE SCIENCE CONCEPTUAL AREA.

Other Integrative Science BAST Competencies	**Your Comments**

Round-Two (EDU)
Conceptual Area I: Biological Science

Definition
Biological Science: the scientific study of living things, which include animals, plants, and other living organisms and can include those things which are closely associated with living organisms.

Part A. Competency Rating

Directions: Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the BIOLOGICAL SCIENCES by recording your degree of agreement or disagreement with each competency as it relates to the conceptual area of BIOLOGICAL SCIENCE using a Scale of 1 to 6(1-strongly disagree to 6-strongly agree). Should you feel that a competency needs to be moved under another conceptual area, please indicate that conceptual area in the move Column.

Rating Scale

1-Strongly Disagree 2-Disagree 3-Somewhat Disagree 4-Somewhat Agree 5-Agree 6-Strongly Agree

No.	Biological Science BAST Competency	Rating Scale	Your Comments	Move to Conceptual Area
1.	Basic Animal Anatomy	1 2 3 4 5 6		
2.	Basic Animal Behaviors	1 2 3 4 5 6		
3.	Basic Animal Environments	1 2 3 4 5 6		
4.	Animal Feeds and Feeding, Nutrition	1 2 3 4 5 6		

5.	Plant Structures, Growth	1 2 3 4 5 6		
6.	Genetics: Plant and Animal	1 2 3 4 5 6		
7.	Genetics Engineering	1 2 3 4 5 6		
8.	Entomology	1 2 3 4 5 6		
9.	Aquaculture	1 2 3 4 5 6		
10.	Cloning	1 2 3 4 5 6		
11.	Food Safety	1 2 3 4 5 6		
12.	Animal Reproduction	1 2 3 4 5 6		
13.	Animal Systems, Digestive, respiratory, circulatory, nervous.	1 2 3 4 5 6		
14.	Breeds and Types of Livestock, and Non-Livestock farm animals	1 2 3 4 5 6		
15.	An understanding of artificial Insemination, cloning, embryo transfer.	1 2 3 4 5 6		

16.	Plant growth and structure	1 2 3 4 5 6		
17.	Bio-Security in Agricultural Systems	1 2 3 4 5 6		
18.	A Basic understanding of DNA Mapping for ID Purposes	1 2 3 4 5 6		
19.	Tissue Culture and other Mass Cloning Techniques	1 2 3 4 5 6		
20.	Plants and Soil Science	1 2 3 4 5 6		
21.	Selection of Livestock	1 2 3 4 5 6		
22.	Plant Identification	1 2 3 4 5 6		
23.	Anatomy and Physiology of Animals	1 2 3 4 5 6		
24.	Anatomy and Physiology of Plants	1 2 3 4 5 6		

Part B. ADDITIONAL COMPETENCIES

Directions: Please identify any additional competencies that you feel should be included under the BIOLOGICAL SCIENCE CONCEPTUAL AREA.

Biological Science BAST Competencies	**Your Comments**

Conceptual Area II: Physical Sciences

Physical Science: the scientific study of non-living things including physics, chemistry, and astronomy.

Part A. Competency Rating

Directions: Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the PHYSCIAL SCIENCE by recording your degree of agreement or disagreement with each competency as it relates to the conceptual area of PHYSICAL SCIENCE using a Scale of 1 to 6(1-strongly disagree to 6-strongly agree). Should you feel that a competency needs to be moved under another conceptual area, please indicate that conceptual area in the move Column.

Rating Scale

1-Strongly Disagree 2-Disagree 3-Somewhat Disagree 4-Somewhat Agree 5-Agree 6-Strongly Agree

No.	Physical Science BAST Competency	Rating Scale	Your Comments	Move to Conceptual Area
1.	Basic Principles of Engines	1 2 3 4 5 6		
2.	Basic Principles of Electricity	1 2 3 4 5 6		
3.	Basic Principles of Power and Hand Tools	1 2 3 4 5 6		
4.	Basic Principles of Shop Safety	1 2 3 4 5 6		
5.	Basic Principles of Motors	1 2 3 4 5 6		

6.	Basic Principles of Plumbing	1 2 3 4 5 6		
7.	Basic Principles of Metal Fabrication	1 2 3 4 5 6		
8.	Basic Principles of Wood Fabrication	1 2 3 4 5 6		
9.	Basic Principles of Concrete	1 2 3 4 5 6		
10.	Global Positioning Satellite Technology	1 2 3 4 5 6		
11.	Understanding of Natural Resources that are beginning to shrink.	1 2 3 4 5 6		
12.	Knowledge and understanding of GMO	1 2 3 4 5 6		
13.	Water Rights and Water Conservation	1 2 3 4 5 6		
14.	Alternative Fuel and their sources.	1 2 3 4 5 6		
15.	Food Production as derived from nutrients.	1 2 3 4 5 6		
16.	Structure and Composition of the Atmosphere	1 2 3 4 5 6		
17.	Global Climate	1 2 3 4 5 6		

18.	Acid Pollution	1 2 3 4 5 6		
19.	Groundwater	1 2 3 4 5 6		
20.	Water Quality	1 2 3 4 5 6		
21.	Soil Structures	1 2 3 4 5 6		
22.	Soil Types and Classes	1 2 3 4 5 6		
23.	Climate and Weather Patterns	1 2 3 4 5 6		
24.	Environmental Studies related to Agriculture	1 2 3 4 5 6		
25.	Plant Growth	1 2 3 4 5 6		

Part B. ADDITIONAL COMPETENCIES

Directions: Please identify any additional competencies that you feel should be included under the PHYSICAL SCIENCE CONCEPTUAL AREA.

Physical Science BAST Competencies	**Your Comments**

Conceptual Area III: Social Sciences

Social Science: the scientific study of human society and the interpersonal relationships of people.

Part A. Competency Rating

Directions: Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the SOCIAL SCIENCE by recording your degree of agreement or disagreement with each competency as it relates to the conceptual area of SOCIAL SCIENCE using a Scale of 1 to 6(1-strongly disagree to 6-strongly agree). Should you feel that a competency needs to be moved under another conceptual area, please indicate that conceptual area in the move Column.

Rating Scale

1-Strongly Disagree 2-Disagree 3-Somewhat Disagree 4-Somewhat Agree 5-Agree 6-Strongly Agree

No.	Social Science BAST Competency	Rating Scale	Your Comments	Move to Conceptual Area
1.	Working with Adverse Individuals and Groups	1 2 3 4 5 6		
2.	Individual Social Skills	1 2 3 4 5 6		
3.	Community Relations	1 2 3 4 5 6		
4.	Learning Styles	1 2 3 4 5 6		
5.	Ethics	1 2 3 4 5 6		
6.	Leadership and Leadership Styles	1 2 3 4 5 6		

7.	Human Behavior	1 2 3 4 5 6		
8.	Types of Communication	1 2 3 4 5 6		
9.	Personal Hygiene	1 2 3 4 5 6		
10.	Cultural Diversity and the way it influences food production and consumption.	1 2 3 4 5 6		
11.	Governmental intervention, local and foreign that affect agricultural production and consumption.	1 2 3 4 5 6		
12.	Policies and Politics of Agricultural Production	1 2 3 4 5 6		
13.	Ethical Concerns related to Food Production	1 2 3 4 5 6		
14.	Career Preparation	1 2 3 4 5 6		
15.	Manners and Etiquette	1 2 3 4 5 6		
16.	Character Education	1 2 3 4 5 6		

Part B. ADDITIONAL COMPETENCIES

Directions: Please identify any additional competencies that you feel should be included under the SOCIAL SCIENCE CONCEPTUAL AREA.

Social Science BAST Competencies	**Your Comments**

Conceptual Area IV: Informational Sciences

Informational Science: the scientific study of knowledge and intelligence as related to society.

Part A. Competency Rating

Directions: Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the INFORMATIONAL SCIENCES by recording your degree of agreement or disagreement with each competency as it relates to the conceptual area of INFORMATIONAL SCIENCE using a Scale of 1 to 6(1-strongly disagree to 6-strongly agree). Should you feel that a competency needs to be moved under another conceptual area, please indicate that conceptual area under the move column.

Rating Scale

1-Strongly Disagree 2-Disagree 3-Somewhat Disagree 4-Somewhat Agree 5-Agree 6-Strongly Agree

No.	Informational Science BAST Competency	Rating Scale	Your Comments	Move to Conceptual Area
1.	Basic Recordkeeping	1 2 3 4 5 6		
2.	Budgeting	1 2 3 4 5 6		
3.	Development and use of data bases	1 2 3 4 5 6		
4.	Ability to access information in ways to solve daily problems and issues	1 2 3 4 5 6		

5.	Problem Solving Skills	1 2 3 4 5 6		
6.	Goal Setting Skills	1 2 3 4 5 6		
7.	Information Technology Skills	1 2 3 4 5 6		
8.	Internet, email and other electronic communication skills	1 2 3 4 5 6		
9.	Computer application skills related to Agricultural Education	1 2 3 4 5 6		

Part B. ADDITIONAL COMPETENCIES

Directions: Please identify any additional competencies that you feel should be included under the INFORMATIONAL SCIENCE CONCEPTUAL AREA.

Informational Science BAST Competencies	**Your Comments**

Conceptual Area V: Other Integrative Sciences

Other Integrative Science: the scientific approach of incorporating areas of relationship to one another.

Part A. Competency Rating

Directions: Please identify the future competencies needed for beginning agricultural science teachers (BAST) that are associated with the OTHER INTEGRATIVE SCIENCE by recording your degree of agreement or disagreement with each competency as it relates to the conceptual area of OTHER INTEGRATIVE SCIENCE using a Scale of 1 to 6(1-strongly disagree to 6-strongly agree). Should you feel that a competency needs to be moved under another conceptual area, please indicate that conceptual area in the move Column.

Rating Scale

1-Strongly Disagree 2-Disagree 3-Somewhat Disagree 4-Somewhat Agree 5-Agree 6-Strongly Agree

No.	Other Integrative Science BAST Competency	Rating Scale	Your Comments	Move to Conceptual Area
1.	Managerial Skills	1 2 3 4 5 6		
2.	Time management	1 2 3 4 5 6		
3.	Goal Setting	1 2 3 4 5 6		
4.	The integration of many areas of Agriculture	1 2 3 4 5 6		

Part B. ADDITIONAL COMPETENCIES

Directions: Please identify any additional competencies that you feel should be included under the OTHER INTEGRATIVE SCIENCE CONCEPTUAL AREA.

Other Integrative Science BAST Competencies	**Your Comments**

Dear Expert Panelist,

Thanks for your commitment to the Beginning Agricultural Science Teachers Competency Study. This is just a reminder that the Round-Two Questionnaire is due. The deadline for completing the survey is January 24 2003. Please take a moment to complete the instrument and return it as soon as possible. Round-three is schedule to be sent in two weeks.

If you have already sent in Round-Two, please disregard this reminder. Thanks for your help!

Tim Rocka,
Graduate Student
Texas A&M University

APPENDIX C

ROUND-THREE

February 21, 2003

Dear Expert Panelist,

Enclosed is the Round-Three Questionnaire of Future Competencies of Beginning Agricultural Science Teachers. This is the final questionnaire of the study. Please confirm your degree of agreement or disagreement for each of the competencies listed by placing a Y or N as your response. Several competencies have been removed as a consensus from the group was not reached on every competency.

After completing the questionnaire, please return it in the self addressed stamped envelope enclosed. The Round-Three Questionnaire is due March 7, 2003. Later this spring, I will send each panelist a copy of the final analysis of the study. Thanks in advance for your assistance in shaping the future of Agricultural Education.

Sincerely,

Tim Rocka,
Graduate Student

Round-Three (ADM)
Conceptual Area I: Biological Science

Definition
Biological Science: the scientific study of living things, which include animals, plants, and other living organisms and can include those things which are closely associated with living organisms.

Directions: Please confirm your response by placing a Y (yes) or N (no) in the confirmation column. Placing a Y will indicate your agreement that the specific competency is one needed by a BAST. Placing an N will indicate you do not agree that the specific competency is needed by a BAST.

No.	Biological Science BAST Competency	Confirmation Y or N	Your Comments
1.	Anatomy of Animals-how life is sustained, cell growth		
2.	Plant and Animal Reproduction		
3.	The future role of genetics in the production of plants and animals		
7.	Animal Anatomy and Physiology		
8.	Animal genetics and reproduction		
11.	Breeds of Livestock		
13.	Plants and Soil Science		
15.	Agricultural Biotechnology		
18.	Animal health and nutritional resources		
22.	Animal Nutrition		

23.	Animal Health and Parasites		
25.	Horticulture/Floriculture		

Conceptual Area II: Physical Sciences

Physical Science: the scientific study of non-living things including physics, chemistry, and astronomy.

Directions: Please confirm your response by placing a Y (yes) or N (no) in the confirmation column. Placing a Y will indicate your agreement that the specific competency is one needed by a BAST. Placing an N will indicate you do not agree that the specific competency is needed by a BAST.

No.	Physical Science BAST Competency	Confirmation Y or N	Your Comments
1.	Soil Science; formations and types		
2.	Plant Science; Fertilizers, minerals, inorganic and organic		
4.	Feed rations/ feed additives		
5.	Welding; gas and electrical		
6.	Basic engineering physics for shop projects		
7.	Chemical properties associated with plant and animal production		
8.	The influence of weather on production agriculture.		
15.	Water requirements of plants.		
16.	Soil classification systems.		

17.	Inorganic and organic fertilizers.		
18.	The development of consumer products.		
21.	Soil Textures		
22.	Photosynthesis		
23.	Soil Profiles		
24.	Soil Classes		
25.	Electricity; Basic terms and principals.		
26.	Engines and power supplies; internal combustion engines.		

Conceptual Area III: Social Sciences

Social Science: the scientific study of human society and the interpersonal relationships of people.

Directions: Please confirm your response by placing a Y (yes) or N (no) in the confirmation column. Placing a Y will indicate your agreement that the specific competency is one needed by a BAST. Placing an N will indicate you do not agree that the specific competency is needed by a BAST.

No.	Social Science BAST Competency	Confirmation Y or N	Your Comments
1.	History of Agriculture		
3.	FFA Activities; Career Development Events		
7.	Global affairs that effect agriculture.		

11.	Concepts associated with being a leader. How leaders function and how they operate.		
12.	The role of citizenship in our society.		
13.	Principles of parliamentary law.		
15.	Team work and team building.		
16.	Characteristics of effective Leadership.		
19.	Employer and employee responsibilities		
20.	Interpersonal communications skills		
21.	Social skills and self discipline		
22.	Learning Styles		
23.	Learning Abilities		
24.	Employment Characteristics		

Conceptual Area IV: Informational Sciences

Informational Science: the scientific study of knowledge and intelligence as related to society.

Directions: Please confirm your response by placing a Y (yes) or N (no) in the confirmation column. Placing a Y will indicate your agreement that the specific competency is one needed by a BAST. Placing an N will indicate you do not agree that the specific competency is needed by a BAST.

No.	Informational Science BAST Competency	Confirmation Y or N	Your Comments
1.	Computer Technology in recordkeeping		
2.	Use of Global Positioning Satellite Systems		
3.	Public Speaking.		
4.	How information is gathered.		
5.	Ethics and how they impact our society.		
6.	The concept of data application and its use in problem solving.		
7.	How knowledge is used in organizations		
8.	Concepts of effective leadership		
9.	Ethics in the workplace		
10.	Resume writing, interviewing		

13.	Recordkeeping skills		
15.	The use of information technology in agriculture.		
16.	Ways to integrate the internet and email to communicate.		
17.	Understanding data collection and the interpretation of data		

Conceptual Area V: Other Integrative Sciences

Other Integrative Science: the scientific approach of incorporating areas of relationship to one another.

. Directions: Please confirm your response by placing a Y (yes) or N (no) in the confirmation column. Placing a Y will indicate your agreement that the specific competency is one needed by a BAST. Placing an N will indicate you do not agree that the specific competency is needed by a BAST.

No.	Other Integrative Science BAST Competency	Confirmation Y or N	Your Comments
3.	Advertising and marketing of agricultural products.		
4.	Concepts associated with problem solving.		
5.	Relationships between basic academic and agricultural science.		
10.	The importance of cooperation, respect, and trust as related to students.		

Round-Three (EDU)
Conceptual Area I: Biological Science

Definition
Biological Science: the scientific study of living things, which include animals, plants, and other living organisms and can include those things which are closely associated with living organisms.

Directions: Please confirm your response by placing a Y (yes) or N (no) in the confirmation column. Placing a Y will indicate your agreement that the specific competency is one needed by a BAST. Placing an N will indicate you do not agree that the specific competency is needed by a BAST.

No.	Biological Science BAST Competency	Confirmation Y or N	Your Comments
1.	Basic Animal Anatomy		
2.	Basic Animal Behaviors		
3.	Basic Animal Environments		
4.	Animal Feeds and Feeding, Nutrition		
5.	Plant Structures, Growth		
12.	Animal Reproduction		
13.	Animal Systems, Digestive, respiratory, circulatory, nervous.		
14.	Breeds and Types of Livestock, and Non-Livestock farm animals		
20.	Plants and Soil Science		
21.	Selection of Livestock		

23.	Anatomy and Physiology of Animals		

Conceptual Area II: Physical Sciences

Physical Science: the scientific study of non-living things including physics, chemistry, and astronomy.

Directions: Please confirm your response by placing a Y (yes) or N (no) in the confirmation column. Placing a Y will indicate your agreement that the specific competency is one needed by a BAST. Placing an N will indicate you do not agree that the specific competency is needed by a BAST.

No.	Physical Science BAST Competency	Confirmation Y or N	Your Comments
1.	Basic Principles of Engines		
2.	Basic Principles of Electricity		
3.	Basic Principles of Power and Hand Tools		
4.	Basic Principles of Shop Safety		
5.	Basic Principles of Motors		
7.	Basic Principles of Metal Fabrication		
13.	Water Rights and Water Conservation		
20.	Water Quality		
21.	Soil Structures		
22.	Soil Types and Classes		

25.	Plant Growth		

Conceptual Area III: Social Sciences

Social Science: the scientific study of human society and the interpersonal relationships of people.

Directions: Please confirm your response by placing a Y (yes) or N (no) in the confirmation column. Placing a Y will indicate your agreement that the specific competency is one needed by a BAST. Placing an N will indicate you do not agree that the specific competency is needed by a BAST.

No.	Social Science BAST Competency	Confirmation Y or N	Your Comments
1.	Working with Adverse Individuals and Groups		
2.	Individual Social Skills		
3.	Community Relations		
4.	Learning Styles		
5.	Ethics		
6.	Leadership and Leadership Styles		
7.	Human Behavior		
8.	Types of Communication		
9.	Personal Hygiene		
10.	Cultural Diversity and the way it influences food production and consumption.		

14.	Career Preparation		
15.	Manners and Etiquette		
16.	Character Education		

Conceptual Area IV: Informational Sciences

Informational Science: the scientific study of knowledge and intelligence as related to society.

Directions: Please confirm your response by placing a Y (yes) or N (no) in the confirmation column. Placing a Y will indicate your agreement that the specific competency is one needed by a BAST. Placing an N will indicate you do not agree that the specific competency is needed by a BAST.

No.	Informational Science BAST Competency	Confirmation Y or N	Your Comments
1.	Basic Recordkeeping		
2.	Budgeting		
4.	Ability to access information in ways to solve daily problems and issues		
5.	Problem Solving Skills		
6.	Goal Setting Skills		
7.	Information Technology Skills		
8.	Internet, email and other electronic communication skills		
9.	Computer application skills related to Agricultural Education		

Conceptual Area V: Other Integrative Sciences

Other Integrative Science: the scientific approach of incorporating areas of relationship to one another.

Directions: Please confirm your response by placing a Y (yes) or N (no) in the confirmation column. Placing a Y will indicate your agreement that the specific competency is one needed by a BAST. Placing an N will indicate you do not agree that the specific competency is needed by a BAST.

No.	Other Integrative Science BAST Competency	Confirmation Y or N	Your Comments
2.	Time management		

Dear Expert Panelist,

Thanks for your commitment to the Beginning Agricultural Science Teachers Competency Study. This is just a reminder that the Round-Three Questionnaire is due. The deadline for completing the survey is March 7 2003. Please take a moment to complete the instrument and return it as soon as possible.

If you have already sent in Round-Three, please disregard this reminder. Thanks for your help!

Tim Rocka,
Graduate Student
Texas A&M University

VITA

Scholar:	Timothy Dee Rocka
Permanent Mailing Address:	4461 Winecup Court Chappell Hill, Texas 77426
Degree:	Doctor of Philosophy
Major Subject:	Agricultural Education
Education:	B.S. in Agricultural Education, Stephen F. Austin State University, Nacogdoches, Texas, December 1989. M.S. in Agricultural Education, Stephen F. Austin State University, Nacogdoches, Texas, May 1993. Ph.D. in Agricultural Education, Texas A&M University, College Station, Texas, August 2003.
Professional:	Agricultural Science Teacher, Jacksonville ISD, Jacksonville, Texas, January 1990 – June 1996. Director of Career and Technology Education, Palestine ISD, Palestine, Texas, July 1996 – June 1997. Director of Career and Technology Education, Jacksonville ISD, Jacksonville, Texas, July 1997 – July 1999. Human Resources Manager, Brenham ISD, Brenham, Texas, July 1999 – May 2001. Director of Business and Finance, Brenham ISD, Brenham, Texas, June 2001 – May 2003. Director of Human Resource Systems, Cypress-Fairbanks ISD, Houston, Texas, May 2003 – Present.