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Influence of Social Cognitive Variables on the Career Exploratory Behaviors of African American Undergraduate STEM-Intensive Agricultural Sciences at Historically Black Land-Grant Institutions

For the degree of Doctor of Philosophy

Is approved by the final examining committee:

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INFLUENCE OF SOCIAL COGNITIVE VARIABLES ON THE CAREER EXPLORATORY BEHAVIORS OF AFRICAN AMERICAN UNDERGRADUATE STEM-INTENSIVE AGRICULTURAL SCIENCES MAJORS AT HISTORICALLY BLACK LAND-GRANT INSTITUTIONS

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ABSTRACT

Ding, Q. Ph.D., Purdue University, August 2015. Influence of Social Cognitive Variables on the Career Exploratory Behaviors of African American Undergraduate STEM-Intensive Agricultural Sciences Majors at Historically Black Land-Grant Institutions. Major Professor: Dr. Levon T. Esters.

Without question, racial and ethnic minority groups are playing more significant roles in American society. However, there still remains a lack of diversity within the STEM workforce, especially within agricultural sciences disciplines. More problematic is the fact that low numbers of African Americans are employed in the agricultural sciences workforce. This study extends the use of Social Cognitive Career Theory by exploring how person, contextual and cognitive factors interplay to influence the career goals and career exploratory behaviors of African American college students pursuing STEM-intensive agricultural sciences majors. Instruments were selected to measure various components of the SCCT framework, focusing primarily on person, cognitive and contextual variables. Data were collected from African American undergraduate students (N = 314) enrolled in STEM-intensive agricultural sciences majors at five Historically Black Land-Grant Institutions. A Structural Equation Modeling technique was utilized to test three research hypotheses. An additional research question was included to identify other factors influencing students' pursuit of STEM-intensive agricultural sciences majors. Overall, the structural models indicated good model fit with significant paths being identified among several of the SCCT variables. There were four conclusions for this study. First, African American college students who were enrolled in STEM-intensive agricultural sciences majors with masculine gender personality attributes were more likely to engage in career exploratory behaviors if they felt more confident in making career decisions. Second, African American students who were enrolled in STEM-intensive agricultural sciences majors who faced career barriers were more likely to engage in career exploratory behaviors. Third, African American college students who were enrolled in STEM-intensive agricultural sciences majors who were confident in their ability in making career decisions and coping with career barriers were more likely to engage in more career exploratory behaviors. Fourth, African American college students who were enrolled in STEM-intensive agricultural sciences majors reported mentoring as the most helpful factor regarding their career pursuits, and academic difficulties as the most hindering factor regarding their career pursuits. Future directions for research are provided as well as implications for the theory, research and practice.

CHAPTER 1. INTRODUCTION

The United States is facing ongoing racial and ethnic population changes that have resulted in racial and ethnic minority groups playing more significant roles in American society. However, there still remains a lack of diversity within the STEM workforce with underrepresented minorities making up a small percentage of those employed in STEM occupations. More problematic is the fact that African Americans are disproportionately underrepresented in the STEM workforce. More actions should be taken to understand why fewer African American students choose STEM as their major or pursue a STEM career. Agricultural sciences have similar problems in recruiting and retaining African American students. In helping to address these issue and attracting more African American students into the agricultural sciences, more research should be conducted to understand what influences the career development of African American students who major the agricultural sciences. A good starting point for exploring this line of research is through the study of African-American students who attend historically black land-grant colleges and universities. As such, this study will explore the factors that influence the career development of African American students pursuing STEM-intensive agricultural sciences majors at HBCUs.

1.1 U.S. Racial & Ethnic Population Changes

The United States is a racially diverse country with minority populations increasing and majority populations becoming minorities in the near future (U.S. Census Bureau, 2013). Higher birth rates of racial and ethnic minority groups have driven the population growth of U.S. society and racial and ethnic minorities accounted for 91.7% of the entire population growth (U.S. Census Bureau, 2013). Recent statistics indicate that Hispanic/Latino Americans and African-Americans will become majority minority groups in the U.S. by 2050 (U.S. Census Bureau, 2013). Also, racial and ethnic minorities including Hispanic/Latino Americans, African Americans, Asian Americans, Native Hawaiian and Other Pacific Islanders, American Indian and Alaska Natives account for about 37.4% of the current U.S. population (including two or more races) (U.S. Census Bureau, 2013).

The U.S. Census Bureau projected that the non-Hispanic White population will peak in 2024, at 199.6 million. However, the non-Hispanic White population will slowly decrease, decreasing by 20.6 million from 2024 to 2060 (U.S. Census Bureau, 2012). Conversely, the African American population is expected to increase from 41.2 to 61.8 million during the same time period (U.S. Census Bureau, 2012). African Americans accounted for 13.2% of the U.S. population, making up the largest racial minority group in 2013 (U.S. Census Bureau, 2013). The overall percentage of people of color is expected to increase to 40% by 2020 and to 50% by 2050 (Palmer & Gasman, 2008).

Without question the racial and ethnic composition of the United States will continue to shift and the United States will be more diverse in the future.

1.2 Lack of Diversity within the STEM Workforce

The labor force demand and supply gap in STEM has been exacerbated by the underrepresentation of minority groups (Poirier et al., 2009). Recent reports show that 71% of individuals in STEM were White and non-Hispanic males (Aud, Fox, & KewalRamani, 2010). Further, ethnic minority groups have a disproportionately low share of the STEM education and workforce composition (National Science Foundation, 2009; National Research Council, 2009; National Science Foundation & National Center for Science and Engineering Statistics, 2013). The lack of diversity within the U.S. workforce will continue in light of the increase of the underrepresented minority (URM) population.

According to the Landivar (2013), except for Whites and Asians, other racial groups held a low share of the STEM workforce relative to their share in the U.S. population. African Americans only held 6% of STEM positions in the workforce, while 15% of STEM positions were held by Asians and 71% held by Whites (American Community Survey, 2011). For example, by 2011, Whites held 67.9% of the computer occupations, while African Americans held only 7.3% of the same occupations; Whites held 70.3% of the mathematical occupations with African Americans holding 9.3%, and Whites held 75.2% of the engineering occupations with African Americans holding only

4.9% (Landivar, 2013). Hence, providing proper African American students support and attracting African American students into STEM disciplines will be a key factor in filling the population gap within the STEM workforce, thus sustaining the United States as a leader in the global research and development arena.

As globalization continues, STEM capability will be the foundation of economic success for the U.S. in the 21st century (U.S. Department of Commerce, 2010). The National Research Council (2011) stated that two goals of current STEM education efforts should be to expand the STEM-capable workforce and to ensure the flow of women and ethnic minority groups into the STEM workforce. Attracting more African American students in STEM career pathways could effectively enrich the STEM workforce culture. To promote diversity in STEM disciplines, more efforts at the institutional and national level aimed at increasing STEM participation of African American groups are needed (Whittaker & Montgomery, 2012).

1.3 Lack of Diversity within the Agricultural Sciences Workforce

There is a disproportionate underrepresentation of African Americans in both degree recipients and labor force in the agricultural sciences (United Census Bureau, 2012). The agricultural sciences workforce is rapidly expanding which offers numerous opportunities for educated and qualified individuals to build a rewarding career that can impact their communities (STEM Food & Ag Council, 2014). In 2014, it was reported that agricultural sciences occupations offered 682,316 jobs in 2013 (STEM Food & Ag

Council, 2014) and the openings are projected to have an average annual grow of 57,900 openings in the next five years (Goecker, Smith, Fernandez, Ali, & Theller, 2015). However, there were only 31,852 students who completed an undergraduate or graduate degree in the agricultural sciences in 2013. Furthermore, African American students continue to be underrepresented in agricultural sciences. For example, the STEM Annual Report projected that the U.S. will experience a shortage of graduates from the agricultural sciences disciplines over the next few years (STEM Food & Ag Council, 2014), especially, students from URM groups (Bobbitt, 2006). Underrepresentation of URM students in the agricultural science has led to a lack of diversity in the agricultural workforce (Gordon, 2003). Currently, about 73.5% of the entire agricultural workforce is White (not Hispanic), compared to 4.4% being African Americans (U.S. Census Bureau, 2012). The lack of diversity in the agricultural sciences would worsen the problem of recruiting a skilled labor force into agriculture and there is an urgent need to address current challenges of the lack of diversity in the agricultural sciences.

The world is now facing many challenges and agriculture is playing a more significant role. For example, the increasing world population exerts a pressure on global food supply (National Research Council, 2009). It is still not clear how the expansion of food production can influence our environment (National Research Council, 2009). These issues were closely related to agriculture, so agriculture is very important for the future sustainability of every country, including the United States. Policymakers have become aware of lacking a skilled labor force (National Science Council, 2009). Actions have been taken to increase STEM participation of URM students in the agricultural sciences. For example, a recent effort was undertaken by the Office of Human Resources Management of the United States Department of Agriculture (USDA) through the development of a Student Employment Program Report (SEPR). This report was designed specifically to encourage the recruitment of minority groups and women in the U.S.D.A. Without question, more actions for the purpose of enhancing participation of African Americans in agriculture should be taken in the future.

Within the broad area of the agricultural sciences, there is a serious issue of lack of diversity within STEM-intensive agricultural sciences disciplines. For this study, STEM-intensive agricultural sciences majors were defined as majors where 50% or more of courses on a degree plan of study are STEM courses. Participation of African Americans in STEM-intensive agricultural sciences can help with increasing diversity within the agricultural sciences field and filling the gap between workforce need and labor supply. More research should also contribute to the current understanding of why fewer African American students choose STEM-intensive agricultural sciences as their major and eventual career.

As such, actions should be taken to attract African American students into agriculture, especially STEM-intensive agricultural sciences to enhance the diversity of the agricultural workforce. More studies are needed to address the educational and workforce needs of African American students who major in the STEM-intensive agricultural sciences (Chastity & Antoine, 2006).

1.4 STEM Career Development of African American Students

Several studies have examined African American students' formation of career interests, career goals, and career development outcomes in STEM. Pre-college competence in science and math has been identified as a critical factor that influences the likelihood of African American students choosing STEM as their college major and African American students who have more access to pre-college math and science courses are more likely to choose STEM as their major (Russell & Atwater, 2005). A study on African American women in STEM summarized four types of contextual barriers including academic, psychological, social and financial that could impede with African American female students' career development in STEM (Perna, Lundy-Wagner, Drezner, Gasman, Yoon, Bose, & Gary, 2009). Results of many previous studies supported the importance of contextual factors in influencing URM students career development in STEM (Byars-Winston & Fouad, 2008). Chang, Sharkness, Hurtado and Newman (2014) suggested that the undergraduate experience is an important venue that could foster URM students' interest in STEM, and help them persist in STEM programs and eventually enter STEM-related careers.

Despite previous studies on the STEM career development of African American students, more in-depth and comprehensive insights on this topic are still needed. A useful framework developed by Lent, Brown and Hackett (1994), originated from Bandura's (1986) concept of self-efficacy, was used to comprehensively understand African American students' career development in STEM. Lent, Lopez, Sheu, Lopez (2011) suggested in their study that African American students who are more confident in their ability to complete STEM-related tasks are more likely to be interested in STEM. Further, African American college students who perceive more social supports and fewer social barriers, it is more likely for them to have higher intention of persisting in a STEM major. Lent et al. (2005) also found that discrepancies between aptitudes and self-efficacy, or between values and outcome expectations can influence minority groups' career development in STEM. Investigation of the STEM career development of African American students is an important step in attracting African American students into STEM because it provides more understanding about African American students' career consideration. Finally, Lent, Brown and Hackett (2000) suggested that more studies should be conducted on the role of contextual factors in the career development process.

1.5 Educational Pipeline Issues Related to STEM Degree Attainment of African American Students

The disproportionate participation and high attrition rates of African American students in STEM education has exacerbated the STEM educational pipeline issues (National Science Foundation, 2009), which has been translated to African American students' underrepresentation in STEM employment (Landivar, 2013). Increasing undergraduate and graduate STEM degree attainment of African American students is a key step in trying to broaden the STEM educational pipeline. Researchers have found that women, African Americans and Hispanics are less likely to major in science, technology and engineering at the start of college and they are also less likely to remain in these majors by graduation (Landivar, 2013).

STEM areas reported very high attrition rates of African American students, with 48.3% of the students who chose STEM fields as their major between 2003-2009 having left their major (e.g., 37.6% left mathematics and 46% left physical sciences), 65.3% of African American students who chose STEM fields as their major left STEM fields during the same period (National Center for Education Statistics, 2012). Between 1995-2004, the number of students completing bachelor's degrees in science and engineering increased by 30,000. Additionally, the number of URM students completing bachelor`s degrees in science and engineering increased by 4.1% from 14.9% to 19.0% (Poirier, Courtney, Charles, Rita, & Carlos, 2009). Yet today, African American students still only have a small share of overall students obtaining STEM bachelor's degree. For example, 80% of bachelor's degree in the agricultural sciences were awarded to Whites, while only 2.6% of bachelor`s degree in the agricultural sciences were awarded to African Americans (National Science Board, 2014). Furthermore, the National Science Board (2014) also reported that the percentage of all STEM bachelor's degrees awarded to African Americans and Hispanics have not increased since 2003.

The need of skilled workers in STEM areas (Augustine, et. al., 2010) raises educational pipeline issues related to STEM education and training, which should concern policymakers and the broad public (Poirier et al., 2009). Although the U.S. STEM workforce surpassed 7.4 million workers in 2012, there would be a need of 8.5 million workers for the U.S. STEM workforce by 2018 (Cornelis, 2013). Additionally, 92% of STEM occupations require postsecondary education and 19 states will be at or above this percentage by 2018 (National Science Board, 2014). The underrepresentation of African American students in STEM education is a significant loss for STEM employers and society. Broadening the STEM education pipeline would benefit the workforce by providing more talented individuals and thus narrow the gap between the STEM labor need and supply.

1.6 Role of HBCUs in the STEM Preparation of African American Students

Although HBCUs only represent 3% of American higher education institutions, they educate over 15% of all African American students (Strayhorn, 2008). HBCUs have served as the conduit for STEM education for African American students (Arroyo & Gasman, 2014), and have long been accommodating the educational needs of this minority group, which reflects a commitment to educating historically underrepresented populations. However, there is a need of comprehensive empirical studies focusing on how and why HBCUs have been successful in the STEM preparation of African American students (Arroyo & Gasman, 2014).

From the perspective of STEM recruitment, it has been shown that African Americans attending HBCUs are more likely to major in the biological sciences and physical sciences than African Americans at predominantly white institutions (PWIs) (Fryer & Greenstone, 2010). Regarding STEM attrition rates, HBCUs enroll a smaller percentage of African American students in natural sciences and engineering majors, but graduate a larger percentage of African American students than PWIs (National Academy of Engineering and Institute of Medicine, 2010). Also, compared to PWIs, HBCUs produced a larger number of STEM degree recipients who are African American students, including those who pursue graduate and other advanced degrees in STEM (Clewell, Decohen, & Tsui, 2010). From 1986 to 2006, the percentage of African American science and engineering doctoral degree recipients who received their bachelor’s degree from HBCUs increased from 25% to 29% (National Science Foundation, 2013). In 2010, 90% of top producers of African American doctoral degree recipients were HBCUs (Palmer, Maramba, & Gasman, 2013).

The National Academy of Sciences (2011a) reported that African American students at HBCUs are more likely to pursue a career in STEM because of more positive learning environments. Clay (2013) indicated that more STEM engagement of African American students at HBCUs might be because of more personal support, more cultural empowerment, and higher expectations. Students also indicated that they like the nurturing environment of HBCUs because of individualized instruction, more minority role models, more peer support and mentoring for minorities in science and engineering, and more access to faculty both in formal and informal settings (Whittaker & Montgomery, 2012).

Clearly, HBCUs supported minority students in their STEM career development and continue to play an important role in STEM education. Clay (2013) and Arroyo and Gasman (2014) have suggested that additional research is needed to examine more in-depth the factors that contribute to how HBCUs facilitate African American students' success in STEM. Furthermore, no studies have been found to investigate if HBCUs have been successful in facilitating African American students' success in STEM-intensive agricultural sciences. More research should focus on experiences of students who are pursuing STEM-intensive agricultural sciences majors.

1.7 Problem Statement

There is a lack of understanding on how personal, contextual and cognitive factors interplay with each other to influence the STEM-intensive agricultural sciences career choice actions of African American students. Previous studies have shown direct and indirect influences of personal and contextual variables on career choice actions (Flores, et al., 2014; Byars-Winston & Fouad, 2008; Lent, et al., 2003). It has been reported that personal variables (e.g., gender), contextual factors (e.g., positive learning environment, more frequent interaction with mentors) and cognitive factors (e.g., confidence in their ability of learning STEM) are important for STEM success (Poirier, et al., 2009; Brown, 2011). However, there is a paucity of studies on the role of personal and contextual factors on the career development of African American college students enrolled in STEM-intensive agricultural sciences majors, especially how personal and contextual factors interact with cognitive variables to influence the career development of African American college students enrolled in STEM-intensive agricultural sciences majors. Moreover, within the agricultural sciences disciplines, understanding how contextual and cognitive factors support or impede African American college students' pursuit of STEM-intensive agricultural sciences majors could also lead to better practices of attracting this population of students into the agricultural sciences workforce.

1.8 Significance of the Study

This study is significant for three reasons: 1) this study will examine students who are pursuing STEM-intensive agricultural sciences majors, 2) this study will extend the scope of social cognitive career theory by exploring less often studied variables including gender role, contextual variables and career exploratory behaviors, and, 3) this study will examine the career development of African American students attending Historically Black Land-Grant Institutions (HBLGIs).

First, this study focuses on career development process of African American students in STEM-intensive agricultural sciences majors. To date, no studies have been found that examined the career development of students who pursue STEM-intensive agricultural sciences majors. To broaden the educational pipeline in the agricultural sciences, there is also a need to assist with and increase African American students' participation in STEM-intensive agricultural sciences. A lack of understanding of the career development of African American students enrolled in STEM intensive agricultural sciences majors could result in a failure to attract and recruit qualified African American students. This study will add to current understanding on what factors support or impede African American students pursuing STEM intensive agricultural sciences majors.

Second, this study can help address the issue of lack of skilled workers in the agricultural workforce by providing support to attract and retain more African American students in STEM-intensive agricultural sciences disciplines. Agriculture has been facing challenges in recruiting and retaining African American students. This study provides more in depth understanding of why fewer African American students choose STEM-intensive agricultural sciences majors, so actions can be taken to address the educational and career development needs of African American college students.

Third, this study will examine the career development of African American students attending HBCUs from a more in-depth manner that is not commonly explored. Specifically, this study will provide a deeper understanding of the mechanisms by which African American students from HBCUs make career decisions. By investigating African American students attending HBCUs, this study could encourage PWIs to implement more comprehensive career interventions and build a more nurturing and supportive learning environment for African American students pursuing STEM-intensive agricultural sciences majors. A more enhanced positive learning environment at PWIs could increase African American students' enrollment and persistence in STEM. As such, this study could help lead to an increase in the number of African American college students pursuing STEM degrees. For example, findings from this study could lead to the development of more effective intervention practices to foster the STEM career development of African American college students.

1.9 Purpose

This study will extend understanding of the original SCCT model proposed by Lent et al. (1994) (See Figure 1.1). The purpose of this study was to examine the influence of personal, contextual and cognitive factors on the career goals and career exploratory behaviors of African American undergraduate students who are enrolled in STEM-intensive agricultural sciences majors at HBLGIs (See Figure 1.2).

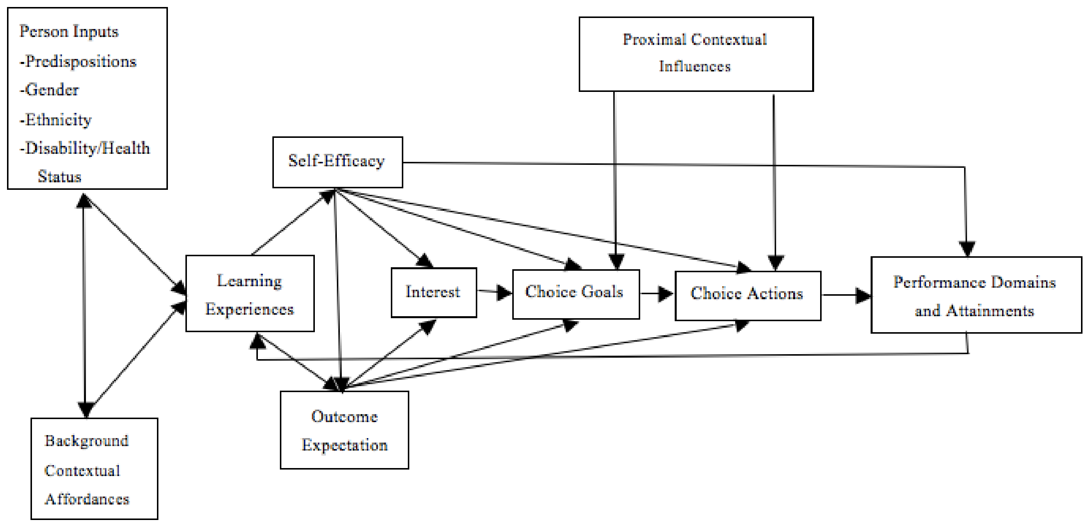

Figure 1.1 The Original SCCT Model

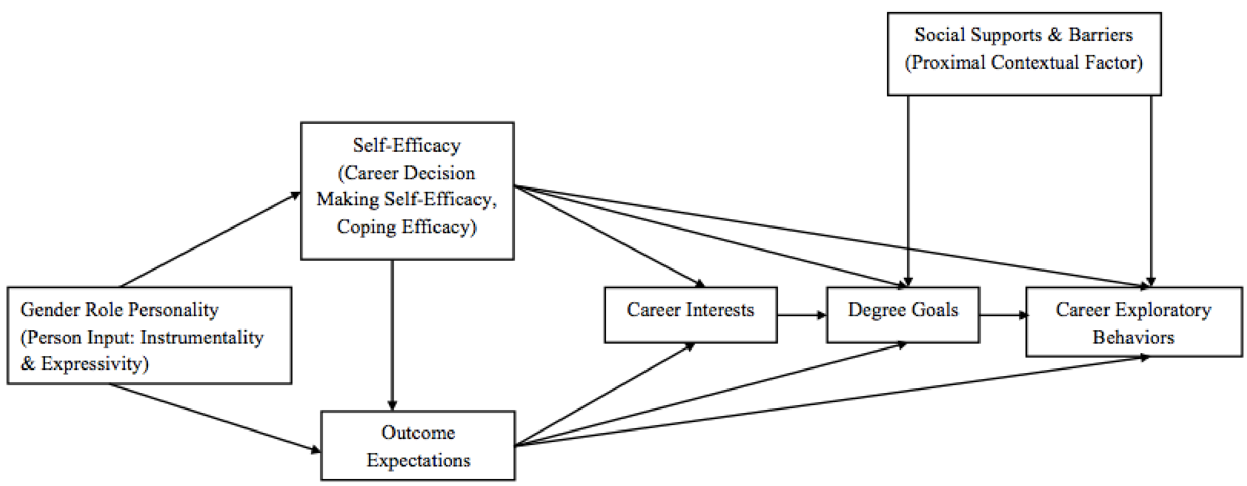

Figure 1.2 Model Examined in Current Study

1.10 Research Questions & Hypotheses

This study aims to examine Lent et al.'s (1994) social cognitive career model by testing three research questions and hypotheses:

Research Question 1: To what extent does gender role personality influence career exploratory behaviors?

Hypothesis 1: Instrumentality and expressivity will indirectly influence career exploratory behaviors through its influences on self-efficacy and outcome expectations (Figure 1.3).

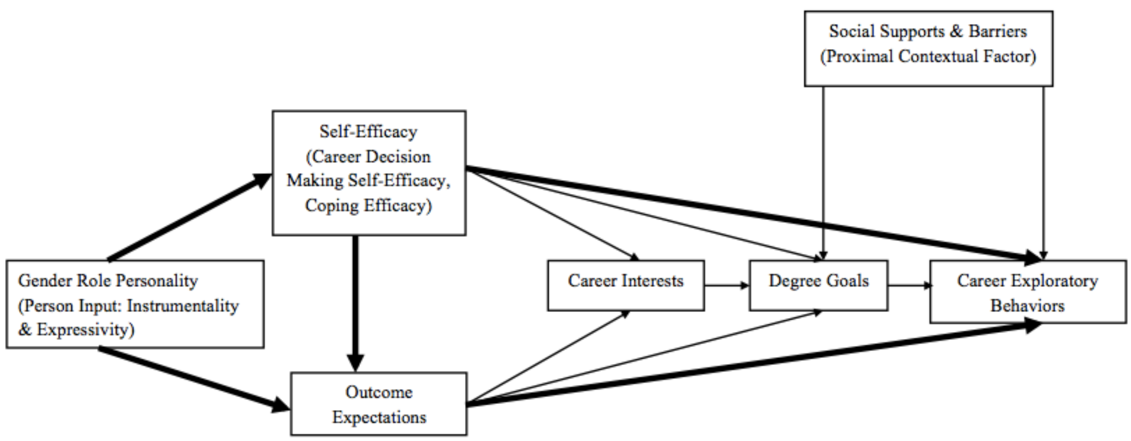

Figure 1.3. Hypothesis 1 Examined in This Study: Model of How Gender Role Personality will Influence Career Exploratory Behaviors. *Note.* Bolded lines depict the paths tested by hypothesis one.

Research Question 2: To what extent do social supports and barriers, influence career exploratory behaviors?

Hypothesis 2: Social supports and barriers will influence career exploratory behaviors directly and indirectly through degree goals (Figure 1.4).

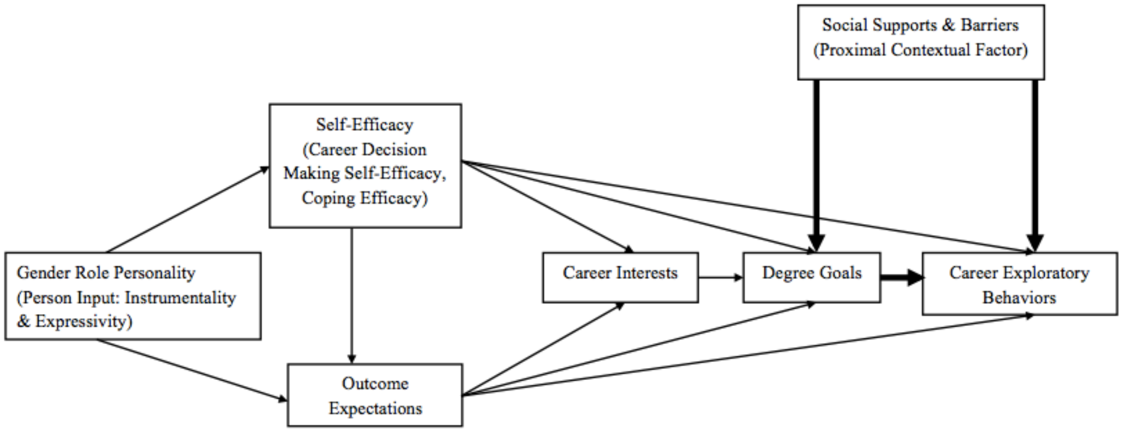

Figure 1.4. Hypothesis 2 Examined in This Study: Model of How Social Supports and Social Barriers Will Influence Career Exploratory Behaviors. *Note.* Bolded lines depict the paths tested by hypothesis two.

Research Question 3: To what extent do self-efficacy and outcome expectations influence career exploratory behaviors?

Hypothesis 3: Self-efficacy and outcome expectations will have direct and indirect influences on career exploratory behaviors through career interests and degree goals (Figure 1.5, SCCT Propositions 3, 4, 6, 7).

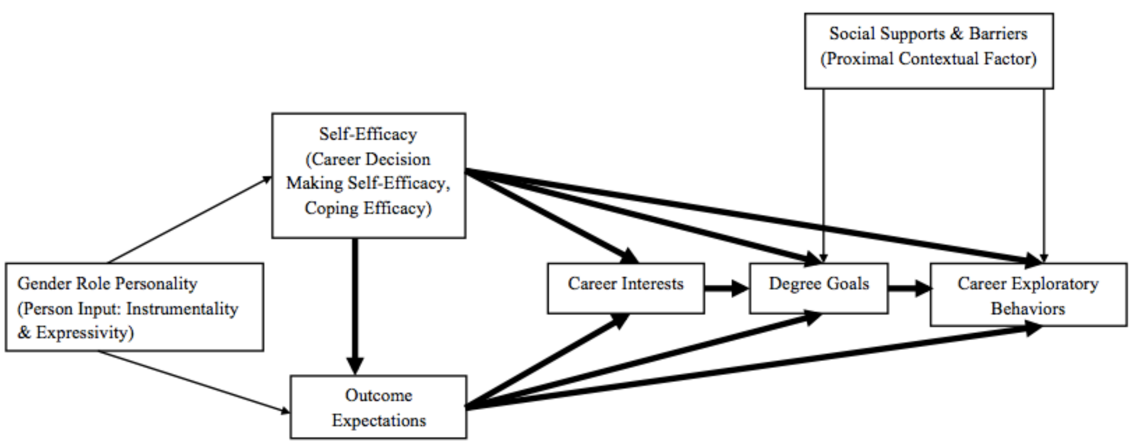

Figure 1.5. Hypothesis 3 Examined in This Study: Model of How Career Decision-making Self-Efficacy, Coping Efficacy, Outcome Expectations, Interests and Degree Goals Will Influence Career Exploratory Behaviors. *Note.* Bolded lines depict the paths examined by hypothesis three.

Research Question 4: What additional factors influence students' pursuit of a STEM-intensive agricultural sciences major?

1.11 Assumptions

The following assumptions were made for this study:

1. The data collected from the survey instruments accurately reflect the participants' thoughts and beliefs.
2. All data were collected using reliable and valid instruments.
3. Participants who completed the questionnaire provided honest answers.
4. The study was conducted in an objective manner, with the bias of the researcher being minimized.
5. The researcher was informed by a positivist paradigm. Positivism paradigm assumes that: 1) there is a objective reality, 2) this objective reality can be observed and described by symbols (Mack, 2010).

1.12 Limitations of the Study

There are seven potential limitations of this study that the researcher acknowledges may impact internal validity. First, the researcher is an international student from China, so the researcher has limited experiences with STEM learning and teaching in the United States. Second, the researcher is a graduate student in the College of Agriculture. Collectively, these biases could impact the interpretation of the findings.

Third, this study relies on self-reported data. Self-reported data rely on the participants' perception about themselves and it could contain biases that jeopardize the external validity of this study. Fourth, the participants are mostly from racial and ethnic minority groups, so the results should be generalized to other populations with caution, which is also a threat to the external validity of this study. Fifth, because the demographic composition of the five HBLGIs selected for this study might be different from other colleges and universities, the results are only generalizable to this study sample. Sixth, the cross-sectional design of the study cannot establish causal relations among variables of interest.

1.13 Definition of the Terms

The following is a list of terms used throughout this study:

1. **Agricultural Science**: "A discipline dealing with selection, breeding, and management of crops and domestic animals for more economical production" ("Agricultural Science", 2003).

2. **Career**: The combination or sequence of roles played by a person during the course of a lifetime (Super, 1980).

3. **Career Development**: The process in which individuals make personal goals regarding future work conditions, and employ specific strategies to achieve these goals. Individuals would evaluate their needs and dynamics of their surrounding environment to eventually make decisions regarding their career path (Haney & Howland, 1978).

4. **Career Decision-making**: The process employed by an individual to evaluate alternatives with respect to their eventual working life in order to make a choice (Schwarz, 2008).

5. **Historically Black Colleges and Universities (HBCUs)**: Institutions established in in the nineteenth century to serve African American students who were excluded from white institutions. The majority of these institutions are located in southern States, stretching from Pennsylvania to Florida (National Academy of Engineering, and Institute of Medicine, 2011).

6. **Historically Black Land-Grant Universities (HBLGUs)**: Seventeen colleges and universities established by the 2nd Morrill Act of 1890 in the southern states with the mission of teaching agriculture and the mechanical arts to African Americans.

7. **Social Cognitive Career Theory (SCCT)**: A framework derived from Bandura`s social cognitive theory that describes how individuals exercise personal agency and interact with contexts to form career interests, make career choices and perform in educational and career pursuits (Lent, Brown, & Hackett, 1994).

8. **STEM**: Science, Technology, Engineering and Mathematics fields.

9. **STEM-Intensive Agricultural Sciences**: Agricultural majors where 50% or more of courses on the degree plan of study are Science, Technology, Engineering and Mathematics.

10. **Underrepresented Minorities (URMs)**: Within the American population, African-

Americans, Hispanic-, and Asian-American, American Indian or Alaskan Native, Hawaiian and Pacific Islanders were defined as the Underrepresented Minorities.

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This chapter will provide an overview of social cognitive career development of African American students. Additionally, this chapter will review the literature of four primary related topic areas: 1) the role of person input factors in influencing career development, 2) the role of contextual factors in influencing career development, 3) the role of cognitive factors in influencing career development, 4) career choice actions, and 5) the career development of underrepresented minority college students who major in STEM. The theoretical and conceptual frameworks will also be introduced in this chapter. Finally, a brief summary will conclude this chapter.

2.2 Literature Review Methodology

This study was informed by literature across several academic disciplines, using an array of search methods. References were found using the Purdue University library direct search, Purdue University e-Journal Database, Purdue University library catalog, and Google Scholar. Examples of search terms and phrases used in the search for literature included: “SCCT,” “STEM career development of minority students,” “SCCT + minority students + STEM,” “contextual factors + minority students,” “HBCUs + career development + minority students + STEM," "career development + minority students + agricultural sciences.

2.3 Bandura`s Social Cognitive Theory

In *Social Foundations of Thought and Action: A Social Cognitive Theory*, Bandura (1986) described that human functioning can be determined by the interactions among, behaviors, personal and cognitive factors and environmental factors. Social Cognitive Theory (SCT) introduced the term "triadic reciprocality" (Bandura, 1986) to describe how behaviors, personal and cognitive factors and environmental factors act as determinants of each other. The construct "triadic reciprocality" refers to the notion that personal attributes (e.g., gender and genetics) and cognitive factors (e.g., personal beliefs and attitudes) influence human behaviors, and human behaviors (e.g., actions to gain skills) would in turn influence how people think, including people`s interpretation of their environment or experiences (cognition) (Bandura, 1986). Personal and cognitive factors include self-efficacy, self-regulation, outcome expectations, intentions and goals (Bandura, 1986). Environmental factors include perceived physical and social environment and social support, and behavioral constructs include behavioral capability (Stevens, 2006).

Bandura (1986, 1999) proposed the construct of "self-efficacy" in social cognitive theory. Self-efficacy was defined as a person's perception about his/her ability in completing a certain activity (Bandura, 1999). Bandura's (1999) model described four types of resources from which self-efficacy is developed: past performance, vicarious learning, social persuasion and physiological or emotional states. Moreover, SCT also takes into account outcome expectations and personal goals along with self-efficacy to predict behaviors (Bandura, 1999). Self-efficacy is to answer the question “Can I do this?” and outcome expectations are to answer the question “What will happen if I do this?” According to Bandura (1986), self-efficacy influences behaviors through outcome expectations. For example, individuals might believe that they are capable of completing the tasks in a certain career, but if there are few role models in this career area, they might be concerned with the negative career outcomes and choose not to pursue it. According to Bandura (1986), outcome expectations have significant impacts on an individual regarding career goal pursuit and how much effort he/she would exert to pursue this goal. Bandura (1986) also described two dimensions of goals: choice-content goals and performance goals. Bandura (1986) stated that through self-efficacy and outcome expectations, goals would be set to regulate individual’s behaviors (Lent, Brown, & Hackett, 1994). Further, progress made towards the goal would result in higher self-efficacy and outcome expectations.

Bandura’s (1986) proposal of interaction among human, behavior and environment has been applied by Lent, Brown and Hackett (1994) to better understand the career development process. In the next section, Social Cognitive Career Theory will be described, which was derived from Social Cognitive Theory.

2.4 Introduction of Social Cognitive Career Theory (SCCT)

Social Cognitive Career Theory, mainly derived from Bandura`s social cognitive theory (Lent, Brown, & Hackett, 1994), is a framework that describes the triadic interplay among person, environment and behaviors in the career development process. More specifically, Lent, Brown and Hackett (1994) described that personal inputs (e.g., gender, ethnicity, health status) and environmental factors (e.g., social supports, social barriers) could restrict or promote the influences of personal agency (e.g., self-efficacy, outcome expectations) (Lent, et al., 2005). Cognitive factors as personal agency variables include self-efficacy, outcome expectations and career goals play a central role within SCCT (Lent, et al., 2005). Personal characteristics, contextual influences and learning experiences could influence behaviors and career outcomes through cognitive factors (Lent, Brown, & Hackett, 1994).

There are three interlocking models within SCCT (Figure 1.1): 1) the interest model focuses on how academic and career interests are developed, 2) the choice model focuses on how people make career choices, 3) the performance model focuses on how people attain different levels of performance within the career development process (Lent & Brown, 1996). These three models integrate many career related constructs to describe how people form career interests, make career choices and how they attain certain career performance (Lent, Brown, & Hackett, 1994). The interests model describes how self-efficacy (one’s perception of his ability to complete certain tasks) (Bandura, 1986) and outcome expectations (one's beliefs on what are the outcomes of certain behaviors) (Bandura, 1986) impact career interests. Lent, Brown and Hackett (1994) stated that person input factors (e.g., gender, race, ethnicity, health status), background contextual factors (e.g., financial supports; familial supports) are important in shaping self-efficacy and outcome expectations through learning experiences (Lent & Brown, 1996). Self-efficacy is determined by one's past performance, vicarious learning and physical or psychological arousal (Bandura, 1986). Self-efficacy plays a central role in the interests model and it directly impacts interests, which means that it is more likely for a person to be interested in a vocational domain if he is confident that he can complete a domain's related tasks (Lent, Brown, & Hackett, 1994). Outcome expectations is yet another critical factor that has direct impacts on career interests. Outcome expectations are partially determined by self-efficacy, so it can also indirectly impact interests through self-efficacy. Lent, Brown and Hackett (1994) argued that a person would believe his/her pursuit of a vocational domain can lead to positive results if he/she is confident about his/her abilities of performing the domain-related activities. Hence, in the career interests model, interests are formed through the combined effects of self-efficacy and outcome expectations. When new learning experiences emerge, or a person's self-efficacy and outcome expectations change, interests on this vocational domain would also change.

The choice model is an extension of the interest model (Dickinson, 2007) and it describes how people set choice goals and take choice actions. Once a career goal has been set, one would take actions to achieve them, which is the choice action. Self-efficacy, outcome expectations and interests can directly impact career goals, which means that individuals would have higher levels of intentions to pursue a career if they have higher confidence in their ability of completing the career related tasks, and more positive outcomes and interests are perceived (Lent, Brown, & Hackett, 1994). Additionally, proximal contextual variables could influence choice goals and choice actions directly (Lent, Brown, & Hackett, 1994). Proximal contextual variables can also moderate the relationship between interests and choice goals, and the relationship between choice goals and choice actions (Lent, Brown, & Hackett, 1994). Lent, Brown and Hackett (1994) further explained that career interests would be more likely to lead to pursuit of a career choice, and one is more likely to take actions upon this goal if the environment is perceived to be supportive and fewer barriers. Conversely, the interests-goal path and goal-action path would be weaker if perceived environment is unsupportive.

The performance model describes how one can attain certain career outcomes. In SCCT, self-efficacy has direct and indirect influences on performance through outcome expectations, interests, goals and actions (Lent, Brown, & Hackett, 1994). Outcome expectations have mainly indirect influences on performance through goals and actions (Lent, Brown, & Hackett, 1994). Also, performance would provide feedback and continue to shape self-efficacy, outcome expectations and behaviors (Lent, Brown, & Hackett, 1994).

Numerous empirical studies have validated the three models of SCCT across various populations, including middle school and high school students (Fouad & Smith, 1996; Lopez, Lent, Brown, & Gore, 1997); college students (Ferry, Fouad, & Smith, 2000; Lent et al., 2001; Lent, Brown, Schmidt, Brenner, Lyons, & Treistman, 2003; Brown et al., 2008); students who major in science/math or engineering (Lent et al., 2001; Lent, Brown, Schmidt, Brenner, Lyons, & Treistman, 2003; Lent, Lopez, Lopez, & Sheu, 2008; Lent, Miller, Smith, Watford, Lim, Hui, Morrison, Wilkins, & Williams, 2013; Lent, Miller, Smith, Watford, Hui, & Lim, 2015); and racial & ethnically diverse students (Fouad & Smith, 1996; Lent, Brown & Schmidt, 2005; Lent, Miller, Smith, Watford, Lim, Hui, Morrison, Wilkins, & Williams, 2013; Lent, Taveira, Pinto, Silva, Blanco, Faria, & Goncalves, 2014). The following sections will provide a more detailed review of the variables within each model component and how the variables are related to each other.

2.5 Person Inputs

2.5.1 Gender

Lent and Brown (1996) proposed in the social cognitive career model that cognitive factors function in concert with other person factors such as gender (Lent & Brown, 1996). Most studies that have used SCCT as their framework to compare the career development between female and male students have found similar findings that SCCT is valid across genders (Lent, Brown, & Schmidt, 2005; Lent, Miller, Smith, Watford, Lim, Hui, Morrison, Wilkins, & Williams, 2013; Lent, Miller, Smith, Watford, Lim, Hui, & Lim, 2015; Inda, Rodríguez, & Peña, 2013). For example, a study of Lent, Lopez, Sheu and Lopez (2011) investigated social cognitive predictors of the interests and choices of computing major students. Their results indicated adequate model fit across genders (Lent et al., 2011). In a longitudinal study of Navarro, Flores, Lee and Gonzalez (2014), they examined the extent to which social supports, self-efficacy and outcome expectations could predict interests, academic satisfaction and persistence at different time points. Their study sampled students attending a Hispanic Serving Institution, and they found invariant findings across genders (Navarro et al., 2014). Lent et al. (2015) conducted another longitudinal study, also to investigate how academic support, self-efficacy and outcome expectations could predict academic satisfaction and persistence. Their study produced results similar to Navarro et al. (2014) in that the model fit was invariant across genders. Additionally, in a qualitative study by Fouad et al. (2010) in which they studied how students' perceptions of contextual support and barriers could influence their career choices, no significant differences were found between female and male students. In another study of Lent et al. (2005), they indicated that male and female college students had similar scores across most social cognitive career variables, but female engineering students perceived more contextual supports and fewer contextual barriers than male engineering students. Another study of Lent et al. (2013), they examined career development of male and female engineering students. Their results have also validated SCCT for both genders, but there was a larger amount of variance explained for female than male college students. From a broader perspective, SCCT studies provided invariant model fit across genders. However, there are still gender differences on scores of certain social cognitive variables (e.g., social supports), which could provide more detailed information about male and female students' career development. Lent et al. (2013) have suggested that more studies are needed to reveal if there are any gender differences on perceived supports or barriers on the career development process.

2.5.2 Race and Ethnicity

Race and ethnicity is yet another person input factor that was proposed by Lent, Brown and Hackett (1994) that could influence individual career development. Several SCCT studies have been conducted on the career development of populations from different racial and ethnic background (Flores & O'Brien, 2002; Constantine, Wallace, & Kindaichi, 2005; Lent, Brown, & Schmidt, 2005; Navarro, Flores, Lee, & Gonzalez, 2014; Lent, Miller, Smith, Watford, Lim, Hui, & Lim, 2015). Lent et al. (2005) examined the interest and choice models on students attending PWIs and HBCUs, and they compared model fit across different racial and ethnic groups. They found that the interest and choice models provided good fit for engineering students from both PWIs and

HBCUs. A longitudinal study of Navarro et al. (2014) also studied students attending a Hispanic Serving Institution and validated the social cognitive career model across racial/ethnic groups. Their results showed that self-efficacy, outcome expectations, and social supports reflected academic satisfaction and persistence of college engineering students attending a Hispanic Serving Institution (Navarro et al., 2014).

However, the literature also revealed racial and ethnic differences on the career development process (Booth & Myers, 2011; Lent et al., 2005; Byars-Winston, 2006). Booth and Myers (2011) used social cognitive career theory as their theoretical framework and compared internal and external career aspirations and multiple role planning between African American female college students and their Caucasian counterparts. They found that African American female students had significantly higher career commitment and they were also more motivated to advance in their career roles than Caucasian female college students (Booth & Myers, 2011). Another study of Lent et al. (2005) found that students from HBCUs reported stronger self-efficacy, outcome expectations, technical interests and social supports while pursuing their engineering majors, although the amount of differences was fairly small. Moreover, a mixed-method SCCT study of Trenor, Yu, Waight, Zerda and Sha (2008) examined how ethnicity related to female engineering students' educational experiences. They surveyed 160 female undergraduate engineering majors and interviewed 37 students. The quantitative analysis of the survey results showed that minority students experienced increased barriers to educational plans, but no significant differences were found in perceived social support, sense of belonging and students' experiences in engineering (Trenor, et al., 2008). The qualitative portion of the study revealed racial and ethnic differences on perceived barriers while pursuing an engineering major. Trenor et al. (2008) stated that students of color in their study indicated that "conflicting role struggles" (Trenor et al., 2008, p.460), lack of academic preparation were the most pertinent barriers for the students of color to pursue an engineer major. Moreover, lack of college educated family role models was identified as the most pertinent barriers for Hispanic students. However, White students in this study did not indicate these barriers as pertinent to them. It was also discovered that African American and Hispanic students showed more difficulties in transitioning to taking rigorous college courses and differences existed between African American and Asian students in their reasons to choose engineering as their major.

Many previous studies have examined the predictive ability of SCCT across various races and ethnicities with results indicating good model fit. However, findings have also suggested racial and ethnic differences on self-efficacy, outcome expectations, technical interests (Lent et al., 2005), perceived supports and barriers (Trenor, Yu, Waight, Zerda, & Sha, 2008) and career outcomes (Booth & Myers, 2011). More SCCT studies are still needed to better understand the career development of underrepresented minority college students. In particular, to date, very few studies have examined the career development of African American college students using the social cognitive model (Byars-Winston, 2006; Dickinson, 2008). As a result, further investigations are warranted to better understand how the SCCT model could be applied to African American college students.

2.5.3 Gender Role

Bem (1974) indicated that the process of gender role socialization could lead to the characterization of personality as masculine, feminine, androgynous, or undifferentiated. Spence, Helmreich, and Stapp (1974) operationalized masculine and feminine as instrumentality and expressivity. Instrumentality represents characters that were desired for a man in American society, such as being independent and not to fall into pieces under pressure. Expressivity represents characters that were desired for a woman in American society, such as being understanding and kind. The current study will examine how instrumentality and expressivity could impact individual career development. Nosek and Smyth (2011) indicated that gender stereotypes could affect career goals, performance and interests of men and women pursuing a STEM career. Betz and Fitzgerald (1987) stated that the environmental socialization of gender would result in undermined self-efficacy of female students while pursuing a career that is not traditional for them. More specifically, Hackett and Betz (1981) explained that socialization of gender roles influenced the information boys and girls received from their environment which was necessary to form strong self-efficacy beliefs towards male-type or female-type occupations. Additional studies have also indicated the important role of instrumentality in influencing the career development process (Flores, Robitschek, Celebi, Andersen, & Hoang, 2010). Flores et al. (2010) indicated in their study that individuals with high levels of instrumentality might attempt more learning opportunities.

Furthermore, several studies investigated how gender role influences the STEM career development of different ethnicities. A study by O'Brien, Blodorn, Adams, Garcia and Hammer (2015) examined European American and African American female college students' gender stereotypes in STEM, their participation in STEM majors, and how their gender stereotypes could predict the ethnic differences in STEM participation. Their results indicated that ethnic differences in gender stereotypes in STEM partially mediated the ethnic differences in STEM participation between African American and European American college women. In another study of Flores, Robitschek, Celebi, Andersen and Hoang (2010), they examined how age, Anglo orientation, Mexican orientation, familiasm, and gender roles (instrumentality and expressivity) influenced Mexican American students' career self-efficacy across the six Holland's themes. The results of their study revealed that students' career interests were consistent with their self-efficacy beliefs, and gender roles of instrumentality and expressivity and orientation to Mexican culture could significantly predict students' career self-efficacy (Flores et al., 2010). Additionally, Caldera, Robitschek, Frame and Pannell (2003) examined how instrumentality and expressivity could contribute to the commitment to the career choices of Mexican American students and non-Hispanic White college women. Their results showed that instrumentality was a significant predictor of Mexican American female students' commitment to career choice, but contradicting results were also found regarding the role of gender role identity in predicting non-Hispanic women college students' career commitment (Caldera, Robitschek, Frame and Pannell, 2003). For example, the authors found that expressivity did not show significant effects on commitment of either group to career choice. Previous theoretical and empirical studies have shown evidence of influences of gender roles on the career development process of minority students. However, SCCT studies that comprehensively examined how gender roles can influences STEM career development of African American college students have not been found. Moreover, it is still unclear the role of expressivity in influencing individual STEM career development. Caldera et al. (2003) have suggested that more studies are needed to investigate how instrumentality and expressivity could contribute to career related variables. This study will add to current understanding of the extent to which gender roles (instrumentality and expressivity) influences the STEM career development among a sample of African American college students.

2.6 Contextual variables

In SCCT, Lent, Brown and Hackett (1994) hypothesized that contextual factors could operate through learning experiences that are sources of shaping self-efficacy and outcome expectations. More specifically, there are two kinds of contextual variables: distal and proximal contextual variables. Distal contextual variables reflect individuals' background influences, which include gender role socialization, familial influences and cultural socialization (Lent, Brown, & Hackett, 1994; Byars-Winston & Fouad, 2008; Byars-Winston, Estrada, Howard, Davis, & Zalapa, 2010). Distal contextual influences affect career development during “formative periods of educational or career development” (Lent et al., 2001, p. 474). Proximal contextual variables are contextual factors that influence individuals’ career development during “active periods of active educational or career choice making” (Lent et al., 2001, p. 475). Proximal contextual variables include personal contacts within the industry, perceived supports and barriers (Lent, Brown, & Hackett, 1994).

2.6.1 Social Supports and Barriers

Proximal contextual factors include social supports and barriers that reflect the social and cultural effects that influence individual career development at the point of choice implementation (Lent, Brown, & Hackett; 1994). Specifically, a more supportive environment with fewer barriers would encourage individuals to set career goals and take actions to pursue certain career paths. Social supports and barriers have important influences on the STEM career development of African American college students. For example, African American students’ experiences of supportive environments at HBCUs might promote their academic confidence, interests and motivation to pursue their career goals (Arroyo & Gasman, 2014). A study by Byars-Winston and Fouad (2008) investigated the contribution of contextual factors to undergraduate students’ academic and career goals. Their results showed that career barriers influence goals through coping efficacy and interests. Another recent study examined the influences of math/science academic self-efficacy, outcome expectations along with ethnic variables and campus climate on the academic interests and goals of 223 ALANA (African American, Latino/a, Southeast Asian, and Native American) undergraduate students majoring in the environmental sciences and biological sciences (Byars-Winston, Estrada, Howard, Davis & Zalapa, 2010). They found that perceived campus climate have indirect influences on academic goals of ALANA students through academic self-efficacy.

However, the degree to which social support and barriers impact career goals and choice actions has been controversial (Lent et al., 2001; Lent et al., 2003; Lent et al., 2005). In SCCT, Lent, Brown and Hackett (1994) posited that proximal contextual variables have direct impacts on career goals and choice actions. Bandura (1999) indicated that social supports and barriers only operate indirectly through self-efficacy. Additionally, some empirical studies have supported Bandura`s proposition that social supports and barriers impact career goals and choice actions through self-efficacy (Lent et al., 2001; Lent et al., 2003; Lent et al., 2005). Lent et al. (2001) found that social supports and barriers impacted choice intentions also indirectly through self-efficacy. Similarly, Lent et al. (2003) found that social supports and barriers impacted educational goals and persistence in engineering indirectly through self-efficacy. These indirect effects were also found by Byars-Winston et al. (2010).

Despite previous studies examining the effects of social supports and barriers on career outcomes; more studies are needed to clarify if social supports and barriers directly or indirectly impact career goals and choice actions through self-efficacy. Additionally, Lent, Brown and Hackett (2000) have suggested that future studies should focus on how contextual supports and barriers impact the career development of diverse samples from different racial and ethnic backgrounds.

2.7 Cognitive Variables

SCCT highlights the central role of cognitive variables in influencing individuals' career development (Lent, Brown, & Hackett, 1994). This section provides a review of studies on self-efficacy, coping efficacy, outcome expectations, career interests and degree goals, respectively.

2.7.1 Self-Efficacy

In SCCT, self-efficacy as a personal agency variable that plays a central role in perceiving and interpreting the environment, and it has significant influences on individuals' behaviors and performance (Lent, Brown, & Hackett, 1994). Bandura (1986) defined self-efficacy as one's confidence in their abilities of organizing and executing a course of action. Bandura (1986) further posited that there are four sources of self-efficacy: mastery experiences, vicarious learning experiences, verbal persuasion and physiological arousal. Self-efficacy is one of the most extensively studied variables within SCCT framework (Lent et al., 1994; Lent et al., 1996; Lent et al., 2008).

Numerous empirical studies have found evidence that self-efficacy plays an important role in impacting individuals' career development process (Lent et al., 2005; Lent et al., 2008; Lent et al., 2011; Lent et al., 2013; Lent et al., 2014; Nauta & Epperson, 2003; Flores et al., 2014; Lee et al., 2015; Lent et al., 2015). Self-efficacy has been studied in STEM education (Lent et al., 2001; Waller, 2006; Quimby, Seyala, & Wolfson, 2007; Byars-Winston & Fouad, 2008), and it has also been studied across gender, racial and ethnic groups (Lent et al., 2005; Waller, 2006; Byars-Winston & Fouad, 2008; Lent et al., 2013; Lent et al., 2014; Lent et al., 2015). More specifically, previous studies have shown that self-efficacy directly impacts outcome expectations (Ferry, Fouad, & Smith, 2000; Lent et al., 2005), college major and career choices (Lent et al., 2002; Lent et al, 2003; Lent et al., 2005), career interests (Ferry, Fouad, & Smith, 2000; Rottinghaus, Larson, & Borgen, 2003; Lent et al., 2005), career goals (Locke &Latham, 2002; Bandura & Locke, 2003; Byars-Winston & Fouad, 2008; Lent et al., 2008; Lent et al., 2010; Lent et al., 2011; Brown et al., 2011), career intentions (Fouad & Smith, 1996), academic persistence (Robbins, Lauver, Le, Davis, Langley, & Carlstrom, 2004), academic achievement (Brown et al., 2008) and school-to-work transition (Kelly, 2009).

Moreover, contextual factors (Lent et al., 2001, 2003b, 2005, 2007) and person inputs are important precursors of self-efficacy and they influence self-efficacy through learning experiences (Robbins et al., 2004). A study of Byars-Winston and Fouad (2008) tested both proximal and distal contextual factors and their relationship with math/science self-efficacy and outcome expectations. They found that math/science self-efficacy mediated the relationship between parental involvement and career interests, and coping efficacy mediated the relationship between perceived barriers and goals (Byars-Winston & Fouad, 2008).

However, other studies have questioned the paths proposed in SCCT from self-efficacy to other variables. For example, a study by Nauta, Kahn, Angell, Cantarelli and Hansen (2002) indicated a reciprocal relationship between self-efficacy and interests. They conducted a longitudinal study on undergraduate students to analyze the strength and direction of the relationship between self-efficacy and interests. In their study, they measured self-efficacy and interests at three time points throughout an academic year. Their results revealed that several self-efficacy-interests paths and interests-self-efficacy paths were significant. Nauta et al. (2002) further explained that interests could be a form of motivation that drives individuals to pursue a course of action and increase self-efficacy after the practice efforts. Armstrong and Vogel (2009, 2010) also supported a bidirectional relationship between self-efficacy and interests. They argued that self-efficacy and interests could be interpreted as components of Holland`s vocational personality themes. Lubinski (2010) also noted in his study that there is a lack of incremental validity in using self-efficacy in addition to cognitive abilities and interests to predict career outcomes. However, Lent et al. (2010) questioned how Armstrong and Vogel (2009) defined and differentiated self-efficacy and interests, and they posited the methodological issues of quantifying self-efficacy-interests relationships. It is suggested that more research should be conducted on the relationship between self-efficacy and interests (Vogel & Armstrong, 2010).

Career decision-making efficacy is a type of self-efficacy that is defined as one's confidence in one's ability to make a career decision (Taylor & Betz, 1983). Blustein, Philips, Jobin-Davis, Finkelberg and Roarke (1997) explained that career decision-making efficacy could be reflected in the process and also in the individual level of stress that is related to career decision-making. Higher levels of career decision-making efficacy is related to higher work satisfaction (Blustein et al., 1997; Lent et al., 2006a; Kelly, 2009) and lower levels of stress (Kelly, 2009). Gushue and Whitson (2006) investigated how gender role attitude, ethnic identity, career decision-making efficacy related to career choice traditionality of Black and Latino/a high school students. Their results indicated that gender role attitudes and ethnic identity were precursors of career decision-making efficacy and students with higher career decision-making efficacy would have lower intentions of choosing a gender traditional occupation. A review of literature revealed that career decision-making efficacy has not been studied comprehensively, and that the relationship between career decision-making efficacy and person inputs and contextual factors has been lacking. Gushue and Whitson (2006) suggested that more research is still needed to examine the role of career decision-making efficacy in SCCT and its influence on individual career development.

2.7.2 Coping Efficacy

Coping efficacy is an individuals' confidence in their ability to overcome obstacles (Lent et al., 2000). The conceptual distinction between self-efficacy and coping efficacy (Lent et al., 2001), and between perceived barriers and coping efficacy (Lent et al., 2000) have been demonstrated. First, self-efficacy is confidence in one`s ability of completing tasks in a certain domain (Lent et al., 2000) and its relationship with coping efficacy has been indicated as two related but distinct constructs in previous studies (Lent et al., 2001; Byars-Winston & Fouad, 2008; Lopez & Yi, 2006). Byars-Winston and Fouad (2008) reported a .42 correlation and Lopez and Yi (2006) reported a .43 correlation between domain specific efficacy and coping efficacy. An examination of the relationship between coping efficacy and self-efficacy can help us understand and enhance coping efficacy (Lindley, 2005). For example, Lindley (2005) conducted a study on 225 undergraduate students and explored self-efficacy in Holland's six types and its relationship with coping efficacy. Her results revealed that conventional and realistic efficacy were strongly related to coping efficacy of male students, which inferred that male students who have higher confidence in their ability of completing tasks in conventional and realistic occupations would have higher confidence in their ability of overcoming the obstacles they encounter in their career development process.

Second, some vocational measurement might confound perceived barriers with coping efficacy (Lent, Brown, & Hackett, 2000). Lent Brown and Hackett (2000) further explained that when investigators are asking subjects to identify their perceived barriers, it is possible that they would not identify a barrier when they think they can cope with it. Hence, it is difficult to distinguish perceived barriers from coping efficacy (Lent, Brown, & Hackett, 2000). It is suggested that a separate measure of coping efficacy should be developed and used along with perceived barriers, which would provide a better understanding of how perceived barriers would impact career development (Lent, Brown, & Hackett, 2000). More specifically, several studies have suggested that coping efficacy plays the role as a mediator in SCCT between social supports and barriers and self-efficacy (Lent et al., 2001; Lent et al., 2003; Lent et al., 2011). In other words, perceptions of barriers can decrease one’s confidence in their ability of overcoming career obstacles and then reduce one’s confidence in his/her ability of executing the actions that are required for pursuing a career path. Meanwhile, perceptions of supports can increase one’s confidence in their ability of overcoming career obstacles and then enhance one’s confidence in their ability of executing the actions that are required for pursuing a career path (Abrams, 2012). Lent et al. (2003) measured self-efficacy, coping efficacy, outcome expectations, interests, academic goals, and contextual variables among 328 undergraduate engineering students. Their results suggested that coping efficacy might have a reciprocal relationship with social supports and barriers, which infers that individuals who have higher levels of coping efficacy could perceive more supports and fewer barriers. Given the close relationship between coping efficacy and contextual supports and barriers, and between coping efficacy and self-efficacy, Lent et al. (2003) suggested that more studies are needed examining the role of coping efficacy in SCCT.

2.7.3 Outcome Expectations

Lent, Brown and Hackett (1994) defined outcome expectations as individuals' perceptions about the consequences of their behaviors. Outcome expectations is hypothesized to interplay with self-efficacy, and thus to directly impact interests, career goals, choice actions and performance (Lent, Brown, & Hackett, 1994). In other words, a person who is more confident in one's ability of organizing and completing a course of career pursuing actions, and who perceives more positive outcomes of the career pursuing behaviors in a certain domain, would have higher interests in that domain. And this person would be more likely to set his/her career goal and have better performance in this career domain. Outcome expectations is also one of the most extensively studied variables in SCCT. Outcome expectations has been studied in STEM education (Lent et al., 2001; Quimby et al., 2007; Byars-Winston & Fouad, 2008), and across gender and racial & ethnic groups (Lent et al., 2005; Waller, 2006; Byars-Winston & Fouad, 2008; Lent et al., 2013; Lent et al., 2014; Lent et al., 2015). Previous studies have found evidence that outcome expectations explained unique variance in career interests (Ferry, Fouad, & Smith, 2000; Lent et al., 2001; Lent et al., 2005; Quimby et al., 2007; Sheu et al., 2010) and choice goals (Ferry, Fouad, & Smith, 2000).

Outcome expectations play a critical role in the interests and choice models within

SCCT, and it is closely related to self-efficacy, interests and choice goals. For example, Bandura (1999) and Lent, Brown and Hackett (1994) posited that self-efficacy is an important source of outcome expectations, which means higher confidence in their ability of completing certain courses of action would result in more positive perceptions of the outcomes. Empirical studies have also shown consistent results that self-efficacy is significantly related to outcome expectations.

Previous studies have also supported the hypotheses of Lent, Brown and Hackett (1994) that the best predictors of interests is to include both self-efficacy and outcome expectations. For example, Quimby, Seyala, & Wolfson (2007) studied self-efficacy, outcome expectations, and career interests of environmental sciences undergraduate students and found that students' career interests could be significantly predicted by self-efficacy and outcome expectations. Another study of Byars-Winston and Fouad (2008) indicated a significant relationship between self-efficacy and interests, and between outcome expectations and interests. Meanwhile, several studies provided evidence that outcome expectations can have an indirect effect on interests or choice goals. Lent et al. (2008) did not find a significant relationship between outcome expectations and interests or between outcome expectations and choice goals of undergraduate engineering students. Another study by Lent et al. (2005) also found a non-significant relationship between outcome expectations and STEM choice intentions of engineering students. In sum, studies have shown that self-efficacy is a precursor of outcome expectations and outcome expectations and self-efficacy together can predict interests. However, more studies are still needed to clarify how outcome expectations contribute to interests and choice goals.

2.7.4 Interests

In SCCT, interest is defined as “likes, dislikes, and indifferences regarding career-relevant activities and occupations” (Lent, Brown, & Hackett, 1994. p. 88). Self-efficacy and outcome expectations are considered to be direct predictors of interests in a particular field (Lent, Brown, & Hackett, 1994). Person inputs (e.g., personality) and contextual factors (e.g., social supports and barriers) are considered to have indirect influences on interests through self-efficacy and outcome expectations (Lent et al., 2001; Lent et al., 2003). More specifically, people with higher levels of self-efficacy and outcome expectations in certain domains are more likely to be interested in domain-related activities, and thus will be more likely to pursue a career goal in that domain. Empirical studies have provided evidence to support the hypotheses in SCCT that: 1) interests are directly predicted by self-efficacy (Lent et al., 2001; Rottinghaus, Larson, & Borgen, 2003; Lent et al., 2005; Lent et al., 2008; Lent et al., 2013; Lent et al., 2015), 2) interests are directly influenced by outcome expectations (Lent et al., 2005; Waller, 2002; Quimby, et al., 2007; Lent et al., 2008; Lent et al., 2013; Lent et al., 2015), 3) interests is an important predictor of choice goals (Lent et al., 2005; Lent et al., 2008), and 4) self-efficacy and outcome expectations influence career choices and performance partially through interests (Lent, Brown, & Hackett, 1994; Lent et al., 2005; Waller, 2002; Quimby, 2007).

However, there have also been arguments regarding the relationship between self-efficacy and interests. Nauta, Kahn, Angell and Cantarelli (2002) conducted a longitudinal study that investigated self-efficacy and interests of undergraduate students. The authors argued that there is a reciprocal relationship between self-efficacy and interests. Subsequently, Armstrong and Vogel (2010) have suggested that more research is still needed to confirm the validity of either unidirectional or bidirectional relationship between self-efficacy and interests.

2.7.5 Choice Goals

Choice goals is defined as the determination to achieve certain outcomes or to be engaged in certain activities (Bandura, 1986). Lent, Brown and Hackett (1994) stated that choice goals would influence individuals to implement self-regulation of behaviors and choice goals can mediate the relationship between interests and choice actions. In the SCCT model, Lent et al. (1994) proposed that learning experiences, self-efficacy, outcome expectations and interests are precursors of choice goals. Previous studies have provided evidence that cognitive ability impacts choice goals through self-efficacy and outcome expectations (Robbins et al., 2004; Brown et al., 2008; Brown, 2011). And self-efficacy (Lent et al., 2003; Lent et al., 2005; Waller, 2002; Byars-Winston & Fouad, 2008; Lent et al., 2011), outcome expectations (Byars-Winston & Fouad, 2008; Sheu et al., 2010), and interests (Sheu et al., 2010) all have direct influences on choice goals. For example, a study of Waller (2002) examined the STEM career development of African American college students. He found a moderately significant standard path coefficient between math self-efficacy and math choice intentions.

Despite previous research on choice goals, the relationship between outcome expectations and choice goals is not conclusive. For example, Waller (2002) did not find a significant relationship between outcome expectations and choice goals. Additionally, Lent et al. (2005) also found a non-significant relationship between outcome expectations and STEM choice intentions of engineering students. However, the studies of Byars-Winston and Fouad (2008) and Lent et al. (2001) found significant relationships between outcome expectations and choice goals. Lent et al. (2001) argued that the relationship between outcome expectations and choice goals is partially mediated by interests. More research is needed to investigate whether outcome expectations have a direct impact on choice goals or if outcome expectations impact choice goals through other variables (e.g., interests or self-efficacy).

Finally, how contextual factors impact choice goals has raised controversy. Lent, Brown and Hackett (1994) proposed that proximal contextual barriers could have direct effects on choice goals and distal contextual factors could have indirect effects on choice goals through self-efficacy, outcome expectations and interests. However, Bandura (1999, 2000) suggested that contextual factors can only influence on choice goals through self-efficacy. A meta-analysis of Sheu et al. (2010) supported both direct and indirect paths from contextual supports and barriers to choice goals, but the direct paths from contextual support and barriers to choice goals were consistently small across six themes, and only three of them were significant (Sheu et al., 2010). Sheu et al. (2010) indicated that the indirect influences of contextual supports and barriers were supported by the results of their study. Sheu et al. (2010) also suggested that there might be moderators that influence the effects of social supports and barriers on choice goals. Lent and his colleagues (2000, 2001) also conducted studies that supported the indirect influences of contextual supports and barriers on choice goals (Lent et al., 2000; Lent et al., 2001). Additional research is needed to describe the relationship between outcome expectations and choice goals (Lent et al., 2003b; Lent et al., 2005; Lindley, 2005; Rivera et al., 2007), and how contextual supports and barriers could influence choice goals (Lent et al., 2001; Lent et al., 2005; Sheu et al., 2010).

2.8 Choice Actions

The choice process in SCCT is subdivided into choice goals/intentions and choice actions (Lent, Brown, & Hackett, 1994). Choice actions in SCCT refer to the actions taken by individuals to implement the choice intentions (Lent, Brown, & Hackett, 1994). Choice actions include enrollment in a training program or any other activities that could help with individual career pursuits. Regarding the role of choice actions within SCCT, Lent, Brown and Hackett proposed that: 1) choice goals have direct effects on choice actions, and it also plays an intermediate role between self-efficacy, outcome expectations, interests and choice actions; 2) self-efficacy has both direct and indirect effects on choice actions through outcome expectations and interests; 3) outcome expectations have direct effects on choice actions; 4) the relationship between choice goals and choice actions could be moderated by proximal contextual factors, and choice actions could be directly impacted by proximal contextual variables; 5) choice actions have direct effects on performance and experience attainment. Thus, once a person sets clear career goals, it is more likely that he/she would execute actions to achieve the goals (Lent, Brown, & Hackett). Additionally, individuals' positive beliefs on outcomes of pursuing certain careers could also result in people's adoption of courses of actions in career pursuits (Lent, Brown, & Hackett). Lent, Brown and Hackett further suggested that if one is encountering barriers at the time of setting career goals or taking actions, this person might change their career goals or actions. For example, an individual who is very interested in art would set a career goal at being an artist, but if this person cannot afford to finish a bachelor's degree in art, this person might have to change his/her career goals and corresponding actions. In SCCT, career choice action can help individuals achieve their career aspirations or goals (Lent, Brown, & Hackett, 1994). Career exploration is an important type of choice action (Rogers & Creed, 2011) and will be examined in the current study as a career outcome variable. The following section is a summary of previous studies on career exploration.

2.8.1 Career Exploratory Behaviors

Career exploration is defined as the purposeful cognition or behaviors that aim at gaining information about occupations, organization and jobs that were not previously in the stimulus field (Stumpf, Colarelli, & Hartman, 1983). By collecting and organizing information during career exploration, one could develop realistic career plans and goals (Sugalski & Greenhaus, 1986). In the literature, Blustein et al. (1997) subdivided career exploration into self-exploration and environmental exploration. Self-exploration is defined as the degree of self-assessment and introspection in which a person engages within the last three months (Stumpf, Colarelli, & Hartman, 1983). In the context of SCCT, environmental exploration can be defined as the degree to which one is engaged in activities that are directed by career goals (Kelly, 2009). Career exploration plays an important role in the career development process in that career exploration supports the processing of gaining occupational information (Stumpf, Colarelli, & Hartman, 1983) and it provides valuable learning experiences for formation of career interests and career value establishment (Betz, 1999). Also, self- and environmental exploration have been found to correlate positively with job satisfaction and self-exploration can also lead to self-knowledge that could facilitate school-to-work transition (Blustein et al., 1997).

Super (1957) stated that late adolescence and early adulthood are the most prominent times for career exploration. However, more attention has been paid to career exploration of high school students (Rogers et al., 2008; Rogers & Creed, 2011; Olle &

Fouad, 2014; Gushe, Scanlan, Pantzer, & Clarke, 2006). The research on career exploration of college students has been lacking. Blustein (1989) measured goal instability, career decision-making self-efficacy, and career exploration of 106 college students. Canonical analysis was used to examine the relationship between predictor variables and criterion variables. Blustein (1989) found that goal-directedness was associated with career exploration to a less degree than career decision-making self-efficacy. Leal-Muniz and Constantine (2005) surveyed a sample of 204 Mexican American undergraduate students and examined how perceived parental support, perceived career barriers, and adherence to career myths would predict vocational exploration and commitment and tendency to foreclose on career options. They found that perceived parental support positively predicted vocational exploration and commitment, while negatively predicting tendency to premature foreclosure on career options. Additionally, career barriers and adherence to career myths positively predicted tendency to foreclosure on career options.

Studies that explore how social cognitive variables (e.g., career decision-making efficacy, outcome expectations, interests and goals) and contextual variables (e.g., social supports and barriers) interplay with each other to influence career exploration are lacking. Kelly (2009) used SCCT as his framework and comprehensively examined if career decision self-efficacy, work outcome expectations, self and environmental career exploration, overall life satisfaction, and socioeconomic status could predict adaptive high school to work transition in a sample of 92 young adults. He found that career decision self-efficacy, work outcome expectations, and overall life satisfaction are all related to job satisfaction. Kelly (2009) also found that self and environmental career exploration was not related to job satisfaction. These findings are contrary to Blustein et al. (1997) who found that self and environmental career exploration was related to job satisfaction.

To date, few SCCT studies have focused on the career exploratory behaviors undergraduate students who major in agricultural sciences. Esters (2008) examined the extent to which career exploration influenced the career certainty of 312 undergraduate students who majored in the agricultural and life sciences. He found that career exploration explained 35% of variance in career certainty for freshmen, and explained 40% of variance in career certainty for seniors. Despite the findings, no studies have been found that explored the career exploratory behaviors of African American college students who pursue STEM-intensive agricultural sciences majors. To address this issue, the current study will explore how personal, contextual and cognitive factors influence the career exploratory behaviors of African American college students pursuing STEM-intensive agricultural majors.

2.9 STEM Career Development of African American College Students

African American students are significantly underrepresented in STEM majors and careers (Lent et al., 2015). Previous literature has revealed that STEM interests and aptitude (Moore, 2008), accessibility to rigorous STEM courses and qualified teachers in K-12 education (National Science Foundation, 2013), social and academic support (Moore, 2008) and contextual factors (Perna, et al., 2009) play an important role in African American students' pursuing a STEM major or career. For example, a study of African American male students, Moore (2008) identified five themes that impact African American male students pursuing a STEM major or career: 1) STEM interests, 2) familial influence and encouragement, 3) strong science and mathematics aptitude, 4) academic experiences and relationships with school personnel, 5) exposure to advanced curricula and career-related programs. Another study of African American female students indicated that academic (prior STEM preparation), psychological and financial barriers limit African American female students' persistence in STEM (Perna et al., 2009). However, these barriers could be mitigated by institutional practices (Perna et al., 2009). From previous studies, cognitive factors (e.g., academic abilities and interests) and contextual factors (e.g., social and academic support and financial barriers, institutional practices) have been identified as playing critical roles in the career development process of African American students.

The social cognitive career theory (SCCT) is a comprehensive framework to describe the career development process was proposed by Lent et al. (1994, 2005, 2011), and numerous empirical studies have proved its validity in explaining the STEM career development of African American students. For example, Gainor and Lent (1998) conducted a SCCT study of 164 African American students attending a Predominantly White Institution (PWI) and found that African American students' confidence in their capability of completing math related tasks and how they expected their math learning outcomes could predict their choice of college major indirectly through interests (Gainor & Lent, 1998). Another study comparing HBCUs and PWIs students indicated that African American students' persistence in computing majors is directly linked to their confidence in their ability of completing academic tasks (self-efficacy), their expectation of persisting in computing majors (outcome expectations), and social supports and barriers (Lent et al., 2011). Specifically, social supports and barriers impact African American students' persistence in computing majors indirectly through self-efficacy (Lent et al., 2011). Lent et al. (2011) also noted that social supports and barriers impact African American students' persistence in computing barriers indirectly through self-efficacy. Lent et al. (2005) conducted another study on PWIs and HBCUs engineering students. They found that the SCCT interest and choice models provided good fit for engineering students from both PWIs and HBCUs, indicating that African American students' interests are predicted by self-efficacy and outcome expectations, and African American students' career choice goals are predicted by self-efficacy and outcome expectations directly and indirectly through interests. They also found that environmental supports and barriers influenced career goals indirectly through self-efficacy and barriers also have significant and direct impacts on choice goals (Lent et al., 2005). Several longitudinal studies also validated the social cognitive career model among African American and Caucasian engineering students (Lent et al., 2008; Lent et al., 2013; Navarro, Flores, Lee, & Gonzalez, 2014; Lent et al., 2015). Collectively, these studies indicate that self-efficacy, outcome expectations, and supports influence academic satisfaction and persistence of college engineering students (Lent et al., 2008; Lent et al., 2013; Navarro, Flores, Lee, & Gonzalez, 2014; Lent et al., 2015). Previous studies have also corroborated that cognitive factors (e.g., self-efficacy, outcome expectations and interests) and contextual factors (e.g., social supports and barriers) are key factors impacting African American college students' academic interests, choices and persistence.

To date, there have been no SCCT studies focusing on African American college students majoring in STEM-intensive agricultural sciences disciplines. Byars-Winston et al. (2010) conducted a multi-group study examining the extent to which social cognitive, cultural and contextual variables influenced URM college students pursuing biological sciences and engineering majors. Their results indicated that for URM groups at PWIs pursuing either a biological science or an engineering degree, it is equally important for them to feel confident on their academic tasks (self-efficacy) and perceive positive consequences of obtaining the degree (outcome expectations). Byars-Winston et al. (2010) suggested that interventions should be conducted to promote URM students' positive interaction with peers, faculty, and staff from other ethnic backgrounds. More studies are needed to comprehensively examine how cognitive and contextual factors influence the career development of African American college students who major in STEM-intensive agricultural sciences disciplines.

2.10 Lack of SCCT Research on STEM Career Development of African American College Students

The SCCT framework provides a lens through which contextual factors such as social supports and barriers can be examined in concert with various personal and cognitive factors. However, there is a lack of SCCT research on the career development of culturally diverse population (Byars-Winston, 2008), especially studies that focus on African American college students.

As described in previous sections, Lent et al. (2005) examined the engineering career choices of students from a PWI and two HBCUs. Lent and his colleagues (2008; 2013; 2015) also conducted a longitudinal study on the SCCT adjustment model. They described how positive effects of social supports and cognitive variables might impact persistence of engineering majors across gender and ethnicity groups. They found that SCCT is equally predictive of engineering career choices of students from PWIs and HBCUs, and for students from different racial and ethnical backgrounds. However, Lent et al. (2005) also found that engineering students attending HBCUs reported higher self-efficacy, outcome expectations, technical interests, social supports and educational goals than their counterparts at PWIs. Considering previous studies have shown possible racial and ethnic differences on the STEM career development process, more SCCT studies are needed focusing on African American college students.

Finally, most studies on the STEM career development of African American college students have focused on computing majors (Lent et al., 2011), engineering majors (Lent et al., 2005; Lent et al., 2008; Lent et al., 2015), and math/science majors (Lent & Brown, 2001). However, little is known about the career development of African American college students who major in other STEM-intensive disciplines. Given that the career development African American college students from STEM majors other than math and science is still unknown, the current study will explore career development of African American college students who pursue STEM-intensive agricultural sciences majors.

2.11 Role of HBCUs in STEM Preparation of African American College Students

Despite the overall underrepresentation of African American students in STEM, HBCUs have been effective in promoting STEM educational attainment of African American students (Palmer, Maramba, & Gasman, 2013). For example, Gasman (2012) demonstrated that HBCUs educated their students to succeed in an increasingly globalized world with 58% of HBCUs providing students opportunities to study abroad. HBCUs also serve a disproportionately high percentage of low-income students. For example, 98% of African American students enrolled at HBCUs qualify for need-based federal aid. Moreover, HBCUs have made significant contributions to STEM education for African American students. In 2012, 32.1% of the bachelor`s degrees in agricultural sciences awarded to African American students were from HBCUs, 28.1% in biological sciences, 14.3% in computer sciences, 29.5 in mathematical sciences, 7.6% in earth, atmospheric, and ocean sciences, 33.4% in physical sciences, and 19% in engineering (National Science Foundation, 2013).

Numerous researchers have acknowledged the prominent role of HBCUs in preparing African American students in STEM (Gasman, 2010; Palmer & Gasman, 2008; Perna et al., 2009), especially when other venues were closed for African American students (Palmer & Gasman, 2008). Rankin and Reason (2005) found that African American students experienced alienation and racial isolation (Astin, 1975) and were less engaged on PWIs campuses compared to their White counterparts. Also, PWIs were lacking ethnic diversity in their student population and they were lacking institutional responsibility in facilitating African American students' success in STEM (Gasman, 2012). Conversely, many studies demonstrated that HBCUs provided a more supportive and nurturing learning environment for African American students, which provide African American students with more leadership opportunities, and promoted African American students' satisfaction, confidence and academic gains (Astin, 1975; Fleming, 2001). More specifically, Gasman (2012) indicated that compared to PWIs, HBCUs: 1) developed a STEM community that emphasized success of all students, which does not make assumptions about African American students, 2) formed a cooperative rather than a competitive learning environment, 3) incorporated role models in course readings and used concrete examples to inspire African American students, 3) hired more faculty of color, 4) organized advising and tutoring programs, 5) provided ample research opportunities for students, and, 6) formed partnerships with local middle and high schools to identify students who are interested in STEM.

From a social cognitive career theory perspective, Lent et al. (2005) suggested that HBCUs contain positive environmental features (e.g., more contextual supports, less contextual barriers, effective role modeling conditions) that can promote academic progress and career aspirations. Lent et al. (2005) also compared the career development of undergraduate students attending HBCUs and PWIs, and they found that compared to their counterparts at PWIs, HBCUs students who were enrolled in an introductory engineering class held higher efficacy beliefs, outcome expectations, greater interests and more environmental supports in engineering learning and in pursuing an engineering major. Additionally, Lent et al. (2010) also investigated engineering students attending two HBCUs (93% of them identified themselves as African Americans). Lent et al. (2010) further noted that social supports play a unique role in aiding African American students to persist in their academic goals. In another study by Lent et al. (2011), they studied self-efficacy, outcome expectations, interests, goals, social supports and barriers of computer science majors at PWIs and HBCUs. They found that compared to European American students, the path from self-efficacy to outcome expectations is larger for

African American students, which means that compared to European American students, African American students' self-efficacy can predict outcome expectations to a larger degree when they are choosing their future career. More research is needed to clarify how outcome expectations and self-efficacy influence African American students' career choices. Although several empirical studies have indicated good model fit of SCCT among African American students attending HBCUs, previous research has also indicated mixed findings regarding if there are any racial or ethnic differences on the path from self-efficacy to outcome expectations (Lent et al., 2011) and what is the role of social supports and barriers within social cognitive career model in influencing African American students' career development (Lent et al., 2005; Lent et al., 2008; Lent et al., 2010). As such, more SCCT studies should focus on African American STEM students.

The literature has revealed that more studies have focused on underachievement of minority students in STEM. However, we know little about how these students successfully navigate their way through the post-secondary education pipeline. Since HBCUs play an important role in educating and promoting student success of African American students (Gasman, 2009; Gasman, 2010), they provide a good context to study African American students' success in STEM. More specifically, previous studies have indicated that the environment of HBCUs is an important source of positive learning experiences of African American students (Clay, 2013). Additionally, several SCCT studies found that contextual factors have important influences on African American students' STEM career outcomes. However, previous SCCT studies have shown mixed findings on how cognitive and contextual factors could influence African American college students' STEM career development.

2.12 Lack of Research on Social Cognitive Career Development of STEM-Intensive Agricultural Sciences Majors attending HBCUs

A review of previous research has revealed only one study that examined the career development of agricultural sciences related majors using the SCCT framework. This study was conducted by Byars-Winston et al. (2010), and it examined the career interests and goals of 223 African American students, Latino/a, Southeast Asian, and Native American (ALANA) undergraduate students in two groups: biological science and engineering majors. Using social cognitive career theory as their framework, Byars-Winston et al. (2010) examined social cognitive variables (math/science self-efficacy and math/science outcome expectations) and ethnic variables (ethnic identity and other-group orientation) and perceptions of campus climate, and how these variables influenced ALANA students' career interests and goal commitment. Consistent with the SCCT framework, students' math/science self-efficacy and outcome expectations were significantly related to their interests and goal commitment. However, when examined closely, their results revealed noticeable group differences between biological sciences and engineering students. First, the path from academic self-efficacy to goal commitment was only significant for biological science students. Byars-Winston et al. (2010) indicated that this significant path might reflect a direct link between biological science students' beliefs about their performance and the likelihood of their success. Second, the path from interests to goal commitment was only significant for engineering students, but not significant for biological science students. Byars-Winston et al. (2010) further indicated that this significant interests-goal relationship among engineering students may reflect Lent, Brown and Hackett (1994)'s proposition that the interests-goal relationship would be stronger for those who perceive a favorable environment to translate their interests into goals. However, Byars-Winston， Estrada, Howard, Davis and Zalapa (2010) did not measure perceived environmental supports and barriers, adding to speculation of whether a non-significant interest-goal relationship would be revealed.

2.13 Need of Study

Gender role (e.g., personality) and contextual factors (e.g., social barriers, social supports, access to role models in STEM, guidance, curriculum, etc.) are important factors in career considerations. For example, contextual factors can influence students' feeling of either more or less welcomed on campus, and the social resources they have access to while encountering difficulties (Clay, 2013; Byars-Winston et al., 2010). Despite current efforts, influences of gender role and contextual factors in SCCT are still understudied (Lent et al., 2000), and what factors can influence career exploratory behaviors is also understudied (Rogers, Creed, & Glendon, 2008). This study extended the scope of social cognitive career theory. Specifically, this study will examine how gender role as well as contextual factors can predict career exploratory behaviors.

Furthermore, although numerous studies have investigated SCCT, there is a lack of research related to the career development of African American college students (Lent et al., 2005). Byars-Winston (2010) also stated that additional studies are needed to determine how personal, contextual and cognitive factors impact the STEM career goals and career choice actions of African American students attending HBCUs. Given the rapidly growing African American population and their underrepresentation in STEM education and the workforce, more studies are needed to add to our understanding of the STEM career development of African American college students. Several researchers have found that African American students from HBCUs are more likely to choose STEM as their major (Clay, 2013; Poirier et al., 2009; National Science Board, 2010; Arroyo & Gasman, 2014). Previous research has also shown that HBCUs have positive features that foster African American students' success in STEM (Lent et al., 2005). Thus, HBCUs can provide an ideal context to explore factors that influence the STEM career development of African American students. However, few studies have examined how contextual and cognitive factors influence STEM career development of African American students attending HBCUs.

Finally, the career development of students who are enrolled in STEM intensive majors within the agricultural sciences has not been explored. The agricultural sciences sector has difficulties in recruiting talented individuals (Bobbitt, 2006) and many students who major in agricultural sciences disciplines are also encountering career barriers (National Research Council, 2009). To date, no studies have been conducted that explore the career development of African American college students who pursue STEM-intensive agricultural sciences majors. Collectively, research that examines the STEM career development of African American students attending HBCUs, especially who are majoring in STEM-intensive agricultural sciences majors is needed. The current study will provide much needed information that could enhance our understanding on how personal, contextual and cognitive factors predict choice actions of African American students who are enrolled in STEM-intensive agricultural sciences majors at HBCUs.

2.14 Chapter Summary

Social cognitive career theory (SCCT, Lent, Brown, & Hackett, 1994) was presented as the theoretical framework for this study. This theory is derived from social learning theory of Bandura (1986) and aims to describe how person, environment and behaviors might impact each other and thus influence individual career development. The conceptual framework was outlined, which includes three sets of variables: contextual variables which for this study included gender roles (a person input variable) and social supports and barriers (proximal contextual variables); cognitive variables includes self-efficacy (career decision-making efficacy and coping efficacy), outcome expectations, interests and choice goals. The career outcome variable of focus in the current study is career exploratory behaviors. A review of previous studies on each variable was conducted and introduced. The literature revealed that career exploration as an important career development factor has been understudied within the SCCT framework. There is also a lack of studies on how gender roles influence career exploratory behaviors. Despite SCCT showing good overall model fit across gender and ethnicity groups, several studies have shown mixed results regarding the paths among cognitive factors proposed by Lent, Brown and Hackett (1994). Additionally, more research is needed to address issues regarding how social supports and barriers influence career exploratory behaviors.

A review of the literature also revealed that more studies are needed on African American college students. In addition, previous SCCT studies on the STEM career development were primarily conducted within math/science and engineering disciplines. Finally, to date, no studies have been conducted on the career development of African American college students who pursue STEM-intensive agricultural sciences majors. Developing a more clear understanding of the factors that contribute to African American college students' career development could lead to interventions aimed at helping increase the number of students who pursue STEM-intensive agricultural sciences majors and who are employed in the agricultural sciences workforce.

CHAPTER 3. METHODOLOGY

3.1 Introduction

This chapter will provide an overview of the research procedures and methods employed in this study. This chapter will describe the purpose, research questions and hypotheses, research design, and the criteria used to choose selected HBCUs and STEM-intensive majors.

This chapter will also explain the selection of the items used to measure the variables as well as the reliability and validity of the measures. Finally, this chapter will conclude with a description of the data collection procedures, participant response rates, and data management and analyses procedures.

3.2 Purpose of the Study

The purpose of this study was to examine the influence of contextual and cognitive factors on the career goals and career exploratory behaviors of African American undergraduate students pursuing STEM-intensive agricultural sciences majors at HBCUs.

3.3 Research Questions

This study aims to examine Lent`s (1994) social cognitive career model by testing three research questions and hypotheses in this study:

Research Question 1: To what extent does gender roles influence career exploratory behaviors?

Hypothesis 1: Gender roles will positively influence career exploratory behaviors through its indirect influences on self-efficacy and outcome expectations.

Research Question 2: To what extent do social supports and social barriers, influence career exploratory behaviors?

Hypothesis 2: Social supports and barriers will influence career exploratory behaviors directly and indirectly through career goals.

Research Question 3: To what extent do self-efficacy and outcome expectations influence career exploratory behaviors?

Hypothesis 3: Self-efficacy and outcome expectations will have direct and indirect influences on career exploratory behaviors through career interests and career goals？

Research Question 4: What additional factors influence students' pursuit of a STEM-intensive agricultural sciences major?

3.4 Research Design

This study used a quantitative research design to examine the career development process of African American undergraduate students pursuing STEM-intensive agricultural sciences majors. Research questions one through three were analyzed using structural equation modeling. The rationale for this approach was taken because of the complexity of this study's theoretical and conceptual framework. Additionally, this analysis approach is chosen based on the recommendation of the literature concerning research using the social cognitive career theory framework. This study was conducted from a positivism paradigm, which refers to the approach that assumes there is a true nature of a phenomenon, and it relies on logics, scientific evidence and reports of experience to reveal this true nature (Larrain, 1979). Hence, a survey research design allows the participants to report their perceptions, cognitions, attitudes and behaviors as defined and operationalized by the SCCT.

3.5 Institutional Review Board Approval

To protect the rights of the participants, the researcher completed the Collaborative Institutional Training Initiative (CITI) Course in The Protection of Human Research Subjects online training. The researcher then submitted the IRB application, research survey instrument, a description of the research purpose, participants consent forms, survey administration script, and the institutional correspondence letters to the Institutional Review Board of Purdue University. The research was granted exemption of *"Influence of Social Cognitive Variables on the Career Goals and Exploration Behaviors of Minority Undergraduate Agricultural, Environmental and Live Science Majors at Historically Black Colleges and Universities (HBCUs)"* from IRB on March 5, 2014 for IRB protocol number 1402014458 (Appendix A). The researcher later submitted an Amendment to Approved Study, requesting to use an information sheet instead of a consent form because of the plan to survey adult students in addition to there being no confidential information or potential risks involved in the study. The Amendment was granted exemption on September 30, 2014. There were five HBCUs willing to participate in the study: Kentucky State University (KSU), University of Arkansas-Pine Bluff (UAPB), North Carolina A & T State University, University of Maryland-Eastern Shore (UMES), and Virginia State University (VSU). IRB applications were submitted for KSU and UAPB. We received IRB approval from Kentucky State University on October 17, 2014 and from UAPB on September 23, 2014. The remaining three institutions: University of Maryland-Eastern Shore, Virginia State University, and North Carolina A&T State University informed us that Purdue's IRB approval was sufficient for the study to be conducted with their students.

3.6 Selection Criteria for Institutions

The target population for the study were all 18 1890 Historical Black Land-Grant Institutions in the United States. Eighteen colleges and universities were established by the 2nd Morrill Act of 1890 in the southern states with the mission of teaching agriculture and the mechanical arts to African Americans. We targeted this group of institutions because they have a focus of teaching agricultural sciences for African American students. After correspondence, five of the universities agreed to collaborate on this research projects. As previously mentioned, the HBCUs participating in this study included: Kentucky State University, University of Arkansas-Pine Bluff, University of

Maryland-Eastern Shore, Virginia State University, and North Carolina A&T State University.

HBCUs have served an important role in preparing African American students in pursuing their careers in STEM (Arroyo & Gasman, 2014). Further, the literature has revealed that there is a need of investigating why compared to PWIs, HBCUs have been more effective in promoting STEM educational attainment of African American students. Moreover, several researchers have indicated how HBCUs have provided a more welcoming and supportive climate for African Americans pursuing their education (Rankin & Reason, 2005; Gasman, 2012). Hence, HBCUs provide an ideal context to examine the extent to which contextual and environmental factors influence African American students' career development.

3.7 Selection Criteria for Study Participants

Undergraduate African American students pursuing STEM-intensive agricultural science majors were the target population of this study. Study participants also had to meet the following criteria in order to be included in the final data analysis: 1) were a full-time and domestic student, 2) were enrolled in a bachelor's degree program, and 3) were an African American student. There were 313 participants who have met the criteria and were included in the final data analysis.

To meet the requirements of being a STEM-intensive agricultural science major, the majority of the bachelor's degree course requirements needed to be STEM courses.

For the purpose of this study, STEM-intensive agricultural majors were defined as majors where 50% or more of the courses on a degree plan of study are Science, Technology, Engineering and Mathematics and prepared students for agricultural careers. Specifically, the number of STEM credit hours on a degree plan of study were counted for each major. Afterwards, the total of STEM credit hours was then divided by the total number credit hours required for the major. If this percentage was 50% or more, the major was considered STEM-intensive. Below are the specific steps that were used to evaluate courses on a plan of study for each major and to determine whether or not it was a STEM-intensive course. The plans of studies for each institution in this study can be found in Appendix B.

3.7.1 Selection Criteria for STEM-Intensive Majors

1. Any course name that includes the words “lab, science, technology, engineer, and mathematics, the suffix -ology” was considered a STEM course.

2. If the course name was ambiguous, the course description was checked for the amount of the STEM content embedded in the course. For example, a course on scientific methods was treated as STEM-intensive if the course description indicated that it included a significant amount of statistics content.

3. Courses listed as general or “free” electives were not counted as STEM-intensive courses because these electives included course options from all the other departments (e.g., psychology, arts). However, if the electives choices were clarified and

restricted within STEM departments (e.g., “animal science electives”) are mostly STEM courses, so they are counted as STEM courses.

4. If there were alternative courses required on a plan of study (indicated by an “or” in the description), these courses were counted as STEM only if both course alternatives were STEM.

7. Social sciences were not considered as STEM (e.g., sociology, education, social psychology, consumer behaviors).

8. For Kentucky State University, the course requirements of the Department of Family and Consumer Sciences was not provided, and the department chair and other relevant staff did not reply to requests regarding obtaining copies of their plans of study, so majors from their department were not included in this study.

Below are tables listing the institutions, bachelor’s degree programs, department or division name, STEM-intensive majors, number of credit hours required for degree, number of STEM-intensive credit hours required for degree, and percentage of STEM-intensive credit hours included in the study (Tables 3.1-3.5).

Table 3.1

Academic Department, Bachelor's Degree Program, and STEM-Intensive Major for Kentucky State University

Department	**Bachelor's Degree Program** • STEM-Intensive Majors	**Number of Credit Hours Required for Degree; Number of STEM-Intensive Credit Hours Required for Degree; Percentage of STEM-Intensive Credit Hours**
Agriculture and Natural Resources	Agricultural Systems	120 credits; 60 credits; 50.8%
Aquaculture	Aquaculture	120 credits; 86 credits; 71.7%
Environmental Studies & Sustainable Systems	Agriculture, Food & Environment	120 credits; 61 credits; 50.8%
Food and Animal Science	Food and Animal Science • Food Science • Agricultural Systems (Animal Science)	 120 credits; 61 credits; 50.8% 120 credits; 61 credits; 50.8%

Table 3.2

Academic Department, Bachelor's Degree Program, and STEM-Intensive Majors for North Carolina A&T State University

Department	Bachelor's Degree Program • STEM-Intensive Majors	Number of Credit Hours Required for Degree; Number of STEM-Intensive Credit Hours Required for Degree; Percentage of STEM-Intensive Credit Hours
Animal Science	Animal Science	79 credits; 125 credits; 63%
	Animal Industry	64 credits; 125 credits; 51%
	Lab Animal Science	79 credits; 125 credits; 63%
Biological and Environmental Sciences	Biological Engineering • Bioprocess Engineering • Natural Resources Engineering	 128 credits; 82 credits; 64.6% 128 credits; 78 credits; 60.94%
	Environmental Studies • Environmental Studies • Urban and Community Horticulture • Sustainable Land Management	 124 credits; 64 credits; 51.6% 126 credits; 68 credits; 54% 63 credits; 124 credits; 50.8%
Family and Consumer Sciences	Food and Nutritional Science • Food Science • Pre-Medicine Nutrition	 124 credits; 83 credits; 66.9% 66 credits; 125 credits; 52.8%

Table 3.3

Academic Department, Bachelor's Degree Program, and STEM-Intensive Majors for University of Arkansas-Pine Bluff

Department	**Bachelor's Degree Program** • STEM-Intensive Majors	**Number of Credit Hours Required for Degree; Number of STEM-Intensive Credit Hours Required for Degree; Percentage of STEM-Intensive Credit Hours**
Agriculture	Plant and Soil Science	120 credits; 76 credits; 63.3%
	Animal Science	120 credits; 74 credits; 61.7%
	General Agriculture	120 credits; 62 credits; 51.7%
	Regulatory Science • Agricultural Science • Environmental science • Industrial health and safety	 120 credits; 66 credits; 55% 120 credits; 66 credits; 55% 120 credits; 64 credits; 53.3%
Aquaculture and Fisheries	Fisheries Biology	120 credits; 64 credits; 53.3%

Table 3.4

Academic Department, Bachelor's Degree Program, and STEM-Intensive Majors for University of Maryland-Eastern Shore

Department	**Bachelor's Degree Program** • STEM-Intensive Majors	**Number of Credit Hours Required for Degree; Number of STEM-Intensive Credit Hours Required for Degree; Percentage of STEM-Intensive Credit Hours**
Agriculture, Food, and Resource Sciences	General Agriculture	120 credits; 61 credits; 50.8%
	Animal and Poultry Science- • Business and Technology • Pre-Vet/ Pre-Professional	120 credits; 65 credits; 54.2% 120 credits; 78 credits; 65%
	Plant and Soil Science Urban Forestry	121 credits; 69 credits; 57% 121 credits; 61 credits; 50.4%
Human Ecology	Dietetics	120 credits; 68 credits; 56.7%
	Family and Consumer Science- • Nutrition	120 credits; 74 credits; 61.7%

Table 3.5

Academic Department, Bachelor's Degree Program, and STEM-Intensive Majors for Virginia State University

Department	**Bachelor's Degree Program** • STEM-Intensive Majors	**Number of Credit Hours Required for Degree; Number of STEM-Intensive Credit Hours Required for Degree; Percentage of STEM-Intensive Credit Hours**
Agricultural Sciences	Animal Science	121 credits; 92 credits; 76%
	Pre-Vet Medicine	120 credits; 94 credits; 78.3%
	Aquatic Science	122 credits; 81 credits; 66.4%
	Environmental Science	121 credits; 86 credits; 71.1%
	Plant and Soil Science	
	• Horticulture	122 credits; 93 credits; 76.2%
	• Plant and Soil Science	122 credits; 93 credits; 76.2%

3.8 Instrumentation

A review of literature revealed no single instrument that met the objectives of the study. As a result, a multi-method approach was taken to develop a single instrument to measure the variables of the study. The final instrument elicited information regarding: 1) demographic characteristics, 2) gender role, 3) career decision-making self-efficacy, 4) coping efficacy, 5) outcome expectations, 6) career interests, 7) degree goals, 8) career exploratory behaviors, and 9) social supports and barriers. Additionally, a section with two open-ended questions was included which asked participants to identify: 1) additional factors that hindered African American students' pursuing a degree in a STEM-intensive agricultural sciences major, 2) factors that helped students' pursuing a degree in a STEM-intensive agricultural sciences major. The instrument used in this study can be found in Appendix C.

3.8.1 Demographic Characteristics

The first section of the instrument contained items regarding demographic information about the study participants. These items elicited information such as: participants' age, gender, current year in college, university, major, degree commitment, post-degree plans (Are you interested in pursuing a degree after you complete your bachelor's degree?), race/ethnicity, and parents' level of education. For the purpose of this study, when a participant identified themselves as having a mixed racial and ethnic ancestry which included being African American, these participants would be considered an African American student.

3.8.2 Gender Role

The Gender Roles was assessed using the Personal Attributes Questionnaire (PAQ; Spence, Helmreich, & Stapp, 1974). The PAQ is a 24-item instrument measuring gender role related social and emotional attributes (Caldera, Robitschek, Frame, & Pannell, 2003). It includes three subscales: 1) Instrumentality (Masculinity subscale), 2) Expressivity (Femininity subscale), and 3) Male-Female subscale. This study only utilized the Instrumentality and Expressivity subscales which contains a total of 16 pairs of bipolar adjectives. Participants were asked to rate "How you perceive yourself." Participants are to choose where they fall on the scale, between each pair of two contradictory characteristics. An example of an item on the Instrumentality subscale was: *Not at All Independent* & *Very Independent*. An example of an item on the Expressivity subscale was: *Not at All Emotional & Very Emotional*. The scores on the items were summed resulting a possible total score of 8-40 and higher scores on the instrumentality scale indicate a higher level of instrumentality. Also, the scores on the items were summed resulting a possible total score of 8-40 and higher scores on the expressivity scale indicate a higher level of expressivity. Caldera et al. (2003) reported that with a female Mexican American sample, the Cronbach's *alpha* was 0.81 for the Instrumentality subscale and 0.79 for the Expressivity subscale. With a non-Hispanic White women sample, the post-hoc reliability coefficient was 0.75 for the Instrumentality subscale and 0.72 for the Expressivity subscale (Caldera et al., 2003). For the current study, the post-hoc reliability coefficient of instrumentality subscale was 0.62, and the *alpha* coefficient of the expressivity subscale was 0.80. Because the reliability coefficients of instrumentality subscales were not satisfying (> 0.70), confirmatory factor analysis on the gender role subscales were conducted.

3.8.3 Career Decision-making Self-Efficacy

Section three of the survey sought information on participants' confidence in their ability of making career decisions. This measure contained nine items developed by Restubog, Florentino and Garcia (2010). This 9-item scale was developed from the 25-item full scale developed by Betz, Klein and Taylor (1996). This section contained nine statements describing different activities and each participant was asked to rate their confidence in accomplishing each activity when making career decisions, on a five-point Likert-type response scale: 1 = *No Confidence at All*, 2 = *Very Little Confidence*, 3 = *Moderate Confidence*, 4 = *Much Confidence*, 5 = *Complete Confidence*. Examples of items included: "Make a plan of your goals for the next five years." or "Determine the steps to take if you are having academic trouble with aspect of your chosen major." The scores on the items were summed resulting a possible total score of 9-45 with higher scores indicating a higher confidence the participants have in their ability of accomplishing each task. The original 25-item full scale showed a reliability of 0.94 (Betz et al., 1996), and Restubog et al. (2010) reported a Cronbach's *alpha* of 0.83 for the 9-item scale. Restubog et al. (2010) also showed evidence that the 9-item scale and the 25-item scale of career decision-making efficacy were highly correlated ($r = .91$, $p < .001$). For the current study, the post-hoc Cronbach's *alpha* was 0.88.

3.8.4 Coping Efficacy

Section four of the survey contained seven items that focused on participants' confidence in their ability of coping with career barriers. The scale was modified based on the coping efficacy subscale from Lent et al.'s (2005) coping efficacy scale. Each item was a barrier or problem that participants have to cope with in order to complete a degree in the agricultural sciences (e.g., "Cope with lack of support from professors or your advisor; Complete a degree in the agricultural sciences despite financial pressures"). This scale is a 10-point scale, ranging from 0 = *No Confidence* to 9 = *Complete Confidence*. Coping efficacy score was calculated by dividing the summed score by 7, with higher score indicating higher confidence in their ability of coping with career barriers. For the current study, the word "engineering" in the scale was replaced with "agricultural sciences." For example, "Find ways to overcome communication problems with professors or teaching assistants in your agricultural sciences courses." And the participants were asked to indicate “how much confidence you have in your ability to complete each of these steps in relation to the major that you are most likely to pursue. Lent et al. (2005) reported a Cronbach’s *alpha* of 0.91. For the current study, the post-hoc reliability was 0.89.

3.8.5 Outcome Expectations

Section five of the survey contained 10 items that measured the extent to which participants believed that completing their plan of study in the agricultural sciences would bring positive outcomes. This scale was modified based on the Engineering Outcome Expectations scale of Lent et al. (2005). Each item of this scale was a statement of one potential positive outcome (e.g., “Receive a job offer quickly”). The participants responded by indicating how strongly they agreed that an agricultural science degree would allow them to experience each positive outcome by using a 10-point Likert-type scale: 1 = *Strongly Disagree* to 10 = *Strongly Agree*. Summed scores were divided by 10, with higher scores indicating greater degree of believing that an agricultural science degree would result in positive outcomes. Lent et al. (2005) reported an *alpha* of 0.89 on a sample of undergraduate engineering students, supported the internal consistency reliability of this measure. For the current study, the post-hoc reliability coefficient was 0.92.

3.8.6 Math/Science Interests

The Math/Science Interest Scale of Byars-Winston and Fouad (2008) was used to measure participants' interest in various math- or science-related activities. This scale is a 17-item scale, with each representing a math/science activity (e.g., "Working as an astronomer"). Participants indicate the extent to which they like each activity by responding to the statements that "I would enjoy this activity," using a 6-point Likert-type scale: 1 = *Very Strongly Disagree*, 2 = *Mostly Disagree*, 3 = *Slightly Disagree*, 4 = *Slightly Agree*, 5 = *Mostly Agree*, 6 = *Very Strongly Agree*. Summed scores were divided by 17 with higher scores indicating that students liked the math/science activities to a greater degree. Byars-Winston and Fouad (2008) reported a reliability coefficient of 0.85 of this scale. In current study, the post-hoc reliability coefficient was 0.91.

3.8.7 Degree Goals

A one-item degree goal scale developed by Byars-Winston et al. (2010) was used to measure participants' goals commitment. Byars-Winston et al. (2010) indicated that if the variables of interests are not complicated, then it is appropriate to use this single item measure. The aim of the current study was to measure participants' intention to complete their agricultural sciences major. As such, the approach of using a one item measure was deemed appropriate. In particular, participants were asked to indicate their level of agreement with the statement using a 5-point Likert-type scale; 1 = *Strong Disagree*, 2 =

Disagree, 3 = *Neither Agree Nor Disagree*, 4 = *Agree*, 5= *Strongly Agree*. For this scale, higher scores indicate stronger commitment to complete a degree in the agricultural sciences. For the current study, this item was modified by changing the "in science or engineering" in the original scale to "in the agricultural sciences" (e.g., "It is important for me to finish my program of studies in the agricultural sciences"). Previous literature supports the validity of this measure and indicates that it is positively related to academic self-efficacy, outcome expectations and STEM interests of multiethnic groups (Byars-Winston et al., 2010).

3.8.8 Career Exploratory Behaviors

Career exploratory behaviors were measured using the self-exploration and environmental exploration subscales of the Career Exploration Scale (Stumpf, Colarelli, & Hartman, 1983). Stumpf et al. (1983) used the self- and environment exploration scales to measure individual self-introspection and environmental exploratory behaviors related to their career choices in the past three months. The environmental exploration scale contained six items that asked the extent to which participants have explored their environment regarding information on their career choices (e.g., "Investigated career possibilities"). Participants' responses were made on a 5-point Likert-type scale: 1 = *Little*, 2 = *Somewhat*, 3 = *Moderate Amount*, 4 = *Substantial Amount*, 5 = *A Great Deal*. The self-exploration scale contains five items that asked the extent to which participants have performed self-introspection regarding their career choices (e.g., “Reflected on how my past experiences and activities relate to my future career plans”). Participants’ responses were made on a 5-point Likert-type scale from 1 = *Little*, 2 = *Somewhat*, 3 = *Moderate Amount*, 4 = *Substantial Amount*, 5 = *A Great Deal*. Higher scores on the self-exploration or environmental scales indicate that the participants involved themselves in either self- or environmental exploration to a greater extent. Stumpf et al. (1983) reported a Cronbach’s *alpha* of .83 for the environment exploration scale and an *alpha* of 0.88 for the self exploration scale on a sample of 241 college students. For the current study, the post-hoc reliability coefficient was .90 for the environment exploration scale and 0.82 for the self-exploration scale.

3.8.9 Social Supports and Barriers

Social supports and barriers were measured using a modified version of the social supports and barriers scale developed by Lent et al. (2005). Participants were asked to rate how likely they believe they would experience nine supportive situations (e.g., “Feel that there are people ‘like you’ in this field”) and five hindering situations (e.g., “Feel pressure from parents or other important people to change your major to some other field”) while pursuing an academic major in the agricultural sciences. Responses were rated on a 5-point Likert-type scale: 1 = *Not at All Likely*, 2 = *A Little Likely*, 3 = *Moderately Likely*, 4 = *Quite Likely*, 5 = *Extremely Likely.* Summed scores on the social supports subscale were divided by 9, with higher scores on the social supports subscale representing more social supports experienced by participants. Summed scores on the social barriers subscale were divided by 5 and higher scores on the social barriers subscale represented more social barriers experienced by participants. Lent et al. (2005) reported an *alpha* of 0.86 for both scales. For the current study, the post-hoc reliability coefficient was 0.87 for both scales.

3.8.10 Supportive and Hindering Factors

Section 10 of the instrument elicited information pertaining to participants' perceptions on the factors that have been helpful or hindering in their pursuit of a STEM-intensive major in the agricultural sciences. Two open-ended questions were utilized to measure supportive and hindering factors, respectively. The two open-ended questions were: "What factors do you consider to have been helpful in pursuing a STEM-intensive major in the agricultural sciences?" and "What factors do you consider to have been hindering in pursuing a STEM-intensive major in the agricultural sciences?"

3.8.11 Field Test

A field test was conducted on September 19, 2014 with three underrepresented minority graduate students. The participants include two African American students who were pursuing their master's degrees and one African American doctoral student. The researcher chose to field test the instrument with these individuals because they obtained their bachelor’s degree from HBLGUs. Feedback was sought from the field test group regarding: 1) the length of time the survey would take for each student to complete, 2) the format of the survey, 3) the content of the survey items, and 4) the survey distribution method. Participants completed the questionnaire in an average of 15 minutes. Feedback obtained during the field test was integrated into the final version of the questionnaire as well as into the survey administration procedures.

3.8.12 Validity

Validity is the extent to which the results can accurately assess the construct of interest (Thomas, 2009). The scales utilized in the current study were evaluated for face and content validity by a panel of experts. The panel of experts consisted of three individuals, including one faculty member and two doctoral students. They were chosen based on their knowledge of research methods, survey development and educational studies. No major issues of validity were identified.

3.8.13 Reliability

Reliability is the extent to which an instrument will provide the same results across occasions (Thomas, 2009). Scales for this study were either utilized or modified from previously used measures, and the reliability of these scales have been supported in the literature. Previous sections provided the reliability coefficients of the scales used in current study.

Most of the *alpha* scores were above 0.70, except for the instrumentality subscale of gender roles measurement (.61). Therefore, they are considered acceptable according to social sciences standards (Kline, 1999).

3.9 Data Collection

Emails regarding a detailed research plan were sent to each of the participating institutions. In order to help develop agendas for the on-campus visits as well as to help identify the classes that would be surveyed, the researcher corresponded with department chairs, secretaries and faculty from the agricultural departments. Participants from four of the institutions (i.e., University of Maryland-Eastern Shore, Virginia State University, University of Arkansas-Pine Bluff, Kentucky State University) were surveyed in their classrooms.

The data collection itinerary and the amount of responses from each institution are shown in Table 3.6. During class visits, the researcher read the information sheet and informed students about the purpose, content, confidentiality, and the contact information of the investigator. Subsequently, paper copies of the survey and an information sheet were distributed to students.

The survey took about 15-20 minutes for the participants to complete. Due to scheduling issues with North Carolina A&T State University, copies of the survey and information sheet were sent to the Associate Dean for Undergraduate Education who then distributed the survey packets to professors from the participating departments who agreed to survey students enrolled in STEM-intensive agricultural sciences majors. The surveys were returned to the researcher after they were completed by the students.

Table 3.6

Steps in the Data Collection Process

Dates of Data Collection	**Institution**	**Number of Classes Visited**	**Total Number of Surveys Completed***
Oct 6 - 8	Visited University of Maryland-Eastern Shore	9	79
Oct 6 - 8	Visited Virginia State University	10	67
Oct 21- 24	Visited Kentucky State University	10	48
Oct 27	Received completed questionnaire from NCAT	N/A	249
Nov 10 -12	Visited University of Arkansas-Pine Bluff	9	74
Total			517

*Note.** The "Number of Surveys Completed" includes all responses from participants, even those who did not meet the study criteria.

3.10 Data Management

Following the coding for the quantitative and qualitative data, data for this study was stored in electronic form on a secured departmental server in accordance with IRB guidelines. Any print information about this study were all locked in a secure file cabinet in accordance with IRB guidelines.

3.11 Data Analysis

The researcher used the Statistical Package for the Social Scientist (SPSS), Version 22 to code and analyze the participants' responses on all quantitative items, utilizing a researcher-developed codebook. Descriptive statistics such as frequencies, means and standard deviations were used to report demographic characteristics of the participants. For research question one to three, Analysis of Moment Structures (AMOS) 17.0 (Byrne, 2001) was used to conduct structural equation modeling (SEM) to examine the model fit on present sample and the path coefficients among variables of interests. The means, standard deviations, and path coefficients of the structural model will be reported to answer research questions and test hypotheses of the study (Table 3.7). Weston and Gore (2006) indicated that two advantages of SEM are: 1) it allows researchers to investigate relationship among multiple variables, and 2) it allows researchers to establish construct validity of factors. Given the number of variables investigated in current study and recommendations of the literature, SEM is an appropriate method to use.

Data were evaluated based on several criteria. First of all, we would examine the accuracy of data entry. Second, the examination of missing values was first conducted on the dataset. The missing values were treated using the full information maximum likelihood method (FIML) procedure. FIML is a model-based method that impute implied missing values based on available data. FIML has been indicated as a good method of imputing missing data, which produced unbiased estimates and has been shown to perform better than other methods such as mean substitution (Schlomer, Bauman, & Card, 2010).

Third, we examined the assumptions for structural equation modeling (SEM), such as linearity, normality, homoscedasticity, and multicollinearity. Every bivariate relationship in the model was tested, and the bivariate relationships were sufficiently linear to conduct model testing. Q-Q plots for each variable were examined and the data for each variable was sufficiently normally distributed for the analysis. Homoscedasticity was examined by examining the residual plot of the standardized predicted values as a function of residuals of the dependent variable. The scatterplots indicated enough homoscedasticity for the data analysis to be conducted. Bivariate correlations were checked to assess multicollinearity among the independent variables. The correlations among independent variables were all below 0.50, so the assumption of independence among predictors was met for SEM analysis.

Fourth, the χ^2 value would assess the overall model fit by comparing the covariances within the hypothesized model and the null model. A low and non-significant χ^2 value would represent a good model fit (Schumacker & Lomax, 2010). Fifth, the Comparative Fit Index (CFI), Tucker-Lewis index (TLI), incremental fit index (IFI) and Root Mean Square Error of Approximation (RMSEA) would also evaluate the model fit. CFI, TLI, IFI should be 0.90 or above to show an acceptable model fit, and be or above 0.95 to show good model fit (Hu & Bentler, 1999). RMSEA should be 0.05 or below to prove a good model fit (Hu & Bentler, 1999).

Qualitative data analysis software was used for the two open-ended items. The qualitative data provided a secondary source of data that allowed the researcher to explore the supportive and hindering factors perceived by African American college students that could affect their pursuit of a degree in STEM-intensive agricultural sciences majors. The researcher used descriptive coding strategy to code and categorize the participants' responses from the two open-ended questions. Frequencies were reported for each theme.

Table 3.7

Research Questions, Variables, Scale of Measurement and Statistical Analysis Methods Utilized

Research Questions	Hypotheses	Variables		Scale of Measurement for All Variables	Data Analyses
		Independent Variable	Dependent Variable		
Research Question 1: To what extent does gender role influence career exploratory behaviors?	Hypothesis 1: Gender role will positively influence career exploratory behaviors through its influence on career decision-making self-efficacy, coping efficacy and outcome expectations.	Gender Role Career Decision-making Self-efficacy, Coping Efficacy, Outcome Expectations	Career Exploratory Behaviors	Interval	Means, Standard Deviations, Path Coefficients
Research Question 2: To what extent do social supports and social barriers, influence career exploratory behaviors?	Hypothesis 2: Social supports and barriers will influence career exploratory behaviors directly and indirectly through career goals.	Social Supports & Barriers, Career Goals	Career Exploratory Behaviors	Interval	Means, Standard Deviations, Path Coefficients
Research Question 3: To what extent do career decision-making self-efficacy, coping efficacy, outcome expectations and career interests influence career exploratory behaviors?	Hypothesis 3: Career decision-making self-efficacy, coping efficacy, outcome expectations will have direct and indirect influences on career exploratory behaviors through career interests after controlling for career goals	Career Decision-making Self-efficacy, Coping Efficacy, Outcome Expectations, Career Interests, Career Goals	Career Exploratory Behaviors	Interval	Means, Standard Deviations, Path Coefficients

CHAPTER 4. RESULTS

4.1 Introduction

This chapter will present findings of the preliminary analysis, measurement model analysis and the structural model analysis. The preliminary analysis results include demographic characteristics of the participants, data screening criteria and procedures, introduction of latent variables and observed variables. The measurement model analysis will examine if the observed variables sufficiently measure the latent variables. Finally, the structural model analysis will evaluate the model coefficients and the relationship among factors. The remaining sections of this chapter will provide an analysis of the results for the four research questions and hypotheses.

4.2 Purpose of the Study

The purpose of this study was to examine the influence of contextual and cognitive factors on the career goals and career exploratory behaviors of underrepresented minority undergraduate students pursuing STEM-intensive agricultural sciences major.

4.3 Research Questions

This study aims to examine Lent's (1994) social cognitive career model by testing three research questions and hypotheses:

Research Question 1: To what extent does gender role influence career exploratory behaviors?

Hypothesis 1: Gender role will influence career exploratory behaviors through its indirect influence on self-efficacy and outcome expectations.

Research Question 2: To what extent do social supports and social barriers, influence career exploratory behaviors?

Hypothesis 2: Social supports and barriers will influence career exploratory behaviors directly and indirectly through degree goals.

Research Question 3: To what extent do self-efficacy, outcome expectations influence career exploratory behaviors?

Hypothesis 3: Self-efficacy and outcome expectations will have direct and indirect influences on career exploratory behaviors through career interests and degree goals.

Research Question 4: What additional factors influence students' pursuit of a STEM-intensive agricultural sciences major?

4.4 Preliminary Analysis Results

This section will present findings from the preliminary analysis. First, the demographic characteristics of the participants will be presented. Then, the data screening criteria and results will be introduced. Followed by the latent variables identification, and item parceling technique utilized in the study.

Table 4.1 highlights the correlations among the latent variables and descriptive statistics for the latent variables. Relationships among the variables in the structural model were described in the correlation table (Table 4.1). Table 4.1 described the mean and standard deviation of the variables, and the correlations among the variables. Conventions for the relationships' strengths were explained (Hopkins, 2000) (Table 4.2). Overall, there was one very large correlation between career exploratory behaviors and self-efficacy (r = .73, very large, positive). Three correlations were high among the variables. Self-efficacy was highly correlated with instrumentality (r = .60, high, positive), and outcome expectations (r = .66, high, positive). Social supports was also highly correlated with self-efficacy (r = .66, high, positive). It should be noted that although self-efficacy was highly correlated with instrumentality, they are distinctly different constructs. Spence, Helmreich and Stapp (1974) indicated that the Instrumentality scale measured the desired masculine attributes in the United States.

Conversely, Bandura (1986) described self-efficacy as people's beliefs of their ability in completing certain tasks or activities. The self-efficacy scale in the current study aims to measure students' confidence in completing career decision-making and career barriers coping related tasks and activities. As such, the Gender Role and Self-Efficacy subscales were measuring two distinctly different constructs.

Table 4.1

Correlations Among Factors and Descriptive Statistics for Factors

	M (*SD*)	IN	EX	SE	OE	CI	CEB	SS	SB	DG
Instrumentality	3.87 (.66)	1.00								
Expressivity	4.09 (.66)	.49	1.00							
Self-Efficacy	5.40 (.93)	.60	.35	1.00						
OE	8.51 (1.32)	.28	.30	.66	1.00					
Career Interests	4.07 (.91)	.18	.05	.26	.27	1.00				
CEB	3.73 (.78)	.36	.33	.73	.44	.38	1.00			
Supports	4.15 (.74)	.30	.28	.66	.47	.01	.44	1.00		
Barriers	2.05 (1.03)	-.05	-.10	-.16	-.11	-.01	.08	-.12	1.00	
Goals	4.81 (.48)	.13	.06	.39	.33	.13	.16	.31	-.11	1.00

Note. *N* = 313. IN = Instrumentality; EX = Expressivity; SE = Self-Efficacy; OE = Outcome Expectations; CI = Career Interests; CEB = Career Exploratory Behaviors; SS = Social Supports; SB = Social Barriers; DG = Degree Goal. Participants' responses on the Instrumentality and Expressivity subscales were based on bipolar characteristics scales. Participants' responses on their self-efficacy were based on the scale: 1= *No Confidence at All*, 2 = *Very Little Confidence*, 3 = *Moderate Confidence*, 4 = *Much Confidence*, 5 = *Complete Confidence*. Participants' responses on the Outcome Expectation (OE) scale were based on a 10-point Likert-type scale from 1 = *Strongly Disagree* to 10 = *Strongly Agree*. Participants' responses on the Career Interests scale were based on a 6-point Likert-type scale: 1 = *Very Strongly Disagree*, 2 = *Mostly Disagree*, 3 = *Slightly Disagree*, 4 = *Slightly Agree*, 5 = *Mostly Agree*, 6 = *Very Strongly Agree*. Participants' responses on the perceived social supports and barriers were based on a 5-point Likert-type scale: 1 = *Not at All Likely*, 2 = *A Little Likely*, 3 = *Moderately Likely*, 4 = *Quite Likely*, 5 = *Extremely Likely*. Participants' responses on the Career Exploratory Behavior (CEB) Scale were based on a 5-point Likert-type scale: 1 = *Little*, 2 = *Somewhat*, 3 = *Moderate Amount*, 4 = *Substantial Amount*, 5 = *A Great Deal*.

Table 4.2
Conventions for Relationship Strength (Hopkins, 2000)

Correlations (r)	**Convention**
0.9 – 1.0	Nearly Perfect
0.7 – 0.9	Very Large
0.5 – 0.7	High
0.3 – 0.5	Moderate
0.1 – 0.3	Low
0.0 – 0.1	Trivial

4.4.1 Demographic Characteristics of the Participants

Of the students (*N* = 314) who met the study criteria (i.e. domestic, African American, full-time, enrolled in STEM-intensive agricultural sciences majors), about 33% (*N* = 103) of the sample were freshmen, 16% (*N* = 49) were sophomores, 22% (*N* = 70) were juniors, and 28% (*N* = 88) were seniors. Regarding the schools where participants attended (Table 4.2), 58.5% (*N* = 183) were from North Carolina A&T State University, 14% (*N* = 54) were from the University of Arkansas-Pine Bluff, 12% (*N* = 38) were from Virginia State University, 11% (*N* = 34) were from the University of Maryland-Eastern Shore, and 5% (*N* = 15) were from Kentucky State University.

Twenty-eight percent (*N* = 89) of the participants were male, and 72% (*N* = 225) were female. Moreover, 93% (*N* = 292) of the participants indicated they wanted to pursue another degree after they completed their Bachelor's degree, while 7% (*N* = 22) of the participants indicated they did not want to pursue another degree after they completed their Bachelor's degree. The age of the participants ranged from under 20 years old to over 30 years old (*M* = 21, *SD* = 3.88). Of the participants who indicated their age, 61% (*N* = 190) were 10-20 years old, 37% (*N* = 114) were 21-30 years old, and 3% (*N* = 8) were above 30 years old (Table 4.3).

Regarding the education level of the participants' father/male guardian (Table 4.5), 10% (*N* = 30) of the participants' father/male guardian did not complete high school, 29% (*N* = 89) indicated that their father/male guardian had a high school diploma, General Education Development certificate, or equivalent, 23% (*N* = 71) had some college, vocational or trade school education, 18% (*N* = 54) had a Bachelor's degree, 7% (*N* = 20) had a Master's degree, 2% (*N* = 5) had a Doctorate or professional degree, 3% (*N* = 9) had at least some graduate or professional schooling after the bachelor's degree, and 9% (*N* = 28) of the participants indicated they were not sure about their father/male guardian's education level.

Regarding the education level of the participants' mother/female guardian (Table 4.5), 4% (*N* = 13) of the participants' mother/female guardian did not complete high school, 15% (*N* = 46) indicated that their mother/female guardian had a high school diploma, GED certificate, or equivalent, 30% (*N* = 91) had some college, vocational or trade school education, 24% (*N* = 75) had a Bachelor's degree, 15% (*N* = 46) had a

Master's degree, 4% (*N* = 12) had a Doctorate or professional degree, 5% (*N* = 16) had at least some graduate or professional schooling after the bachelor's degree, and 3% (*N* = 8) of the participants indicated they were not sure about their mother/female guardian's education level.

Regarding the discipline of study of the participants (Table 4.6), 43% of students indicated that they majored in animal science, 9% in food, nutrition, medical and dietetics, 9% in pre-vet, 1% in agriculture, food and environment, 2% in agricultural engineering, 8% in general agricultural sciences, 4.2% in agriculture and environmental studies, 3.5% in plant and soil science, 1.9% in fisheries, 1.3% in family and consumer science, 1.9% in horticulture, 8% in landscape, 3.2% in regulatory science, and 0.3% in urban forestry.

Table 4.3

Frequencies and Percentages of Participants' Gender, Age and Grade

Characteristics		
Gender	***f*[a]**	**%**
Male	89	28.3
Female	225	71.7
Total	314	100
Age		
Under 20 years old	190	60.9
21-30 years old	114	36.5
Over 30 years old	8	2.6
Total	312	100
Grade		
Freshman	103	33.2
Sophomore	49	15.8
Junior	70	22.6
Senior	88	28.3
Total	310	100

Note. [a]Frequency reported for participants who indicated their gender, age and grade on the survey.

Table 4.4

Listing of Schools and Number of Students Participating in Study

Schools	f^a	**%**
Kentucky State University	15	4.8
North Caroline A & T State University	183	58.5
Virginia State University	38	12.1
University of Arkansas-Pine Bluff	54	13.7
University of Maryland-Eastern Shore	34	10.9
Total	314	100

Note. [a]Frequency reported for participants who indicated their university name on the survey.

Table 4.5

Highest Level of Education Completed by Father/Male and Mother/Female Guardians

Level of Education	**Father/Male Guardian**[a]		**Mother/Female Guardian**[b]	
	f*	**%**	***f****	**%**
Did not complete high school	30	9.8	13	4.2
Earned a high school diploma, GED (General Educational Development) Certificate, or equivalent	89	29.1	46	15.0
Had some college, vocational or trade school education (including 2-year degree)	71	23.2	91	29.6
Earned a Bachelor's degree	54	17.6	75	24.4
Earned a Master's degree	20	6.5	46	15.0
Earned a Doctoral or professional degree (e.g., Ph.D., J.D., M.D.)	5	1.6	12	3.9
At least some graduate or professional schooling after bachelor's degree	9	2.9	16	5.2
Not Sure	28	9.2	8	2.6

Note. [a]N = 306. [b]N = 307. *Frequencies reported for participants who indicated the education level of their father/male guardian and mother/female guardian on the survey.

Table 4.6

Frequencies and Percentage of Participants' Major

Majors	***f****	**%**
Food, Nutrition, Medical Sciences & Dietetics	41	13.1
Pre-Vet	27	8.6
Agriculture, Food & Environment (AFE)	4	1.3
Agricultural Engineering	5	1.6
General Agricultural Sciences	25	8.0
Agriculture and Environmental Studies	13	4.2
Animal Science	135	43.1
Plant & Soil Science	11	3.5
Fisheries	6	1.9
Family & Consumer Science	4	1.3
Horticulture	6	1.9
Landscape	25	8.0
Regulatory Science	10	3.2
Urban Forestry	1	0.3
Total	313	100

Note. [a]Frequencies reported for participants who indicated their discipline of study.

4.4.2 Gender Role

The Personal Attributes Questionnaire (PAQ) measured participants' gender related attributes. The current study utilized two subscales of the PAQ: Instrumentality and Expressivity. Participants' responses were based on a bipolar characteristics scale and the participants' average scores on instrumentality ranged from 1= *Not at All Instrumental* to 5 = *Very Instrumental* and their average scores on expressivity ranged from 1 = *Not at All Expressive* to 5 = *Very Expressive*. Of the participants who responded to the Instrumentality Scale (N = 306), the average response indicated that participants perceived themselves toward the end of "Very Instrumental" of the scale (M = 3.87, SD = .66). Of the participants who responded to the Expressivity Scale (N = 310), the average response indicated that participants perceived themselves toward the end of "Very Expressive" of the scale (M = 4.09, SD = .66).

4.4.3 Self Efficacy

The Self Efficacy Scale measured participants' confidence in their ability of completing career decision making related activities and coping with career barriers while pursuing STEM-intensive agricultural sciences majors. Participants' responses on their self efficacy were based on the scale: 1= *No Confidence at All*, 2 = *Very Little Confidence*, 3 = *Moderate Confidence*, 4 = *Much Confidence*, 5 = *Complete Confidence*. The participants' average perceived confidence in their ability of accomplishing the tasks for career decision-making was “Complete Confidence” (*M* = 5.40, *SD* = .93), which indicated that participants were very confident in their ability of completing career decision making and career barriers coping related tasks and activities in STEM-intensive agricultural sciences.

4.4.4 Outcome Expectations

The Outcome Expectations Scale measured the extent to which the participants believed that an STEM-intensive agricultural sciences degree would bring positive outcomes. Participants’ responses on this scale were based on a 10-point Likert-type scale indicating the extent to which they agree or disagree with the outcome statements: 1 = *Strongly Disagree* to 10 = *Strongly Agree*. The participants’ average score on the scale was “Strongly Agree” (*M* = 8.51, *SD* = 1.32). The average response indicated the participants’ positive beliefs about the relevance of a STEM-intensive agricultural sciences degree to positive life outcomes.

4.4.5 Interests

The Math/Science Interest Scale measured participants’ interest in math- or science-related activities. Participants’ responses on the scale were based on a 6-point Likert-type scale: 1 = *Very Strongly Disagree*, 2 = *Mostly Disagree*, 3 = *Slightly Disagree*, 4 = *Slightly Agree*, 5 = *Mostly Agree*, 6 = *Very Strongly Agree*. The participants’ average score on this scale was “Slightly Agree” (*M* = 4.07, *SD* = .91), which indicated that participants were slightly interested in participating in math/science activities.

4.4.6 Degree Goals

The one-item Degree Goal Scale measured participants' goal to complete a degree in STEM-intensive agricultural sciences. Participants' responses on their degree goal were based on a 5-point Likert-type scale: 1 = *Strong Disagree*, 2 = *Disagree*, 3 = *Neither Agree Nor Disagree*, 4 = *Agree*, 5= *Strongly Agree*. Participants' average score on this scale was "Agree" (*M* = 4.81, *SD* = .48). The participants' average score indicated participants' strong commitment to a degree in the STEM-intensive agricultural sciences.

4.4.7 Social Supports and Barriers

The Social Supports Scale measured students' perceptions on how likely they would be to experience supportive conditions if they were to pursue a STEM-intensive agricultural sciences major. Participants' responses on their perceived social supports were based on a 5-point Likert-type scale: 1 = *Not at All Likely*, 2 = *A Little Likely*, 3 = *Moderately Likely*, 4 = *Quite Likely*, 5 = *Extremely Likely*. The participants' average score was "Quite Likely" (*M* = 4.15, *SD* = .74). The participants' average score on this scale indicated they had strong positive expectations on the supportive experiences in their pursuit of a STEM-intensive agricultural sciences major.

The Social Barriers Scale measured students' perceptions on how likely they would be to experience career barriers if they were to pursue a STEM-intensive agricultural sciences major. Participants' responses on their perceived social barriers were based on a 5-point Likert-type scale: 1 = *Not at All Likely*, 2 = *A Little Likely*, 3 = *Moderately Likely*, 4 = *Quite Likely*, 5 = *Extremely Likely*. The participants' average score was "A Little Likely" (*M* = 2.05, *SD* = 1.03). The participants' average score on this scale indicated that they did not expect to experience many career barriers relative to the pursuit of a STEM-intensive agricultural sciences major.

4.4.8 Career Exploratory Behaviors

Participants' levels of their engagement in career exploratory behaviors were assessed using the Career Exploratory behaviors Measurement. Participants' responses on the Career Exploration Scale were based on a 5-point Likert-type scale: 1 = *Little*, 2 = *Somewhat*, 3 = *Moderate Amount*, 4 = *Substantial Amount*, 5 = *A Great Deal*. The mean for the overall career exploratory behaviors composite score was *M* = 3.73 (*SD* = .78), which was indicating that participants were engaged in a moderate amount of overall career exploratory behaviors. There were two components of the composite career exploratory behaviors score: the self-exploratory behaviors score and the environmental exploratory behaviors score. The mean Self-exploration score was "Substantial Amount" (*M* = 4.01, *SD* = .77), which indicated that the participants substantially performed self-introspection regarding their career choices within the previous three months. The mean Environmental Exploration score was "Moderate Amount" (*M* = 3.50, *SD* = 1.01), which indicated that the participants moderately engaged in environmental exploration activities that could help them acquire information on occupations, jobs and organizations within the previous three months.

4.5 Confirmatory Factor Analysis of the Gender Role Subscales

The first step of structural equation model was to test if the chosen observed variables adequately reflect latent variables (Moel, 2007). As previously mentioned in chapter three, only the post-hoc reliability coefficient for the instrumentality subscale was 0.62, which is less than the recommended score 0.70 (George & Mallery, 2003), as such, a confirmatory factor analysis was conducted on the gender role subscales. Table 4.7 shows the factor loadings of each item on the subscales of instrumentality and expressivity. Two items (V26: “can make decision easily & has difficulty making decisions” and V19: “very passive & very active”) of the instrumentality subscale had low factor loadings of -0.31 and 0.29, respectively, indicating that these two items were not representing the construct of instrumentality sufficiently. One item of the expressivity subscale (V18: “emotional”) had a low factor loading of 0.10. As such, these items were not properly measuring the latent variables of interest within the study sample and were deleted to improve model fit.

After deleting the aforementioned three items in Gender Role subscales that were not loading well on the factors, the reliability coefficient for the modified instrumentality subscale was 0.76 and the reliability coefficient for the modified expressivity subscale was 0.82. Both reliability coefficients were above the recommended score 0.70 (George & Mallery, 2003). As such, the modified Instrumentality and Expressivity were accurately measuring the constructs of interests.

4.6 Confirmatory Factor Analysis of the Measurement Model

To control for measurement error, we employed multiple indicators for each latent construct. The indicators of self-efficacy were career decision-making self-efficacy and coping efficacy. Career exploration was represented by self-exploration and environmental exploration. Also, item parcels were used to create multiple indicators for outcome expectations, interests, and social supports. More specifically, items from the outcome expectations, interests, and social supports scales were assigned randomly to one of two or three parcels corresponding to each construct (Lent, Lopez, Lopez, & Sheu, 2008). The longer measure (interests) was indexed by four item parcels with 4-5 items in each parcel. The shorter measures (outcome expectations and social supports) were represented by three item parcels with 3-4 items in each parcel. Finally, the average score of each parcel was calculated to represent a new indicator for the corresponding factor.

After the item parceling procedures, a confirmatory factor analysis was conducted on the measurement model. Factor loadings of each indicator were assessed for evaluating the relationship between measured variables and latent variables (Table 4.8).

The results of this analysis indicated that the measurement model was a good fit for the data because most of the fit indices were very close to the suggested cut-off scores: CFI = 0.93, TLI = 0.92, IFI = 0.94, RMSEA = 0.04. The Chi-square value for this measurement model was 737.82 (df = 460, p < .000). Although the chi-square value indicated poor model fit, it is problematic to use Chi-square value to describe model fit when the sample size is large (N > 200) because a small difference can be detected as significant (Moel, 2007). The other fit indices including CFI, TLI, IFI and RMSEA indicated good model fit. Also, most of the standardized coefficients or factor loadings of the indicators were above 0.40. Only one item (V21: “very rough”) of the expressivity subscale had a factor loading of 0.39, which is very close to 0.40, which is the cut-off level that indicated a sufficient amount of variance in the factor was explained by the indicator. In sum, the confirmatory factor analysis showed that the indicators adequately reflected the latent factors.

Table 4.7

Items and Factor Loadings for the Gender Role Subscales

Indicators		Factors	Factor Loadings
Goes to Pieces under Pressure	<---	Instrumentality	.683
Feels Very Inferior	<---	Instrumentality	.604
Not at All Self-Confident	<---	Instrumentality	.722
Gives Up Very Easily	<---	Instrumentality	.630
Can Make Decisions Easily	<---	Instrumentality	-.305
Not at All Competitive	<---	Instrumentality	.401
Very Passive	<---	Instrumentality	.291
Not at All Independent	<---	Instrumentality	.431
Very Cold in Relations with Others	<---	Expressivity	.712
Not at All Understanding of Others	<---	Expressivity	.772
Not at All Aware of Feelings of Others	<---	Expressivity	.740
Not at All Kind	<---	Expressivity	.754
Not at All Helpful to Others	<---	Expressivity	.682
Very Rough	<---	Expressivity	.349
Not at All Able to Devote Self Completely to Others	<---	Expressivity	.488
Not at All Emotional	<---	Expressivity	.097

Note. *N* = 313.

Table 4.8

Items and Factor Loadings for the Overall Measurement Model

Indicators		Factors	Factor Loadings
V32_PA	<---	Instrumentality	.684
V29_PA	<---	Instrumentality	.571
V28_PA	<---	Instrumentality	.720
V27_PA	<---	Instrumentality	.678
V23_PA	<---	Instrumentality	.402
V17_PA	<---	Instrumentality	.447
V31_PA	<---	Expressivity	.679
V30_PA	<---	Expressivity	.760
V25_PA	<---	Expressivity	.739
V24_PA	<---	Expressivity	.734
V22_PA	<---	Expressivity	.664
V21_PA	<---	Expressivity	.387
V20_PA	<---	Expressivity	.507
Coping_average	<---	Self-Efficacy	.716
CDMSE_Ave	<---	Self-Efficacy	.816
Parcel 1_OE	<---	Outcome Expectations: item1, 2, 3	.745
Parcel 2_OE	<---	Outcome Expectations: item 4, 5, 6	.891
Parcel 3_OE	<---	Outcome Expectations: item 7, 8, 9, 10	.897
Parcel 1_IN	<---	Interests: item 1, 2, 3, 4	.777
Parcel 2_IN	<---	Interests: item 5, 6, 7, 8	.868
Parcel 3_IN	<---	Interests: item 9, 10, 11, 12	.779
Parcel 4_IN	<---	Interests: item 13, 14, 15, 16, 17	.819

Note. N = 313.

Table 4.8
Continued

Indicators		Factors	Factor Loadings
SE_AVE	<---	Exploration	.592
EE_AVE	<---	Exploration	.770
Parcel 1_Support	<---	Supports: item 1, 2, 3	.824
Parcel 2_Support	<---	Supports: item 4, 5, 6	.826
Parcel 3_Support	<---	Supports: item 7, 8, 9	.813
V97_Barrier	<---	Barriers	.783
V98_Barrier	<---	Barriers	.573
V99_Barrier	<---	Barriers	.619
V100_Barrier	<---	Barriers	.875
V101_Barrier	<---	Barriers	.824

Note. *N* = 313

4.7 Primary Analysis

Analysis of the hypothesized structural model (Figure 4.1) was conducted to determine how person, contextual and cognitive variables interact to influence the career exploratory behaviors of African American students pursuing STEM-intensive agricultural sciences majors.

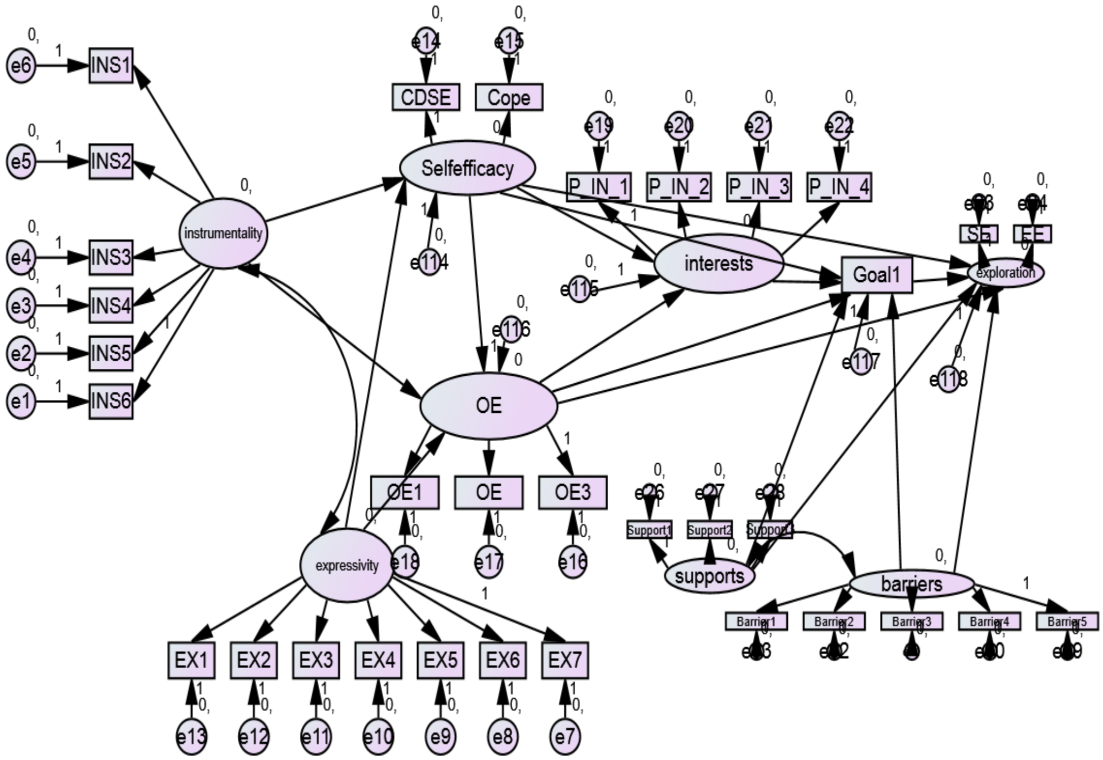

Figure 4.1 The Structural Model Examined in the Primarily Analysis

4.7.1 Overall Model Fit

Results of the structural model analysis showed adequate overall model fit to the data. All of the goodness-of-fit indices of the structural model approached or exceeded the recommendations: χ^2 (df = 477, $p < .000$) = 886.027, CFI = 0.90, TLI = 0.89, IFI = 0.91, RMSEA = 0.05. As previously noted, it is problematic to evaluate the goodness of model fit using Chi-square value when the sample is larger than 200. As such, the chi-square value of the structural model was evaluated along with the fit indices.

4.7.2 Model Estimates

Standardized and unstandardized path coefficients of the structural model are shown in table 4.9. In total, the structural model explained 54.3% of the variance in career exploratory behaviors, which is showing that a large amount of variance in the dependent variable was explained by the independent variables. The following paths within the structural model were significant (Figure 4.2): instrumentality to self-efficacy (β= .520, *S.E.* = .066, $p < .000$), instrumentality to outcome expectations (β= -.199, *S.E.* = .146, p = .024), expressivity to outcome expectations (β= .134, *S.E.* = .127, p = .048), self-efficacy to outcome expectations (β= .714, *S.E.* = .201, $p < .000$), self-efficacy to interests (β= .224, *S.E.* = .135, p = .017), social supports to degree goals (β= .154, *S.E.* = .039, p = .013), self-efficacy to career exploratory behaviors (β= .762, *S.E.* = .112, $p < .000$), career barriers to career exploratory behaviors (β= .175, *S.E.* = .029, p = .008). The coefficients from self-efficacy to degree goals (β= .177, *S.E.* = .081, p = .061) and from social supports to career exploratory behaviors (β= .124, *S.E.* = .040, p = .064) approached the recommended cut-off score $p = 0.05$, which indicated that these paths were approaching significance.

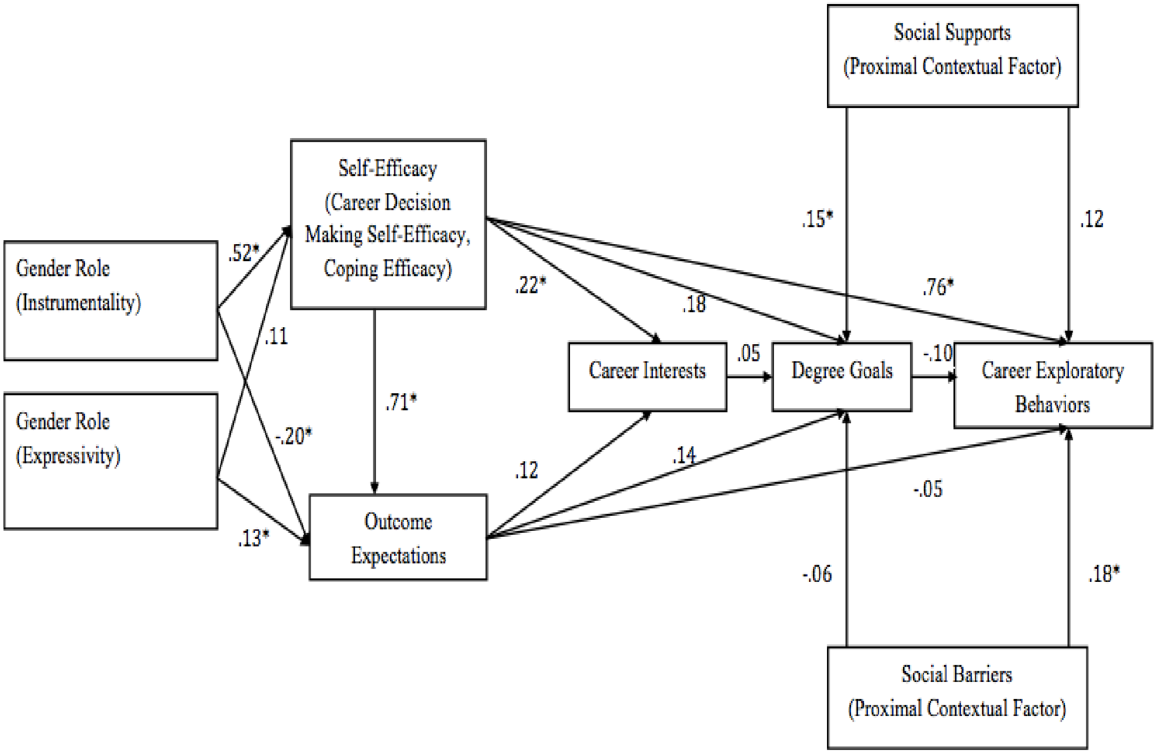

Figure 4.2 Standardized Parameter Estimates from the Structural Model Analysis.
$^*p \leq .05$.

Table 4.9
Structural Model Estimates

Effects	Model		Estimates		R^2
	b	β	S. E.	*p*	
On self-efficacy					.335
Of instrumentality	.403	.520	.066	***	
Of expressivity	.091	.105	.065	.159	
On outcome expectations					.448
Of instrumentality	-.331	-.199	.146	.024	
Of expressivity	.251	.134	.127	.048	
Of self-efficacy	1.540	.714	.201	***	
On interests					.100
Of self-efficacy	.321	.224	.135	.017	
On degree goals					.124
Of self-efficacy	.151	.177	.081	.061	
Of outcome expectations	.057	.142	.035	.105	
Of interests	.028	.046	.038	.473	
Of social supports	.097	.154	.039	.013	
Of social barriers	-.028	-.060	.028	.324	
On career exploratory behaviors					.543
Of self-efficacy	.614	.762	.112	***	
Of outcome expectations	-.019	-.050	.037	.614	
Of degree goals	-.090	-.095	.065	.168	
Of social supports	.073	.124	.040	.064	
Of social barriers	.076	.175	.029	.008	

Note. $N = 313$. $***p < .001$

4.8 Results for Research Question 1

Research Question 1: *To what extent does gender role influence career exploratory behaviors?*

Hypothesis 1: *Gender role will positively influence career exploratory behaviors through its indirect influence on self-efficacy and outcome expectations (Figure 4.3).*

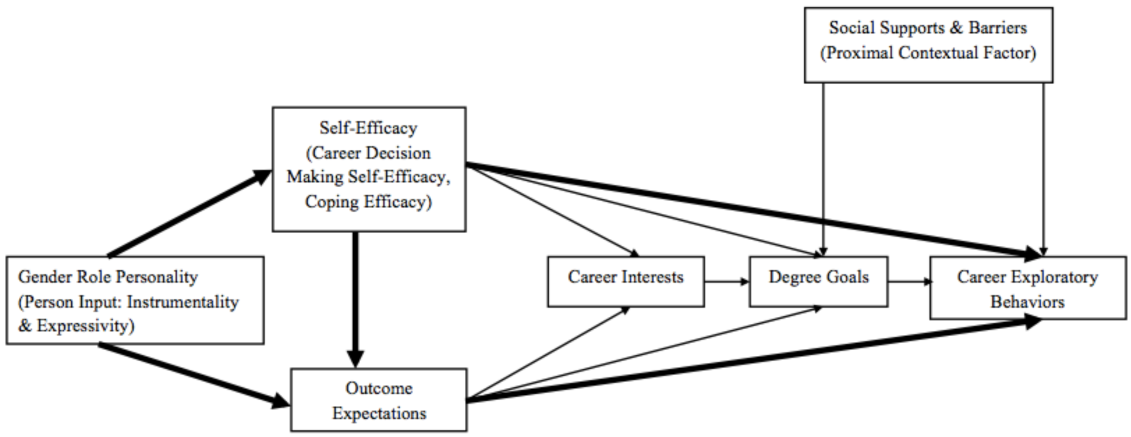

Figure 4.3 Hypothesis One Examined in This Study. *Note.* Bolded lines depict the paths tested by hypothesis one.

4.8.1 Influences of Gender Role on Career Exploratory Behaviors

According to the structural model, gender role had an indirect influence on career exploratory behaviors through self-efficacy, outcome expectations, career interests and degree goals. Instrumentality had a standardized indirect effect of 0.38 on career exploratory behaviors. Expressivity had a standardized indirect effect of 0.065 on career exploratory behaviors.

4.8.2 Mediation Effect of Self-Efficacy and Outcome Expectations

Instrumentality had a standardized indirect effect of 0.38 on career exploratory behaviors, and expressivity had a standardized indirect effect of 0.065 on career exploratory behaviors (Table 4.6). The hypothesis that outcome expectations would mediate the relationship between gender role and career exploratory behaviors was examined using the Sobel test. First, while controlling for other variables in the structural model, the mediation effect of outcome expectations on the relationship between instrumentality and career exploratory behaviors was examined. The unstandardized path coefficients from the independent variable (Instrumentality) to the hypothesized mediator outcome expectations (b = -.331, *S.E.* = .146) and the path coefficients from the hypothesized mediator to the dependent variable career exploratory behaviors (b = -.019, *S.E.* = .037) were examined using the online Sobel's test calculator. The results show that the mediation effect was not significant (t = .50, p = .31). Second, while controlling for other variables in the structural model, the mediation effect of outcome expectations on the relationship between expressivity and career exploratory behaviors was examined. The path coefficients from the independent variable (Expressivity) to the hypothesized mediator outcome expectation (b = .251, *S.E.* = .127) and the path coefficients from the hypothesized mediator to the dependent variable career exploratory behaviors (b = -.019, *S.E.* = .037) were examined. The results show that the mediation effect was not significant (*t* = -.50, *p* = .31). Therefore, the hypothesis that outcome expectations would mediate the relationship between gender role and career exploratory behaviors was not supported.

While controlling for other variables in the structural model, a Sobel test was also utilized to test if the mediation effect of self-efficacy on the relationship between gender role and career exploratory behaviors were significant. First, the mediation effect of self-efficacy on the relationship between instrumentality and career exploratory behaviors was examined. The path coefficients from the independent variable (Instrumentality) to the hypothesized mediator self-efficacy (*b* = .403, *S.E.* = .07) and the path coefficients from the hypothesized mediator to the dependent variable career exploratory behaviors (*b* = .614, *S.E.* = .112) were examined. The results show that the mediation effect was significant (*t* = 3.98, *p* < .000). Therefore, self-efficacy mediated the relationship between instrumentality and career exploratory behaviors. Second, while controlling for other variables in the structural model, the mediation effect of self-efficacy on the relationship between expressivity and career exploratory behaviors was examined. The path coefficients from the independent variable (expressivity) to the hypothesized mediator self-efficacy (*b* = .091, *S.E.* = .065) and the path coefficients from the hypothesized mediator to the dependent variable career exploratory behaviors (*b* = .614, *S.E.* = .112) were examined. The results show that the mediation effect was not significant (*t* = 1.36, *p* = .09). Therefore, self-efficacy only mediated the relationship between instrumentality and career exploratory behaviors, but self-efficacy did not mediate the relationship between expressivity and career exploratory behaviors.

4.9 Results for Research Question 2

Research Question 2: *To what extent do social supports and social barriers, influence career exploratory behaviors?*

Hypothesis 2: *Social supports and barriers will influence career exploratory behaviors directly and indirectly through career goals(Figure 4.4).*

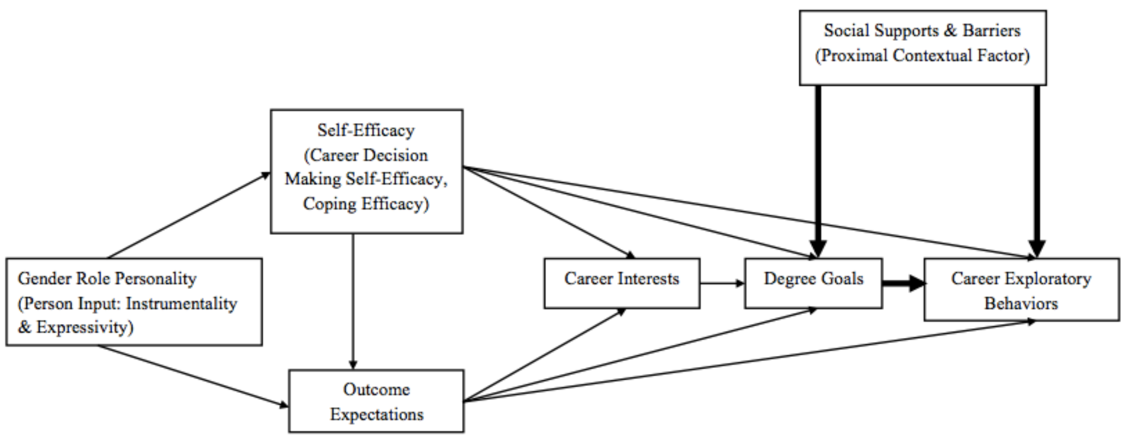

Figure 4.4 Hypothesis Two Examined in This Study. *Note.* Bolded lines depict the paths tested by hypothesis two.

4.9.1 Influences of Social Supports and Barriers on Career Exploratory Behaviors

According to the results, social supports had moderately significant direct influences on career exploratory behaviors (β = .124, *S.E.* = .040, *p* = .064), and career barriers significantly predicted career exploratory behaviors (β = .175, *S.E.* = .029, *p* = .008). Social supports had a standardized total effect of 0.110, a standardized direct effect of 0.12 and a standardized indirect effect of -0.02 on career exploratory behaviors. Social barriers had a standardized total effect of 0.18, a standardized direct effect of 0.18 and a standardized indirect effect of .006 on career exploratory behaviors.

4.9.2 Mediation Effects of Degree Goals

The hypothesis that social supports and barriers would have indirect effects on career exploratory behaviors through degree goals was examined using the Sobel test. First, while controlling for other variables in the structural model, the mediation effect of degree goals on the relationship between social supports and career exploratory behaviors was examined. The unstandardized path coefficients from the independent variable (social supports) to the hypothesized mediator degree goals (b = .097, *S.E.* = .039) and the path coefficients from the hypothesized mediator to the dependent variable career exploratory behaviors (b = -.090, *S.E.* = .065) were examined using the online Sobel's test calculator. The results show that the mediation effect was not significant (t = -1.21, p = .11). Second, while controlling for other variables in the structural model, the mediation effect of degree goals on the relationship between social barriers and career exploratory behaviors was examined. The unstandardized path coefficients from the independent variable (social barriers) to the hypothesized mediator degree goals (b = -.028, *S.E.* = .028) and the path coefficients from the hypothesized mediator to the dependent variable career exploratory behaviors (b = -.090, *S.E.* = .065) were examined using the online Sobel's test calculator. The results showed that the mediation effect was not significant (*t* = .81, *p* = .21). Therefore, the hypothesis that degree goals would mediate the relationship between social supports and barriers and career exploratory behaviors was not supported.

4.10 Results for Research Question 3

Research Question 3: *To what extent do self-efficacy, outcome expectations influence career exploratory behaviors?*

Hypothesis 3: *Self-efficacy and outcome expectations will have direct and indirect influences on career exploratory behaviors through career interests and career goals (Figure 4.5)?*

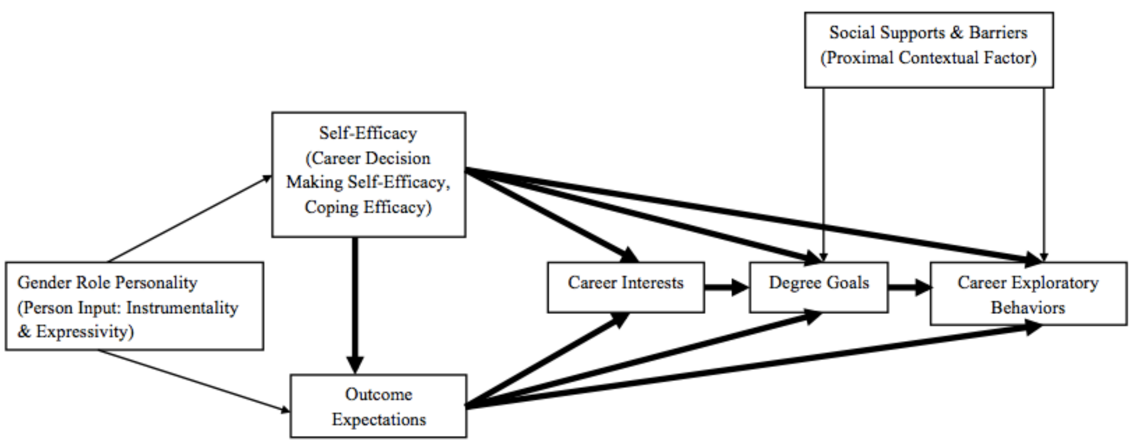

Figure 4.5 Hypothesis Three Examined in This Study. *Note.* Bolded lines depict the paths examined by hypothesis three.

4.10.1 Influences of Self-Efficacy and Outcome Expectations on Career Exploratory Behaviors

According to the results, self-efficacy had significant direct effects on career exploratory behaviors (β = .762, *S.E.* = .112, $p < .000$). Outcome expectations did not have a significant direct effect on career exploratory behaviors (β = -.050, *S.E.* = .037, $p = .614$). Self-efficacy had a standardized total effect of .698, a standardized direct effect of 0.76 and a standardized indirect effect of -0.06 on career exploratory behaviors. Outcome expectations had a standardized total effect of -0.06, a standardized direct effect of -0.05 and a standardized indirect effect of -0.01 on career exploratory behaviors. Career interests had a standardized indirect effect of -0.004 on career exploratory behaviors. Degree goals had a standardized direct effect of -0.10 on career exploratory behaviors.

4.10.2 Mediation Effects of Career Interests and Degree Goals

First, while controlling for other variables in the structural model, the hypothesis that career interests would mediate the relationship between self-efficacy and degree goals was examined using the Sobel test. The unstandardized path coefficients from the independent variable (self-efficacy) to the hypothesized mediator career interests ($b = .321$, *S.E.* = .135) and the path coefficients from the hypothesized mediator to the dependent variable degree goals ($b = .028$, *S.E.* = .038) were examined using the online Sobel's test calculator. The results show that the mediation effect was not significant ($t = .70$, $p = .24$). Then, while controlling for other variables in the structural model, the hypothesis that career interests would mediate the relationship between outcome expectations and degree goals was also examined using a Sobel test. The unstandardized path coefficients from the independent variable (outcome expectations) to the hypothesized mediator career interests (*b* = .080, *S.E.* = .059) and the path coefficients from the hypothesized mediator to the dependent variable degree goals (*b* = .028, *S.E.* = .038) were examined using the online Sobel test calculator. The results showed that the mediation effect was not significant (*t* = .65, *p* = .26). The hypothesis that career interests would mediate the relationship between self-efficacy and degree goals, and the relationship between outcome expectations and degree goals was not supported. Finally, while controlling for other variables in the structural model, the hypothesis that degree goals would mediate the relationship between career interests and career exploratory behaviors was examined. The unstandardized path coefficients from the independent variable (career interests) to the hypothesized mediator degree goals (*b* = .028, *S.E.* = .038) and the path coefficients from the hypothesized mediator to the dependent variable, career exploratory behaviors (*b* = -.090, *S.E.* = .065) were examined using the online Sobel test calculator. The results show that the mediation effect was not significant (*t* = -.65, *p* = .26). The hypothesis that degree goals would mediate the relationship between career interests and career exploratory behaviors was not supported.

4.11 Results for the Research Question 4

Research Question 4: *What additional factors influence students' pursuit of a STEM-intensive agricultural sciences major?*

Students were asked to answer the question: "What factors do you consider to have been helpful (or hindering) in pursuing a STEM-intensive major in the agricultural sciences? Using open-ended questions allowed the researcher to answer research question four and provide additional information that can inform future studies. After data collection, the researcher imported data from this open-ended question into the web application tool Dedoose. Descriptive coding strategy was applied and words or phrases were used to categorize the participant's responses into themes (Saldana, 2003). The current study followed the method of Saldana's (2013) qualitative analysis approach that assigned summarizing words or phrases to label the factors in students' responses. Frequencies were reported for each label.

A total of 410 factors were identified by the participants they believed to be helpful in their pursuit of a STEM-intensive agricultural sciences major fell into 10 thematic categories (See Table 4.10): mentor availability (*f* = 104, 25%), positive career outcome expectations (*f* = 37, 9%), academic interests (*f* = 31, 8%), peer factors (*f* = 32, 8%), personal characteristics (*f* = 33, 8%), family factors (*f* = 19, 5%), positive learning experiences (*f* = 20, 5%), other environmental supports (*f* = 15, 4%), financial factors (*f* =

8, 2%), and confidence in the subjects (*f* = 4, 1%). Positive career outcome expectations included items such as “career goals in the agricultural sciences” and “positive job market outlook.” Other environmental supports included “good university infrastructure”, “access to technology”, and “organized curriculum structure.” Personal characteristics mentioned by participants included skills and abilities that can help them pursue a major in STEM-intensive agricultural sciences disciplines, including “analytical skills”, “proactive personality”, and “good time management skills”.

A total of 273 factors were identified by the participants they believed to be hindering their pursuit of a STEM-intensive agricultural sciences major. These factors fell into 13 thematic categories (see Table 4.11): academic difficulties (*f* = 105, 38.46%), lack of mentoring and poor teaching (*f* = 55, 20.15%), other environmental barriers (*f* = 24, 8.79%), financial difficulties (*f* = 11, 4.03%), lack of interest (*f* = 11, 4.03%), lack of helpful learning experiences (*f* = 11, 4.03%), negative career outcomes (*f* = 7, 2.56%), peer conflicts and disconnection (*f* = 6, 2.20%), personal issues and characteristics (*f* = 14, 5.13%), family factors (*f* = 3, 1.10%), lack of academic preparation (*f* = 3, 1.10%), racial and ethnic barriers (*f* = 3, 1.10%) and social misunderstanding of agricultural sciences (*f* = 3, 1.10%). Academic difficulties included “math courses are very difficult”, “large amount of study time”, “chemistry and physics courses”, and other difficulties that related to schoolwork. Family factors include any factors related to family members or family issues. Lacking helpful learning experiences include lack of hands on experiences, lack of study abroad opportunities, and lack of other opportunities to be educated. For example, “courses do not offer enough hands on experiences to the students” was coded as lacking helpful learning experiences. Negative career outcomes included lack of job opportunities as compared to other majors. Financial difficulties include difficulties related to tuition, fees, and school expenses. Other environmental barriers include disorganized curriculum structure, difficult and stressful environment, inappropriate class times, lack of resources and lack of tutoring. For example, “lack of support or recognition from the university” was coded as other environmental barriers. Peer conflicts and disconnection included “miscommunication with peers”, “conflicts with roommates” and “feeling disconnected with peers.” Personal issues and characteristics included personal characters that can influence students’ career pursuits. The personal issues and characteristics theme included “not willing to go to class”, “procrastination”, “being nervous”, “self doubts”, “lacking of time management skills”, “too social”, “lack of confidence” and “lack of worth.” Racial and ethnic barriers included “lack of diversity in agriculture”, “being a minority and stereotypes.” Three students raised the issue of “social misunderstanding of the agricultural sciences.” They pointed out that “agriculture is sometimes not viewed as a science field”, and there is a lack of awareness on the importance of agriculture.

Table 4.10

Frequencies and Percentage of Helpful Factors

Helpful Factors	**f**	**%**
Academic Interests	31	7.6
Positive Career Outcome Expectations	37	9.0
Confidence in studying the Subjects	4	1.0
Family Factors	19	4.6
Peer Factors	32	7.8
Financial Factors	8	2.0
Positive Learning Experiences	20	4.9
Mentor Availability	104	25.4
Other Environmental Supports	15	3.7
Personal Characteristics	33	8.1
Total	410	100

Note. *N* = 319.

Table 4.11

Frequencies and Percentage of Hindering Factors

Hindering Factors	**f**	**%**
Academic Difficulties	105	38.5
Family Factors	3	1.1
Financial Difficulties	11	4.0
Lack of Mentoring and Poor Teaching	55	20.2
Lack of Academic Preparation	3	1.1
Lack of Helpful Learning Experiences	11	4.0
Negative Career Outcomes	7	2.6
Other Environmental Barriers	24	8.8
Peer Conflicts and Disconnections	6	2.2
Personal Issues and Characteristics	14	5.1
Racial and Ethnic Barriers	3	1.1
Social Misunderstanding	25	8.0
Regulatory Science of Agricultural Sciences	3	1.1
Total	273	100

Note. *N* = 247

CHAPTER 5. CONCLUSIONS

5.1 Introduction

This study assessed how key variables of Social Cognitive Career Theory (SCCT) could predict the career exploratory behaviors of African American undergraduate students who are enrolled in a STEM-intensive agricultural sciences majors. In the current study, measures of gender role (instrumentality, expressivity), cognitive variables (career decision-making self-efficacy, coping efficacy, outcome expectations, goals, interests), contextual variables (social supports, social barriers) and outcome variables (career exploratory behaviors) were assessed among a group of African American undergraduate students pursuing STEM-intensive agricultural sciences majors at HBLGIs. A structural equation modeling method was utilized to examine the relationship among the variables of interest. This chapter presents a summary of the conclusions, implications and recommendations for the study.

5.2 Purpose of the Study

The purpose of this study was to examine the influences of contextual and cognitive factors on the career goals and career exploratory behaviors of underrepresented minority undergraduate students pursuing STEM-intensive agricultural sciences majors.

5.3 Research Questions

This study aims to examine Lent`s (1994) social cognitive career model by testing four research questions and three hypotheses of the study:

Research Question 1: To what extent does gender role influence career exploratory behaviors?

Hypothesis 1: Gender role will influence career exploratory behaviors through its indirect influences on self-efficacy and outcome expectations.

Research Question 2: To what extent do social supports and social barriers, influence career exploratory behaviors?

Hypothesis 2: Social supports and barriers will influence career exploratory behaviors directly and indirectly through degree goals.

Research Question 3: To what extent do self-efficacy, outcome expectations influence career exploratory behaviors?

Hypothesis 3: Self-efficacy and outcome expectations will have direct and indirect influences on career exploratory behaviors through career interests and degree goals.

Research Question 4: What additional factors influence students' pursuit of a STEM-intensive agricultural sciences major?

5.4 Conclusions of the Study

The following sections will present conclusions for the study. Four major conclusions are discussed below, along with how the conclusions relate to prior SCCT studies and contributions to the current literature.

5.4.1 Conclusion 1: Higher Level of Masculine Attributes Can Predict Higher Level of Self-Efficacy and Result in More Career Exploratory Behaviors

In this study, African American college students who are enrolled in STEM-intensive agricultural sciences with masculine gender personality attributes would be more likely to engage in career exploratory behaviors if they feel more confidence in making career decisions. Instrumentality was found to significantly predict career exploratory behaviors through self-efficacy. This result was indicating that participants who were more independent, active, or competitive were more likely to have positive beliefs towards their ability of making career decisions and coping with career barriers, and therefore be engaged in more career exploratory behaviors. As hypothesized by Lent, Brown and Hackett (1994), person input variables are precursors of self-efficacy and outcome expectations and are expected to indirectly influence career outcomes through cognitive variables. In this study, the parameters among instrumentality, self-efficacy and career exploratory behaviors supported the proposed role of the person input variable in SCCT (Lent, Brown, & Hackett, 1994). Also, this result was consistent with the finding of Flores et al. (2010) that engineer students with high levels of instrumentality might engage themselves in more career exploration.

However, the paths from instrumentality to career exploratory behaviors through outcome expectations were not significant, which indicated that African American college students who have more masculine attributes did not necessarily have more positive career outcome expectations upon completing a degree in STEM-intensive agricultural sciences majors.

Also, expressivity significantly predicted outcome expectations. This result provided new perspectives on the role of expressivity within social cognitive career theory. In particular, participants who indicated they were kind and helpful to others were more likely to have positive expectations on the career outcomes upon completing a degree in STEM-intensive agricultural sciences. This was suggesting that a career in some STEM-intensive agricultural sciences areas can require engagement in behaviors of helping and caring for others. Because feminine characteristics can help students pursue their careers in these areas, students who are more caring, understanding and helpful would perceive positive career outcomes upon completing a degree in STEM-intensive agricultural sciences. For example, the students who care about animals are more likely to perceive positive career outcomes upon completing a degree in animal science.

5.4.2 Conclusion 2: Career Barriers Can Motivate Students' Career Exploratory Behaviors and Social Supports Can Encourage Students to Complete A Degree

According to the results of this study, African American college students who were enrolled in STEM-intensive agricultural sciences who faced career barriers were more likely to engage in career exploratory behaviors. Career barriers can significantly predict career exploratory behaviors in STEM-intensive agricultural sciences disciplines. This leads to the conclusion that awareness of career barriers can motivate African American college students to engage in more career exploratory behaviors. It is possible that African American college students who perceived more career barriers also had more opportunities to practice their coping skills. Byars-Winston and Fouad (2008) found out that career barriers can significantly predict coping efficacy. The significant relationship between career barriers and career exploratory behaviors in this study reflected the importance of increasing African American college students' awareness of career barriers when they are pursuing STEM-intensive agricultural sciences majors. Very few studies revealed the role of career barriers as a potential motivator for African American college students.

Additionally, African American college students in this study who perceived more social supports were more committed to completing a degree in STEM-intensive agricultural sciences disciplines. It is possible that African American college students who perceived more social supports would be more willing to complete a STEM-intensive agricultural sciences degree because they perceived having more resources and encouragement, hence, they feel more confident and comfortable to remain in school and complete the degree. Further, this conclusion was consistent with the proposed direct effects of proximal contextual variables on career choice actions (Lent, Brown, & Hackett, 1994). And this conclusion also supported Arroyo and Gasman's (2014) contention that African American students' positive experiences at HBCUs could promote a motivation of pursuing their career goals.

Finally, the indirect effects of social supports and barriers on exploratory behaviors through degree goals were not significant in this study. As such, it is possible that self-efficacy played a more important role than degree goals in mediating the relationship between social supports and barriers and career exploratory behaviors. Bandura (1999) supported this explanation that social supports and barriers only operate through self-efficacy, and several empirical studies have supported this hypothesis as well (e.g., Lent et al., 2001; Lent et al., 2003; Lent et al., 2005; Byars-Winston, Estrada, Howard, Davis & Zalapa, 2011). The indirect effects of social supports and barriers provides information on how these mechanisms influence career exploratory behaviors and their roles within SCCT.

5.4.3 Conclusion 3: Self-efficacy Plays Essential Role in Predicting Career Exploratory Behaviors

According to the results of this study, African American college students who were enrolled in STEM-intensive agricultural sciences majors who were confident in their ability of making career decisions and coping with career barriers were more likely to engage in more career exploratory behaviors. This conclusion supported the SCCT proposal of Lent, Brown and Hackett (1994) that self-efficacy has direct influences on choice actions. Also, the significant influence of self-efficacy on career exploratory behaviors confirmed the important role of self-efficacy in motivating the participants to set career goals and take actions in their career pursuits, which supported previous studies of Locke and Latham (2014) and Fouad and Smith (1996). For example, Locke and Latham (2014) indicated that self-efficacy could directly predict career goals. Similarly, Fouad and Smith (1996) stated in their study that self-efficacy can directly influence career intentions.

The results of this study also indicated that the participants' outcome expectations and degree goals did not have a significant influence on career exploratory behaviors. These findings did not support the hypothesized significant effects of outcome expectations and degree goals on career exploratory behaviors (Lent, Brown, & Hackett, 1994). In this study, self-efficacy explained a significant amount of variance in outcome expectations, interests and career exploratory behaviors, but neither outcome expectations, interests or degree goals explained a significant amount of variance in any variables in the structural model. This finding reinforces the significant role of self-efficacy in explaining the variance in the model. A possible explanation for the non-significant relationships between degree goals and career exploratory behaviors, and between outcome expectations and career exploratory behaviors might be that because self-efficacy explained such a large amount of variance in career exploratory behaviors, this caused the variance explained by outcome expectations and degree goals not to be significant.

5.4.4 Conclusion 4: Mentoring Availability and Academic Difficulties Were Significantly Influencing African American Students' Career Pursuit in STEM-Intensive Agricultural Sciences

African American college students who were enrolled in STEM-intensive agricultural sciences majors reported mentoring was the most helpful factor regarding their career pursuits, and the academic difficulties was the most hindering factors regarding their career pursuits. The two open-ended questions at the end of the survey provided valuable information for researchers and practitioners. For example, the top most frequently mentioned helpful factors was that having access to a mentor for the participants to pursue a STEM-intensive agricultural sciences major. This finding supported Clay (2012) that mentoring helped students more successful at HBCUs. Additionally, the most frequently mentioned hindering factors were academic difficulties. Lack of mentoring availability was the second most mentioned hindering factor, which indicated that African American college students having access to mentors can significantly influence their career pursuits of STEM-intensive agricultural sciences majors. Mentoring can also increase the level of social supports students perceive. This conclusion supported the SCCT framework of Lent, Brown and Hackett (1994) that social supports can positively predict choice goals and choice actions. However, few studies have investigated the role of mentoring in influencing the STEM career development of students (Dolenc, Mitchell & Tai, 2015). Several contextual factors were identified by students most often as being helpful in their pursuit of a STEM-intensive agricultural sciences degree. For example, participants have identified mentoring availability, family supports, peer supports, financial supports, and other environmental supports in their answers to the open ended questions. As such, it can be assumed that a supportive environment can encourage African American college students to achieve their success in STEM (Clay, 2012; Whittaker & Montgomery, 2012). The importance of contextual factors was also supported by Byars-Winston, Estrada, Howard, Davis and

Zalapa (2011) who found that perceived campus climate had direct influences on minority students' self-efficacy and indirect influences on minority students' academic goals.

Several participants also mentioned that academic difficulties hindered their pursuit of a STEM-intensive agricultural sciences major. Because academic difficulties can decrease students' academic self-efficacy, more supports (e.g., tutoring programs) should be provided for students with academic difficulties. One possible strategy can be to provide more tutoring programs for students who are pursuing STEM-intensive agricultural sciences majors.

There are still other factors that should also draw attention from educators and practitioners. Positive learning experiences including hands-on experiences, workshops, seminars and internships were mentioned by students as helpful factors for their pursuit of STEM-intensive agricultural sciences majors. The lack of helpful learning experiences was also identified by students as a hindering factor for students' academic success. Gasman (2012) also argued that positive learning experiences can facilitate learning effectiveness of students.

5.5 Implications for Theory and Research

This study suggested the essential role of self-efficacy in career development process. This study supported the proposal of Bandura (1986) and Lent, Brown and

Hackett (1994) that self-efficacy can play a central role in the interactions among human, behavior and environment. In this study, self-efficacy had the most significant relationships with other variables in the structural model. Self-efficacy had a significant direct effect on choice actions and self-efficacy was also a significant mediator between person input and choice actions. This study also proposed new evidence to support the important role of feminine gender role personality and career barriers.

Several propositions of the Social Cognitive Career Theory (SCCT; Lent, Brown, & Hackett, 1994) were closely related to this study. Table 5.1 highlights the propositions in SCCT and the conclusions of this study that were closely related. Results of this study supported SCCT in that person inputs are important resources of self-efficacy and outcome expectations, and person inputs can also predict choice actions through self-efficacy (Lent, Brown, & Hackett, 1994). However, it is important to note that different person input variables predicted different cognitive variables in this study. For example, instrumentality only significantly predicted self-efficacy while expressivity only significantly predicted outcome expectations. Hence, different aspects of person input can influence human behaviors through different cognitive processes. For example, masculine attributes might tie more closely with participants' confidence in their ability of completing tasks. Additionally, feminine attributes can relate more closely with participants' expectations towards their future career outcomes.

Further, results from this study provided new evidence to support the role of expressivity as a significant precursor of outcome expectations in SCCT. No previous studies had been found that revealed the significant role of expressivity in SCCT. Hence, this study provides new insights on how feminine characteristics can influence the career development process. Bem (1971) indicated feminine personality reflected a more emotional, caring and understanding aspect of a human being, and can be related to more feelings, rather than thoughts. This study provided a new perspective to consider how evaluation of career related information is not totally a rational process, and can involve feelings and emotions.

Also, the findings of this study suggested that degree goal might not be perceived as a precursor of career exploration. The degree goal variable measured in the current study did not significantly predict career exploratory behaviors. It is possible that African American college students did not perceive completing a degree as a necessary step before they explore career opportunities in the STEM-intensive agricultural sciences, or perhaps African American college students perceived completing a degree in the STEM-intensive agricultural sciences as a way of getting the skills for their future career in other disciplines. Considering that 93% of the participants indicated that they would pursue another degree after they complete their Bachelor's degree in the STEM-intensive agricultural sciences, it is also possible that African American college students disagreed that a Bachelor's degree can get them fully prepared for the job market, thus it is not necessary for them to explore their career opportunities during this phase of their education.

Results from research question two indicated that career barriers had a significant effect on career exploratory behaviors, while social supports only showed a significant direct effect on degree goals. This result supported SCCT's hypothesized direct path from social supports to choice goals, but contradicted SCCT's hypothesized direct path from social supports to choice actions. It is possible that the support participants received from their learning environment were more related to the academic difficulties they experienced, rather than career-related difficulties. Hence, when career barriers were perceived by the participants, they might take more actions to cope with the barriers and be engaged in career exploratory behaviors. As mentoring was identified as the most helpful factor and academic difficulties as the most hindering factor for students' pursuit of STEM-intensive agricultural sciences majors, these two factors can also help us understand the importance of social support and self-efficacy. Mentoring is the social support provided by the institutions and academic difficulties are related to students' self-efficacy, and mentoring can help increase students' self-efficacy in completing their degrees. These two factors helped us understand the important role of self-efficacy in SCCT and how social support can be an important precursor of self-efficacy in SCCT.

Table 5.1

SCCT Propositions and Conclusions of This Study

SCCT Propositions		Conclusions of this Study
SCCT Proposition 3: Self-efficacy beliefs affect goals and actions both directly and indirectly.	1	Self-efficacy did not have significant influences on goals directly or indirectly. Self-efficacy had significant direct influence on career exploratory behaviors, but self-efficacy did not have significant indirect effects on career exploratory behaviors.
SCCT Proposition 4: Outcome expectations affect choice goals and actions both directly and indirectly.	2	Outcome expectations did not affect choice goals directly or indirectly. Outcome expectations did not affect choice actions directly or indirectly.
SCCT Proposition 6A: There will be a positive relation between choice goals and entry behaviors.	3	There was no positive relation between choice goals and entry behaviors.
SCCT Proposition 7: Interests affect entry behaviors (actions) directly through their influence on choice goals.	4	There was no positive relation between interests and career exploratory behaviors through goals.

Table 5.1
Continued

SCCT Propositions		Conclusions of this Study
	5	Instrumentality positively influenced career exploratory behaviors through self-efficacy. There was no significant indirect effect of outcome expectations on career exploratory behaviors. *
	6	Social supports did not have significant direct or indirect influences on career exploratory behaviors. Career barriers had significant direct effects on career exploratory barriers, but career barriers did not have any significant indirect effects on career exploratory behaviors. *

Note. * There were no SCCT propositions developed in the original work of Lent, Brown and Hackett (1994) related to this finding

5.6 Implications for Practice

The first implication for practice is that more career related mentoring should be provided to African American college students who are enrolled in STEM-intensive agricultural sciences majors at HBLGIs. More career education and career mentoring can encourage students to take the initiative to acquire information about the occupations and organizations they are interested in, and also get prepared for the job market. Super (1957) indicated that early adulthood can be a critical period for career exploration. Further, Blustein (1989) indicated that, to some extent, goal-directedness was associated with career exploration of college students. Therefore, it is critical for college students to feel less confused and have clear directions during their career exploration. For example, more career mentoring and counseling could be provided to assist African American college students with the career exploration process.

The second implication for practice is that university administrators, educators and practitioners should be aware of the important role of career decision-making self-efficacy and coping efficacy for African American students to be engaged in career exploratory behaviors. Career related workshops, work related learning experiences and other career-related opportunities can be provided by the institutions to increase students' confidence in their ability of making career decisions and coping with career barriers. Career counselors who provide career guidance services for students pursuing STEM-intensive agricultural sciences majors can also design and implement career counseling programs to help African American college students increase confidence in their ability to make career decisions and cope with career barriers.

The third implication for educators and administrators in Predominantly White Institutions (PWIs) is that social supports play an important role in African American college students' commitment of completing a degree in STEM-intensive agricultural sciences disciplines. As such, administrators at PWIs should empower students by providing more environmental support and facilitate a more supportive learning environment for African American college students. A supportive campus climate can be represented by: 1) providing more resources for students who are experiencing academic difficulties, 2) presenting more African American role models in STEM-intensive agricultural sciences, and 3) encouraging African American college students to complete their STEM-intensive agricultural sciences degrees. Also, university educators and administrators should also consider resilience of students and help students be aware of career barriers, so they can be engaged in more career exploratory behaviors.

5.7 Recommendations for Future Research

The present study represents an effort of extending the scope of SCCT by being the first to explore the role of instrumentality and expressivity in influencing the career exploratory behaviors of African American college students pursuing STEM-intensive agricultural sciences majors.

The interpretation of the research findings might be biased because of the researcher's limited experiences with STEM learning and teaching in the United States. Also, confounding variables including personal characteristics that were not included in this study might influence the data collection, data analysis and results interpretation. Additionally, the results of this study may be not generalizable to explain the career development process of non-African American college students who are not pursuing STEM-intensive agricultural sciences degrees. Because the current study only examined students who were enrolled in STEM-intensive agricultural sciences majors at five HBLGIs, findings of this study can only be generalized to students enrolled in similar types of majors and institutions. Also, the participants of this study were predominantly female, and most participants majored in animal science, so the findings of this study should be generalized to other populations with caution. Moreover, because of the cross-sectional design of the study, causal relationship among variables of interest cannot be made. Finally, this study provided valuable information to explain the career development of African American college students, so the results should be generalized to other racial and ethnic groups with caution.

What follow are several recommendations for future research that should be considered.

1. This study revealed that expressivity influences outcome expectations. The degree to which expressivity can influence other social cognitive variables is still unknown. As such, additional research should further explore the role of expressivity in the STEM career development of African American college students.
2. The results of this study showed the direct influences of social supports on degree goals and the direct influences of career barriers on career exploratory behaviors. However, the indirect influences of social supports and career barriers on career outcomes through self-efficacy were not examined in current study. Future studies should test the mediation effects of self-efficacy on the relationship between social supports and barriers and career outcomes.
3. Outcome expectations in this study did not explain a significant amount of variance in career interests and degree goals, and career interests did not explain a significant amount of variance in degree goals, which both contradicted the hypothesized interests and goal models in SCCT (Lent, Brown, & Hackett, 1994). The relationships among self-efficacy, outcome expectations, career interests, and degree goals need further examination in future studies.
4. In this study, a number of students identified mentor availability and positive learning experiences as helpful factors in their pursuit of a STEM-intensive agricultural sciences major. However, this study did not include these factors as part of the SCCT

model testing, yet they could be beneficial in future studies. As such, future research should include measures that assess various indicators of mentoring support available to students as well as students' positive learning experiences resulting from having engaged in a structured mentoring program. An examination of how various mentoring variables can contribute to the prediction of students' self-efficacy, outcome expectations, career interests, goals and career outcomes could provide a more clear picture on how campus climate and resources influence African American college students' STEM career development.

5. Future research should implement group comparison studies to examine how the SCCT framework fits across gender, race/ethnicity, STEM major, university type. For example, using SCCT as the framework, future research could explore the STEM career development of female and male students, different race/ ethnicity groups, or students enrolled in different STEM majors. Future studies could also be conducted to examine if SCCT fits with the data across different university types. For example, Lent et al. (2005) examined SCCT at both PWIs and HBCUs, and found that SCCT can help explain the STEM career development of engineering students from these two institution types.
6. This study focused only on the perspective of undergraduate students. Because the STEM career development of the graduate student population has been understudied

in the SCCT literature, studies with graduate students could provide expanded perspectives on the utility of SCCT. Specifically, studies should be conducted with graduate students who are enrolled in STEM-intensive agricultural sciences majors.

7. Future research should examine the factors that make the campus climate at HBLGIs a more welcoming environment for African American students. Gasman (2012) indicated that HBCUs developed a STEM community that emphasized success of all students. Factors that help students feel welcomed in this community should be explored by future research. A major implication from this research efforts could be that PWIs could gain insights into what helps facilitate minority undergraduate students' academic success.

8. Future studies could expand on the qualitative portion of the current study. For example, qualitative research can provide more in depth insights on individual students' thoughts and can also provide directions for future quantitative studies. A comprehensive qualitative study should be conducted examining African American college students' learning experiences and the identification of factors that facilitates their academic and career success in STEM-intensive agricultural sciences majors.

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APPENDICES

Appendix A IRB Approval

PURDUE
UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

To:	LEVON ESTERS AGAD
From:	JEANNIE DICLEMENTI, Chair Social Science IRB
Date:	03/06/2014
Committee Action:	**Exemption Granted**
IRB Action Date:	03/05/2014
IRB Protocol #:	1402014458
Study Title:	Influence of Social Cognitive Variables on the Career Goals and Exploration Behaviors of Minority Undergraduate Agricultural, Environmental and Live Science Majors at Historically Black Colleges and Universities (HBCUs)

The Institutional Review Board (IRB) has reviewed the above-referenced study application and has determined that it meets the criteria for exemption under 45 CFR 46.101(b)(2) .

If you wish to make changes to this study, please refer to our guidance **"Minor Changes Not Requiring Review"** located on our website at http://www.irb.purdue.edu/policies.php. For changes requiring IRB review, please submit an **Amendment to Approved Study** form or **Personnel Amendment to Study** form, whichever is applicable, located on the forms page of our website www.irb.purdue.edu/forms.php. Please contact our office if you have any questions.

Below is a list of best practices that we request you use when conducting your research. The list contains both general items as well as those specific to the different exemption categories.

General

- To recruit from Purdue University classrooms, the instructor and all others associated with conduct of the course (e.g., teaching assistants) must not be present during announcement of the research opportunity or any recruitment activity. This may be accomplished by announcing, in advance, that class will either start later than usual or end earlier than usual so this activity may occur. It should be emphasized that attendance at the announcement and recruitment are voluntary and the student's attendance and enrollment decision will not be shared with those administering the course.
- If students earn extra credit towards their course grade through participation in a research project conducted by someone other than the course instructor(s), such as in the example above, the students participation should only be shared with the course instructor(s) at the end of the semester. Additionally, instructors who allow extra credit to be earned through participation in research must also provide an opportunity for students to earn comparable extra credit through a non-research activity requiring an amount of time and effort comparable to the research option.
- When conducting human subjects research at a non-Purdue college/university, investigators are urged to contact that institution's IRB to determine requirements for conducting research at that institution.

- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Category 1

- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Categories 2 and 3

- Surveys and questionnaires should indicate
  - only participants 18 years of age and over are eligible to participate in the research; and
  - that participation is voluntary; and
  - that any questions may be skipped; and
  - include the investigator's name and contact information.
- Investigators should explain to participants the amount of time required to participate. Additionally, they should explain to participants how confidentiality will be maintained or if it will not be maintained.
- When conducting focus group research, investigators cannot guarantee that all participants in the focus group will maintain the confidentiality of other group participants. The investigator should make participants aware of this potential for breach of confidentiality.
- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). This is an institutional requirement.

Category 6

- Surveys and data collection instruments should note that participation is voluntary.
- Surveys and data collection instruments should note that participants may skip any questions.
- When taste testing foods which are highly allergenic (e.g., peanuts, milk, etc.) investigators should disclose the possibility of a reaction to potential subjects.

PURDUE
UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

To:	ESTERS, LEVON T
From:	DICLEMENTI, JEANNIE D, Chair Social Science IRB
Date:	09 / 30 / 2014
Committee Action:	Amended Exemption Granted
Action Date:	09 / 30 / 2014
Protocol Number:	1402014458
Study Title:	Influence of Social Cognitive Variables on the Career Goals and Exploration Behaviors of Minority Undergraduate Agricultural, Environmental and Live Science Majors at Historically Black Colleges and Universities (HBCUs)

The Institutional Review Board (IRB) has reviewed the above-referenced amended project and has determined that it remains exempt.

If you wish to make changes to this study, please refer to our guidance"**Minor Changes Not Requiring Review**" located on our website at http://www.irb/purdue.edu/policies.php. For changes requiring IRB review, please submit an **Amendment to Approved Study** form or **Personnel Amendment to Study** form, whichever is applicable, located on the forms pages of our website www.irb.purdue.edu/forms.php. Please contact our office if you have any questions.

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University of Arkansas – Pine Bluff

Institutional Review Board Response to Request for Review

UAPB IRB IORG0002614	Registration 091814 Date 09/18/14	
Principal Investigator	Dr. Levon Esters (Purdue) Phone c/o Teki Hunt-Jimenez 870-575-8538	E-mail huntjimenezt@uapb.edu
Project Title or Description	Influence of Social Cognitive Variables on the Career Goals and Exploration Behaviors of Minority Undergraduate Agricultural, Environmental and Live Science Majors at Historically Black Colleges and Universities (HBCUs)	
The items checked need to be completed for further review	Add advisor/student contact information Add a statement that the participant is at least 18 years of age. (Under 18 require parental/guardian permission.) Add a statement that participation is voluntary and that participation can be withdrawn at any time without penalty. Provide a signature and date line for participants on the consent form. Add a space on the Parental Permission form for the child's name. Develop a simple assent form for review Add statement regarding video/audio tapes must include where they will be kept, for how long, when or if they will be destroyed, who will have access to them, etc. A statement from the school, institution, facility, etc., granting permission to conduct research is needed	A cover letter for mail surveys is needed. A copy of the survey instrument is needed. A copy of the consent form is needed. A copy of the assent form is needed. A statement of how the data will be kept confidential is needed. What is the expected duration of the study? How will you protect the privacy of the subjects? How will you recruit subjects? Address debriefing or attach form References are needed. Comments: ______

Recommendations:

Exempt from Review

Signature: Approved as submitted

Institutional Review Board Coordinator

Date must be met prior to initiation of research

Expedited Review

Date: 09/18/14

Approved with conditions noted which

Not approved

Approved as submitted

Institutional Review Board Coordinator

Signature: Richard B. Walker

Full Board Review

X :

Approved with conditions noted which must be met prior to initiation of research

Not approved

Date

Signature:

Institutional Review Board Coordinator

Note: Approval Expires one (1) year from the date above. If significant changes are made to this protocol, prior approval from the IRB must be obtained. If you disagree with the final IRB recommendation, you may appeal the decision.

KSU IRB #: 15-006

KENTUCKY STATE UNIVERSITY
IRB EXEMPTION CERTIFICATION REQUEST
PROCEDURES AND APPLICATION

The Code of Federal Regulations (Title 45 CFR Part 46) identifies several different categories of research that pose no risk or little risk that are exempt from the federal regulations for the protection of human subjects research. Although these categories of research activities are exempt, the KSU IRB is responsible for certifying that the research meets the exemption requirements. Exempt research does not require continuation reviews; however, projects that continue beyond five years require submission of a new application for exemption. It is the researcher's responsibility to timely notify the IRB in writing of any changes to the study once it is initiated that do not fall within research exempted from the regulations.

Research that is certified as Exempt from review does not absolve the researcher from ensuring that the welfare of human subjects participating in the research is protected, research methods are appropriate, and informed consent is obtained.

Exempt Research Categories:

- Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
- Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or (iii) be damaging to the subjects' financial standing, employability, or reputation.
- Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) Federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.
- Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.
- Research and demonstration projects which are conducted by or subject to the approval of Department or Agency heads, and which are designed to study, evaluate, or otherwise examine: (i) Public benefit or service programs; (ii) procedures for obtaining benefits or services under

KSU IRB #: ____________________

those programs; (iii) possible changes in or alternatives to those programs or procedures; (iv) possible changes in methods or levels of payment for benefits or services under those programs; (v) projects for which there is no statutory requirement for IRB review; (vi) projects that do not involve significant physical invasion or intrusion upon the privacy interests of participants; (vii) authorization or concurrence by finding agencies that exemption from IRB review is acceptable.

- Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

<u>Exempt Research Procedures</u>:

1. The researcher preliminarily determines whether a research project is eligible for exemption based on the categories noted above.
2. If the research falls into one of the categories, the researcher completes the Exemption Certification Application.
3. The Exemption Certification Application must be reviewed and approved by the researcher's Department Chairperson or subsequent administrative supervisor (e.g., Dean). If the research is being conducted to fulfill academic requirements, the researcher's faculty advisor overseeing the project must sign the Application.
4. If the research being submitted to OR is supported by extramural or internal funding agency or program, a copy of the grant or contract proposal must also be submitted with the Application.
5. If the research includes a survey, interview, or assessment, the survey instrument, interview guide, or assessment scale must be submitted with the Application.
6. If the research is subject to the Health Insurance and Portability Act (HIPAA) regulations, the HIPAA Authorization OR waiver must be submitted with the Application.
7. The KSU IRB will notify the researcher upon review of the materials whether (1) Exemption Certification is Approved; (2) Additional Information is Required from the researcher; or (3) Exemption Certification is not approved because the research does not qualify.
8. An application for an Expedited OR Full Review must be submitted if an Exemption is not approved.

KSU IRB #: ____________________

EXEMPTION CERTIFICATION RESEARCH DESCRIPTION

1. Background. (Provide information about the proposed research activities.)

Much research has been published on the career development of students majoring in science, technology, engineering, and math (STEM) disciplines. However, less is known about underrepresented minorities (URMs) majoring in STEM-intensive food, agricultural sciences majors. Our project is to examine the role of personal, contextual and cognitive variables on the career goals and career exploration behaviors of underrepresented minority undergraduate students enrolled in colleges of agriculture at 1890 land-grant institutions. We anticipate the findings from our study will lead to educational interventions designed to help increase and retain the number of students from underrepresented populations pursuing postsecondary education and careers in science, technology, engineering, agriculture, and math (STEAM) disciplines.

2. Objectives. (List the objectives of the research activities.)

The overall goal of this study is to examine the influences of selected social cognitive, cultural and contextual factors on the career goals and career exploration behaviors of underrepresented minority undergraduate students in the college of agriculture.

3. Study Population. (Describe the characteristics of the study population, including the anticipated number of subjects, age range, gender, ethnicity, and health status. Specify any inclusion and exclusion criteria.)

The participants for this study will be undergraduate students from six collaborating 1890 land-grant HBCUs. Specifically, the participants will be underrepresented minority undergraduate students who are majoring in science-intensive agricultural sciences majors.

4. Subject Recruitment. (Describe the process of identifying and recruiting subjects for the research activities. Attach a copy of any recruitment material, such as flyers, advertisements, cover letters, etc.)

The research team at Purdue University is responsible for identifying the inclusion critertia for students be considered as "STEM-intensve majors". Majors are considered "STEM-intensive" if 50% or more of the cousres needed to sastify the major were science, technology, engineering or math courses.

5. Research Procedures. (Describe the procedures that will be used.)

The data will be collected from students enrolled in selected agricultural sciences classes at each of the land-grant HBCUs using a researcher-developed survey instrument. The survey contains items that measure various social cognitive, cultural and contextual variables. It is anticipated that the survey will take less than 20 minutes to complete. After the data is collected and analyzed, the results will be shared with each of the collaborating institutions.

Created 2/06/2010
REV 9/28/2010

KSU IRB #: ____________________

6. Data Collection. (Specify the data collection process that will be used and the data that will be collected from subjects. Attach all instruments to be used, such as survey instruments, interview guide, assessment tools, and data collection form for existing data.)

The researcher from Purdue will travel to each HBCU, explain the study and distribute surveys to the participants. A valid and reliable survey instrument will be administered to the participants. Responses of students to each question will be collected and analyzed.

7. Potential Risks. (Describe any potential risks that the study poses to subjects, whether seen or unforeseen, including physical, social, psychological, legal, or other risks.)

There is no risk of participation. This survey is completely voluntary and should take no more than 20 minutes to complete. The participants are free to withdraw from completing this survey at any time without penalty. The participants are free to not answer any questions they choose without penalty.

8. Research Materials, Records, and Privacy Issues. (Identify the sources of material that will be obtained from subjects, what information will be recorded, concerns relating to privacy of subjects, and explain why this information is needed to conduct the research activities.)

The students would be asked about their personal attributes, self-efficacy, outcome expectations, career interests, career goals, and career exploration behaviors because we are interested in exploring the influences of these factors on students' career development.

9. Confidentiality. (Specify the procedures that will be used to safeguard and protect information gathered to maintain privacy and confidentiality. Explain the process that will be used to destroy the information upon conclusion of the study. If the information will be maintained, provide an explanation. Also discuss what safeguards will be used by the researcher if data will be shared with other entities (e.g., aggregate data, de-identification, etc.).

All the responses will be held in strictest confidence. All the information will also be kept fully confidential. The surveys will be kept on a secure server that only the researchers have access to and will in no way be able to be traced back to the participants.

If the participants have any questions about this research or its conduct, and research subjects' rights, they may contact the Principal Investigator: Dr. Levon T. Esters, 765-494-8423, lesters@purdue.edu or the Co-Principal Investigator: Qi Ding, 765-404-9457, dingq@purdue.edu.

KSU IRB #: ____________________

KENTUCKY STATE UNIVERSITY
EXEMPTION CERTIFICATION APPLICATION

1. Researcher 's Contact Information
   Name: Levon Esters
   Campus Address Agricultural Administration Building - Rm. 224
   615 W. State St. West Lafayette, IN 47907-2053
   Telephone Number (765) 494-8423
   Email Address lesters@purdue.edu
   Fax Number NA
   Faculty Advisor Supervising Research (if applicable) NA

2. Researcher's Identification Information
   Employee/Student I.D. Number NA
   Degree and Rank PhD, Associate Professor
   College/Department/Unit Purdue University, College of Agriculture, Department of Youth Development and Agricultural Education

3. Title of Research Project (if funded, use the same title used on the grant/contract application):
   Influence of Social Cognitive Variables on the Career Goals and Exploration Behaviors of Minority Undergraduate STEM Intensive Agricultural Sciences Majors at HBCUs

4. State the anticipated number and age range of the human subjects in your study.
   Number of subjects 100 Age Range of subjects Undergraduate, 18-25

5. Check (√) all items that apply to your research project.
   - [ ] Academic Degree/Required Research
   - [ ] HIPAA Authorization
   - [ ] HIPAA Waiver of Authorization
   - [ ] HIPAA De-identification
   - [ ] Waiver of Informed Consent
   - [x] Waiver of Requirement for Documentation of Informed Consent
   - [ ] Consent & Assent (if applicable) Authorization
   - [ ] Consent Preamble Used

Created 2/06/2010
REV 9/28/2010

KSU IRB #: ____________________

6. Check (√) all items that apply to your research project if the research is being submitted to, supported by, or conducted in cooperation with an external or internal funding source.
   - ☐ Not Applicable
   - ☐ DHHS (Dept of Health and Human Services)
   - ☐ NIH (National Institutes of Health)
   - ☐ CDC (Center for Disease Control)
   - ☐ HRSA (Health Resources and Services Administration)
   - ☐ SAMHSA (Substance Abuse and Mental Health Services Administration) NSF
   - ☐ (National Science Foundation)
   - ☐ DOE (Dept of Education) DOD
   - ☐ (Dept of Defense) USDA
   - ☐ (Dept of Agriculture)
   - ☐ Other Federal Government Agency (Specify:____________________)
   - ☐ State Government Agency (Specify:____________________)
   - ☐ Private Foundation or Industry (Specify:____________________)
   - ☐ Other Institution of Higher Learning (Specify:____________________)
   - ☐ Other Not Listed (Specify:____________________)

KSU IRB #: ____________________

7. Specify the external or internal funding source(s) and/or cooperating organization(s):
Purdue University, Department of Youth Development and Agricultural Education

8. Check (√) the appropriate response:
☐ Grant/contract application attached ☐ Not Applicable

9. Specify the site(s) where the research will be conducted (attach any documentation, if available, approving such site activities):
Kentucky State University, Agricultural Sciences Classes

10. State all individuals who will be assisting in the research activities (include Name, Rank/Degree, Employee/Student I.D. Number, Contact Information, and responsibility in the research activities):
QiDing, Email: dingq@purdue.edu; Phone Number: 765-404-9457. Qi will be the person that goes to the research sites to administer the survey.

11. All individuals who engage in externally-funded research activities shall comply with University requirements concerning Research Financial Disclosure and Research Conflict of Interest standards.

12. Research activities are Exempt from federal regulations (45 CFR 46.101(b)) for the protection of human subjects when the activities meet one or more categories below. Check (√)the appropriate category(ies) that apply to your research.

(a) [X] Research conducted in established or commonly accepted educational settings, involving normal educational practices, such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.
(b) ☐ Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be

identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or (iii) be damaging to the subjects' financial standing, employability, or reputation.

(c) ☐ Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) Federal statute(s) require(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

(d) ☐ Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available or if the information is recorded by the investigator in such a manner that subjects cannot be identified, directly or through identifiers linked to the subjects.

(e) ☐ Research and demonstration projects which are conducted by or subject to the approval of Department or Agency heads, and which are designed to study, evaluate, or otherwise examine: (i) Public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; (iv) possible changes in methods or levels of payment for benefits or services under those programs; (v) projects for which there is no statutory requirement for IRB review; (vi) projects that do not involve significant physical invasion or intrusion upon the privacy interests of participants; (vii) authorization or concurrence by finding agencies that exemption from IRB review is acceptable.

(f) ☐ Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the Food and Drug Administration or approved by the Environmental Protection Agency or the Food Safety and Inspection Service of the U.S. Department of Agriculture.

13. Exemption categories do not apply in research activities involving the following special populations:

*Prisoners
*Survey or interviews with minors as subjects (applies to category (b) only)
*Observation of minors where the researcher participates in the activities being observed (applies to category (b) only)
*FDA regulated research (applies to categories ((a-e) and includes projects in which the data will be submitted to or held for inspection by the FDS, or projects in which the researcher gathers data on participants who serve as controls for participants who receive FDS-regulated drugs or medical devises, other than in the course of medical practice).

KSU IRB #: ____________________

Researcher's Assurances:

I understand Kentucky State University's policies concerning human subjects research. I agree to the following conditions in support of my research activities:

1. I agree to comply with all KSU IRB policies, decisions, conditions, and requirements;
2. I agree to accept responsibility for the scientific and ethical conduct of the research activities that I engage;
3. I agree to obtain approval from the KSU IRB prior to amending or modifying the research protocol, including any changes to the approved consent/assent form and procedures;
4. I agree to notify the University in writing as appropriate of the development of any financial interest or conflict of interest that has not already been disclosed;
5. I agree that I and all research staff listed on the application have received the mandatory human subjects protections education training.
6. I attest that the research activities and only involvement of human subjects will be in a category that qualifies for an exemption.

Researcher's Signature: Levon T. Estes Date: 10-15-14

Researcher's Printed Name: Levon T. Estes

Department Chair or Next Level Administrator's Assurances:

This is to certify that I have reviewed this research protocol and that I attest to the scientific validity and importance of these activities. I attest to the competency of the researcher[s] to conduct the research and support these activities. I will provide continued guidance as appropriate.

Signature: Roger Tornmekbed Date: 10/15/14

Printed Name: Roger Tornmekbed

*Faculty Advisor's Assurances:

This is to certify that I have reviewed this research protocol and that I attest to the scientific validity and importance of these activities. I attest to the competency of the researcher(s) to conduct the research and support these activities. I will provide continued guidance as appropriate.

Created 2/06/2010
REV 9/28/2010

KSU IRB #: 15-006

Leron T. Peters 10-15-14

Printed Name: Leron T. Peters

*If the researcher is a student who is completing this project to meet academic requirements, the student's faculty advisor who is responsible for supervising the research project must sign the assurance in addition to the Department Chair.

Created 2/06/2010
REV 9/28/2010

Appendix B Plan of Studies for the STEM-Intensive Agricultural Sciences Majors

1. Kentucky State University
Plan of Studies for Agricultural Sciences majors

2. North Carolina A & T State University
Plan of Studies for Agricultural Sciences majors

4. University of Arkansas-Pine Bluff
Plan of Studies for Agricultural Sciences majors

3. University of Maryland-Eastern Shore
Plan of Studies for Agricultural Sciences majors

5. Virginia State University
Plan of Studies for Agricultural Sciences majors

Plan of Studies for Kentucky State University

Division of Agriculture & Natural Resources: Academic Programs

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Degrees Offered:

Beginning in the fall Semester of 2012, the College of Agriculture, Food Science, and Sustainable Systems will offer a baccalaureate degree program in Agriculture, Food, and Environment (AFE) with an **Option in Agricultural Systems**.

The United States Department of Agriculture and U.S. Department of Labor predict significant job growth in the areas of food, renewable energy, and environment. Using an interdisciplinary approach, students will develop a broad understanding of relationships between agricultural systems, food safety, and the environment and graduates will be trained for jobs and graduate school opportunities in these growth areas in the U.S. economy.

Graduates of a the AFE Degree Option in Agricultural Systems will learn the science behind the practical applications, discover real-world solutions, collaborate with cutting-edge industries, benefit from greater faculty interaction in small classes, and you'll make life-long friends.

The **AFE Degree Option in Agricultural Systems** requires a general core of university required class. Additional AFE general required courses include:

- AFE 116 Intro Agriculture, Food, and Environment
- AFE 117 Global Perspectives in Agriculture, Food, and Environment
- AFE 211 Intro Animal Science
- AFE 217 Plant Science
- AFE 311 Practicum I*
- AFE 340 Environmental Science and Agroecology
- AFE 401 AFE Seminar
- AFE 411 Practicum II*
- AFE 450 Human Health & Environment

* Intensive experience involving practical on-site "hands-on" participation working in the area of agriculture (University, state, or private) such as a laboratory, farm, or business.

The Option in Agricultural Systems requires four Core courses in:

- AEC 305-Food and Ag Marketing Principles
- AFE 318-Environmental Entomology
- AFE 334-Soil Science
- AFE 445-Agriculture and Energy

Additionally, the Option requires three option electives. Acceptable **Option in Agricultural Systems Elective** courses include:

- AFE 425-Organic Agriculture
- AFE 435-Urban Agriculture
- AFE 440-Ornamental & Landscape Plants
- AQU 480-Introduction to Geographic Information Systems

As well as other AFE or advanced Aquaculture courses.

Program Admission Requirements:

Please see visit KSU's Prospective Students section for details.

Bachelor of Science in Agriculture, Food & Environment

Kentucky State University
400 East Main Street, Frankfort, KY 40601
(502) 597-6000

Eight-Semester Plan

Aquaculture Courses from Fall 2011- Spring 2015

Course #	Aquaculture Course Titles	Hours	Fall 2011	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014	Spring 2015
AQU 407	Fish Genetics	3	YES		YES	YES	YES		YES	YES
AQU 409	Biostatistics	3				YES				YES
AQU 410	Fish Diseases Lab	1			YES				YES	
AQU 411	Fish Diseases	4		YES	YES	YES		YES	YES	YES
AQU 412	Fish Morphology & Physiology	4	YES				YES			
AQU 413	Aquatic Ecology	4	YES				YES			
AQU 416	Computer Applications in Statistics	3				YES				YES
AQU 421	Fish Nutrition	3		YES				YES		
AQU 422	Principles of Aquaculture	3	YES	YES	YES	YES	YES	YES	YES	YES
AQU 425	Aquaculture Economics & Marketing	4		YES				YES		
AQU 427	Fish Repro & Spawning Techniques	4	YES	YES	YES		YES	YES	YES	
AQU 428	Fish Reproduction Lab	1		YES				YES		
AQU 451	Survey of Production Methods	3			YES				YES	
AQU 460	Water Quality Management	3	YES	YES		YES	YES	YES		YES
AQU 461	Water Quality Management Lab	1	YES				YES		YES	
AQU 480	Intro to Geographic Inform Systems	3	YES	YES	YES	YES	YES	YES	YES	YES
AQU 507	Fish Genetics	3	YES		YES	YES	YES		YES	YES
AQU 509	Biostatistics	3				YES				YES
AQU 510	Fish Diseases Lab	1			YES				YES	
AQU 511	Fish Diseases	4		YES	YES	YES		YES	YES	YES
AQU 512	Fish Morphology & Physiology	4	YES				YES			
AQU 513	Aquatic Ecology	4	YES				YES			
AQU 516	Computer Applications in Statistics	3				YES				YES
AQU 521	Fish Nutrition	3		YES				YES		
AQU 522	Principles of Aquaculture	3	YES	YES	YES	YES	YES	YES	YES	YES
AQU 525	Aquaculture Economics & Marketing	4		YES				YES		
AQU 527	Fish Repro & Spawning Techniques	4	YES	YES	YES		YES	YES	YES	
AQU 528	Fish Reproduction Lab	1		YES				YES		
AQU 551	Survey of Production Methods	3			YES				YES	
AQU 560	Water Quality Management	3	YES	YES		YES	YES	YES		YES
AQU 561	Water Quality Management Lab	1	YES				YES			
AQU 580	Geographic Information Systems	3	YES	YES	YES	YES	YES	YES	YES	YES

HOME

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Division of Environmental Studies & Sustainable Systems: Academic Programs

Degrees Offered:

Bachelor of Agriculture, Food & Environment

Required Classes:

- AFE 116 Intro Agriculture, Food, and Environment
- AFE 117 Global Perspectives in Agriculture, Food, and Environment
- AFE 211 Intro Animal Science
- AFE 217 Plant Science
- AFE 311 Practicum I*
- AFE 334 Soil Science
- AFE 340 Environmental Science and Agroecology
- AFE 401 AFE Seminar
- AFE 411 Practicum II*
- AFE 450 Human Health & Environment

*Intensive experience involving practical on-site "hands-on" participation working in the area of agriculture (University, state, or private) such as a laboratory, farm, or business.

Electives Classes:

- Environmental Hydrology
- Introduction to GIS / Remote Sensing
- Quantitative Analysis in Agriculture
- Climate Change Studies
- Agriculture and Environmental Policy & Regulations
- Natural Resources management
- Agriculture Economics

Master of Science in Environmental Studies

Required Classes:

- ENV 501 Introduction to Environmental Studies (3 cr. hr.)
- ENV 502 Population and Community Ecology (3 cr. hr.)
- ENV 503 MES Student Team Project (3 cr. hr.)

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- ENV 509 Biostatistics (3 cr. hr.)
- ENV 511 Energy and the Environment (3 cr. hr.)
- ENV 699 MES Capstone Research Project (6 cr. hr.)

Elective Classes:

- ENV 508 Introduction to Geographic Information Systems
- ENV 513 Aquatic Ecology
- ENV 515 Environmental Ethics
- ENV 517 Environmental and Resource Economics
- ENV 595 Environmental Science & Bioremediation
- ENV 545 Molecular Techniques for Environmental and Aquatic Studies
- ENV 519 Sustainable Agriculture Systems

Division Admission Requirements:

- GPA of 2.0 or higher – ACT Score of 15 or higher for Undergraduate
- GPA of 2.5 or higher – GRE Score for graduate

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Kentucky State University
400 East Main Street, Frankfort, KY 40601
(502) 597-6000

Division of Food & Animal Science: Academic Programs

The **Option in Agricultural Systems (including Animal Sciences)** emphasizes sustainable, integrated and small-scale livestock production systems, and yet is applicable to all production systems and scales of production. It has a focus on food safety and local food systems. Students will learn modern livestock production skills through classroom and hands-on training.

The **Option for Food Systems** emphasizes human nutrition, health, dietary needs, metabolism, chronic disease prevention, and food safety, with an emphasis on minority and limited-resource individuals and communities. Students will learn practical and highly-technical skills in classroom and hands-on laboratories. Enroll in one of our undergraduate programs and you will embark on a course of study that will challenge, excite and change the way you think about the world of food, health and nutrition. When you graduate, you'll have the tools, knowledge and opportunity to shape the future of animal production, wellness, the nutrition education, and the changing food environment.

Undergraduate research assistant positions, work-study opportunities and stipends are available in division units during the school year and the summer for interested students.

Degrees Offered:

Beginning in the fall Semester of 2012, the **College of Agriculture, Food Science, and Sustainable Systems** will offer a baccalaureate degree program in **Agriculture, Food, and Environment (AFE)** with an **Option in Food Systems** and an **Option in Agricultural Systems (Animal Science)**. Using an interdisciplinary approach, students will develop a broad understanding of animal production, food safety, and nutrition and graduates will be trained for jobs and graduate school opportunities in these growth areas in the U.S. economy.

The **AFE Degree Option in Food Systems and the AFE Option in Animal Sciences** requires a general core of university required classes. Additional AFE general required courses include:

- AFE 116 Introduction Agriculture, Food, and Environment
- AFE 117 Global Perspectives in Agriculture, Food, and Environment
- AFE 211 Introduction to Animal Science
- AFE 217 Plant Science
- AFE 311 Practicum I*
- AFE 340 Environmental Science and Agroecology

- AFE 401 AFE Seminar
- AFE 411 Practicum II*
- AFE 450 Human Health & the Environment

  * Intensive experience involving practical on-site "hands-on" participation working in the area of agriculture (University, state, or private) such as a laboratory, farm, or business.

The Option in Food Systems requires four Core courses in:

- FNU 104 Basic Nutrition
- AFE 455 Food Microbiology and Safety
- AFE 465 Food Systems
- BIO 302 General Microbiology

Acceptable option electives include:

- BIO 303 Human Physiology
- AFE 435 Urban Agriculture
- AFE 445 Agriculture and Energy
- NUR 412 Vulnerable Populations
- BIO 408 Cell Biology

The Option in Agricultural Systems (including Animal Science) requires four Core courses in:

- AEC 305 Food and Agricultural Marketing Principles (University of Kentucky, on-line)
- AFE 318 Environmental Entomology
- AFE 334 Soil Science
- AFE 445 Agriculture and Energy

Acceptable option electives include:

- AFE 425 Organic Agriculture
- AFE 455 Food Microbiology and Safety
- AFE 465 Food Systems
- BIO 302 General Microbiology
- BIO 408 Cell Biology
- AFE 318 Environmental Entomology
- BIO 417 Ecological Field Methods
- BIO 316 Ecology
- AQU 460 Water Quality Management
- ACC 201 Principles of Accounting
- MGT 301 Principles of Management
- MKT 301 Principles of Marketing
- COM 215 Mass Communication and Society

Additional coursework in animal husbandry and food science will be available in the future.

Kentucky State University
400 East Main Street, Frankfort, KY 40601
(502) 597-6000

Agriculture, Food, and Environment (AFE) Degree Program

AFE Curriculum Ladder with General Core Requirements

(120 credits, **boldface** denotes new course)

Fall Freshman Year

AFE	**116**	**Introduction to Ag, Food, and Environment**	**(2)**
BIO	111	Prin of Biol	(4)
ENG	101	Eng Comp I	(3)
MAT	115	College Algebra	(3)
CHE	101	Gen Chem I	(3)
CHE	110	Gen Chem I Lab	(1)
			16

Spring Freshman Year

AFE	**117**	**Global Perspectives on AFE**	**(3)**
ENG	102	Eng Comp II	(3)
ART	130	Intro Art **OR**	
MUS	130	Intro Music	(3)
HIS	103	Western Civ	(3)
CHE	102	Gen Chem II	(3)
CHE	120	Gen Chem II Lab	(1)
			16

Fall Sophomore Year

AFE	**217**	**Plant Science**	**(3)**
	101	Foreign Language I	(3)
ECO	200	Economics	(3)
ENG	211	Intro to Lit	(3)
IGS	200	Found Cultures	(3)
			15

Spring Sophomore Year

AFE	**211**	**Animal Science**	**(3)**
	102	Foreign Language II	(3)
IGS	201	Converg Cultures	(3)
PHY	130	Physics & Society	(3)
SPE	103	Inter Comm	(3)
			15

Fall Junior Year

AFE	**450**	**Human Health & Env**	**(3)**
	xxx	**Option Requirement**	**(3)**
AFE	**4xx**	**Option Elective**	**(3)**
SOC	203	Intro Sociology	(3)
	xxx	General Elective	(3)
			15

Spring Junior Year

AFE	**311**	**Practicum I**	**(2)**
AFE	**340**	**Env Sci & Agroecology**	**(3)**
AFE	**3/4xx**	**Option Requirement**	**(3)**
AFE	**4xx**	**Option Elective**	**(3)**
	xxx	General Elective	(3)
			14

Fall Senior Year

AFE	**411**	**Practicum II**	**(2)**
AFE	**3/4xx**	**Option Requirement**	**(3)**
IGS	300	New Cultures	(3)
	3/4xx	Lib Studies Elective	(3)
	3/4xx	General Elective	(3)
			14

Spring Senior Year

AFE	**401**	**AFE Seminar**	**(1)**
AFE	**4xx**	**Option Requirement**	**(3)**
AFE	**4xx**	**Option Elective**	**(3)**
IGS	3xx	Cultures Elective	(3)
HED	221	Pers Health **OR**	
PHE	1/2xx	(two activity courses)	(2)
	3/4xx	General Elective	(3)
			15

Plan of Studies for North Carolina A&T State University

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY
SCHOOL OF AGRICULTURE AND ENVIRONMENTAL SCIENCES
DEPARTMENT OF ANIMAL SCIENCES
B.S. ANIMAL SCIENCE DEGREE

CURRICULUM GUIDE FOR ANIMAL SCIENCE MAJOR

Fall Semester – Year 1		Spring Semester – Year 1	
Engl 100-Ideas and their Expression I	3	Engl 101-Ideas and their Expression II	3
Phil 268[3]-Introduction to Ethics	3	MATH 112-Calculus for Non-Math Majors	4
LASC 161-Orientation	1	ANSC 211-Animal & Lab Animal Science	3
FRST 100-University Survival	1	BIOL 100 or 101-Biological Sci or Concepts in Bio	4
LASC 162-Into to Animal and Laboratory Ani Sci	3	HIST 201[2]-African American History to 1877	3
MATH 111-College Algebra & Trigonometry*	4	FRST 101-College Success	1
HPED 200-Personal Health	2		
Total Credit Hours:	**17**	**Total Credit Hours:**	**18**

Fall Semester – Year 2		Spring Semester – Year 2	
CHEM 106-General Chemistry VI	3	CHEM 107-General Chemistry VII	3
CHEM 116-General Chemistry Lab	1	CHEM 117-General Chemistry VII Lab	1
HIST 130[4]- The World Since 1945	3	ENGL 200-Survey of Humanities I	3
ANSC 214-Agricultural Genetics	3	MATH 224-Intro Probability & Statistics	3
LASC 261-Medical Terminology	3	ANSC 212-Feeds and Feeding	3
PSYC 320-General Psychology	3	SOCI 100[2]-Principles of Sociology	3
Total Credit Hours:	**16**	**Total Credit Hours:**	**16**

Fall Semester – Year 3		Spring Semester – Year 3	
CHEM 221-Organic Chemistry I	3	CHEM 222-Organic Chemistry II	3
CHEM 223-Organic Chemistry I Lab	2	CHEM 224-Organic Chemistry II Lab	2
ANSC 411-Livestock Production	3	BIOL 220- Microbiology or BIOL 221 Gen. Microbiology	4
ANSC 411-Livestock Production Lab	0	ANSC 451-Poultry Production	3
LASC 459-Integrated Anatomy	4	ANSC 451-Poultry Production Lab	0
PHYS 225-College Physics	3	SPCH 250-Speech Communication	3
PHYS 235-College Physics Lab	1		
Total Credit Hours:	**16**	**Total Credit Hours:**	**15**

Fall Semester – Year 4		Spring Semester – Year 4	
CHEM 251-Elementary Biochemistry	2	LASC 461-Physiology of Domestic Animals	3
CHEM 252-Elementary Biochemistry Lab	1	Major Elective [1]	3
PHYS 226-College Physics I	3	ANSC 665-Biotechnology	3
PHYS 236-College Physics I Lab	1	ANSC 665-Biotechnology Lab	0
LASC 460-Microscopic Anatomy	3	ANSC 619 (Capstone)	3
LASC 460-Microscopic Anatomy Lab	0	ANSC 416-Swine Production	3
ANSC 413-Sanitation & Diseases of Farm Animals	2	ANSC 416-Swine Production Lab	0
Total Credit Hours:	**12**	**Total Credit Hours:**	**15**

- *The student in consultation with advisor should choose major and other electives*
- *Special consideration to changes in the curriculum will be considered based upon Students career goals*

[1]*Major electives include (ANSC 217, 312, 415, 421, 555, 614, 624; LASC 363, 463, 569)*
[2] *The following courses can be used for a social/behavioral science: SOCI 200; African American: HIST 202,203*
[3]*The following courses can be used for humanities/fine arts: ENGL 201, 206; SPAN 101, 102; MUSI 216; PHIL 260 266, 267; African American: ENGL 209;LIBS 202, 223, 241; MUSI 220*
[4]*Social and Behavioral Science Global Awareness Studies: HIST 231or Humanities and Fine Arts Global Awareness*

North Carolina Agricultural and Technical State University
School of Agriculture and Environmental Sciences
Department of Animal Sciences

B.S. Animal Science, Concentration in Animal Industry

CURRICULUM

Fall Semester – Year 1		Spring Semester – Year 1	
Engl 100-Ideas and their Expressions I	3	Engl 101-Ideas and their Expression II	3
PHIL 268[3]-Introduction to Ethics	3	MATH 102-Fundamental Algebra & Trig II	3
LASC 161- Orientation	1	HIST 130[4]-The World Since 1945	3
FRST 100 University Survival	1	ANSC 211-Animal & Lab Animal Science	3
LASC 162-Into to Animal and Laboratory AnSc	3	HIST 201[2]-African American History to 1877	3
BIOL 100 or 101-Biological Sci. or Concepts in Bio.	4	FRST 101- College Success	1
MATH 101- Fund Algebra & Trig I	3		
Total Credit Hours:	**18**	**Total Credit Hours:**	**16**

Fall Semester – Year 2		Spring Semester – Year 2	
CHEM 100-Physcial Science	3	CHEM 104-General Chemistry IV	3
CHEM 110-Physical Science Lab	1	CHEM 114-General Chemistry IV Lab	1
SOCI 100[2]–Principles of Sociology	3	PSYC 320-General Psychology	3
ACCT 203-Fund Acct Decision Making	3	ANSC 212-Feeds and Feeding	3
ANSC 214-Agricultural Genetics	3	ANSC 217-Anatomy & Physiology of Farm Animals	3
ABM 240-Into to Computers in Agribusiness	3	BIOL 220 or 221-Basic Micro, Gen Micro	4
Total Credit Hours:	**16**	**Total Credit Hours:**	**17**

Fall Semester – Year 3		Spring Semester – Year 3	
ECON 201-Prin of Economics-Macro	3	ABM 434-Marketing Ag Products	3
ENGL 200- Survey of Humanities I	3	ANSC 416-Swine Production	3
ANSC 413-Sanitation and Disease	2	ANSC 416-Swine Production Lab	0
ABM 330-Intro Agri Economics	3	ANSC 451-Poultry Production	3
ANSC 411-Livestock Production	3	ANSC 451-Poultry Production Lab	0
ANSC 411-Livestock Production Lab	0	MGMT 422-Management Concepts	3
LASC 365-Biology, Diseases & Care LASC	4	LASC 363 or 463-Internship I or Internship II	3
LASC 365-Biology,Diseases & Care LASC Lab	0		
Total Credit Hours:	**18**	**Total Credit Hours:**	**15**

Fall Semester – Year 4		Spring Semester – Year 4	
ABM 446-Fin. Mgmt. Agri Farm	3	ABM 436-Agricultural Prices	3
SPCH 250 Speech Communication	3	ABM 438-Resource and Environ. Econ. And Pol.	3
Major Elective[1]	3	Major Elective [1]	3
LASC 569-Seminar in Animal Science	1	ANSC 619-Special Problems in Ani Sci (Capstone)	3
ANSC 555-Advanced Com. Poultry Management	4		
Total Credit Hours:	**14**	**Total Credit Hours:**	**12**

- *The student in consultation with advisor should choose major and other electives*
- *Special consideration to changes in the curriculum will be considered based upon Students career goals*
- *Management courses may range from MGMT 220 and/or 422*
- *Courses needed for a Certificate in Equine Management: ANSC 218, 219, 220, 313, 314, and LASC 363.*

[1]Major electives include (ANSC 312,415,421, 555; LASC 261)
[2] The following courses can be used for a social/behavioral science: SOCI 200; Africam American: HIST 202,203
[3]The following courses can be used for humanities/fine arts: ENGL 201, 206; SPAN 101, 102; MUSI 216; PHIL 260 266, 267;Africam American: ENGL 209;LIBS 202, 223, 241; MUSI 220
[4]Social and Behavioral Science Global Awareness Studies: HIST 231or Humanities and Fine Arts Global Awareness Studies: PHIL 265; ENGL 230, 231

Total Credit Hours for Degree Program= 126 hours

North Carolina Agricultural and Technical State University
School of Agriculture and Environmental Sciences
Department of Animal Sciences
B.S. Laboratory Animal Science Degree

CURRICULUM GUIDE FOR LABORATORY ANIMAL SCIENCE MAJOR

Fall Semester – Year 1		Spring Semester – Year 1	
ENGL 100-Ideas and their Expression I	3	ENGL 101-Ideas and their Expression II	3
PHIL 268[2]-Introduction to Ethics	3	MATH 112-Calculus for Non-Math Majors	4
HPED 200[1]-Personal Health	2	BIOL 100 or 101-Biological Sci, Concepts of Biology	4
LASC 161-Orientation	1	ANSC 211-Animal & Lab Animal Science	3
FRST 100- University Survival	1	HIST 201[2]-African American History to 1877	3
LASC 162-Into to Animal and Laboratory Ani Sci	3	FRST 101-College Success	1
MATH 111*-College Algebra & Trigonometry	4		
Total Credit Hours:	**17**	**Total Credit Hours:**	**18**

Fall Semester – Year 2		Spring Semester – Year 2	
CHEM 106-General Chemistry VI	3	CHEM 107-General Chemistry VII	3
CHEM 116-General Chemistry Lab	1	CHEM 117-General Chemistry VII Lab	1
HIST 130[4]-The World Since 1945	3	PSYC 320-General Psychology	3
ENGL 200-Survey of Humanities I	3	ANSC 212-Feeds and Feeding	3
LASC 261-Medical Terminology	3	MATH 224-Intr. Probability & Statistics	3
ANSC 214-Agricultural Genetics	3	SPCH 250- Speech communications	3
Total Credit Hours:	**16**	**Total Credit Hours:**	**16**

Fall Semester – Year 3		Spring Semester – Year 3	
CHEM 221-Organic Chemistry I	3	CHEM 222-Organic Chemistry II	3
CHEM 223-Organic Chemistry I Lab	2	CHEM 224-Organic Chemistry II Lab	2
LASC 459-Integrated Anatomy	4	LASC 460-Microscopic Anatomy	3
LASC 459-Integrated Anatomy Lab	0	LASC 460-Microscopic Anatomy Lab	0
LASC 365-Biology, Diseases & Care of Lab Animal	4	SOCI 100[2]-Principles of Sociology	3
PHYS 225-College Physics	3	PHYS 226-College Physics I	3
PHYS 235-College Physics Lab	1	PHYS 236-College Physics I Lab	1
Total Credit Hours:	**17**	**Total Credit Hours:**	**15**

Fall Semester – Year 4		Spring Semester – Year 4	
CHEM 251-Elementary Biochemistry	2	BIOL 221-General Microbiology	4
CHEM 252-Elementary Biochemistry Lab	1	LASC 636 or ANSC 665, 611	3
MGMT 220-Business Environment	3	LASC 461 or ANSC 451	3
LASC 462-Principles of Medical Sciences	3	LASC 653-Lab Animal Mgmt & Clinical Tech	4
LASC 569-Seminar in Laboratory Ani Sci	1		
LASC 363 or 463 (Capstone)	3		
Total Credit Hours:	**13**	**Total Credit Hours:**	**14**

Notes:

- *The student in consultation with advisor should choose major and other electives*
- *Special consideration to changes in the curriculum will be considered based upon Students career goals*
- *Management courses may range from MGMT 220 and/or 422*

[1] *Any (2) 1 credit hour HPED courses may be selected*

[2] *The following courses can be used for a social/behavioral science: SOCI 200; African American: HIST 202,203*

[3]The following courses can be used for humanities/fine arts: ENGL 201, 206; SPAN 101, 102; MUSI 216; PHIL 260, 266, 267;African American: ENGL 209;LIBS 202, 223, 241; MUSI 220
[4]Social and Behavioral Science Global Awareness Studies: HIST 231or Humanities and Fine Arts Global Awareness Studies: PHIL 265; ENGL 230, 231
**Math 111 (Sat qualification is 490-550)-Otherwise students of 440-480 will take Math 103 and 104 And then proceed to Math 112.*

Total Credit Hours for Degree Program: 126

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY
SCHOOL OF AGRICULTURE AND ENVIRONMENTAL SCIENCES
DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL DESIGN
CURRICULUM
B.S. BIOLOGICAL ENGINEERING

Natural Resources Engineering Track

FALL		SPRING	
FIRST YEAR			
GEEN 111 College of Eng. Colloquium I	1	GEEN 121 College of Eng. Colloquium II	1
ENGL 100 Written Communication I	3	ENGL 101 Written Communication II	3
CHEM 106 – Gen Chem I**	3	MATH 132 – Calculus II**	4
CHEM 116 - Gen Chem I Lab	1	PHYS 241 – Gen Phys I**	3
MATH 131 – Calculus I**	4	PHYS 251 – Gen Phys I Lab	1
GEEN 100 – Engr Design and Ethics	2	CHEM 107 – General Chemistry VII**	3
		CHEM 117 - Gen Chem II Lab	1
Total	14	Total	16
SECOND YEAR			
CAEE 331 Mechanics I- Statics	3	CAEE 232 Engineering Solid Mechanics I**	3
MATH 231 Calculus III	4	CAEE 334 Engineering Mechanics II**	3
PHYS 242 General Physics II	3	BIOE 216 Geographic Information System	3
PHYS 252 General Physics II Lab	1	BIOL 221 General Microbiology	4
BIOL 101 Concepts of Biology	4	GEEN 161 Computer Programming in MatLab	2
African/American Studies, Elective	3	CAEE 101 – Graphics in Engineering	2
Total	18	Total	17
THIRD YEAR			
CAEE 204 Fundamentals of Surveying	3	BIOE 360/CAEE 364 Engineering Hydrology	3
CAEE 362/MEEN 416 Engineering Fluid Mechanics & Hydraulics	3	BIOE 432/SLSC 632 Physical and Eng Properties of Soil	3
MEEN 441 Fundamentals of Thermodynamics	3	BIOE 330 Engineering Systems Analysis & Design	4
Global Studies, Elective	3	ECEN 340 Electrical Circuits and Systems**	3
BIOE 440 Engineering Properties of Biological Materials	3	MATH 431 Introduction to Differential Equations**	3
Total	15	Total	16
FOURTH YEAR			
Statistics Elective	3	BIOE 424 Water Resources Engineering	3
BIOE 400 Soil and Water Engineering 1	3	BIOE 423 Fundamentals of Renewable Energy Systems	3
INEN 360 Engineering Economy	2	BIOE 502 Engineering Design II (capstone)	2
EASC 622 Environmental Sanitation and Waste Management	3	BIOE Elective	3
Humanities, Elective	3	Social Behavioral Science, Elective	3
BIOE 501 Engineering Design I (Capstone)	1		
CAEE 400 General Engineering Topics Review	1		
Total	16	Total	14
		Grand Total	126

**A grade of "C" is required.

BIOE Electives:

BIOE 404, BIOE 415, BIOE 425, BIOE 426, BIOE 505, BIOE 510, CHEN 422, BIOE 364, CIEN 310, CIEN 668 or other senior level courses approved by the faculty advisors

Statistics Electives:

MATH 224, ECON 305, INEN 370, and CAEE 304

North Carolina Agricultural and Technical State University
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B.S. BIOLOGICAL ENGINEERING

Bioprocess Engineering Track

FALL		SPRING	
FIRST YEAR			
GEEN 111 College of Eng. Colloquium I	1	GEEN 121 College of Eng. Colloquium II	1
ENGL 100 Written Communication I	3	ENGL 101 Written Communication II	3
CHEM 106 – General Chem I**	3	CHEM 107 General Chemistry VII**	3
CHEM 116 - Gen Chem I Lab	1	MATH 132 – Calculus II**	4
MATH 131 – Calculus I**	4	PHYS 241 – General Phys I**	3
GEEN 100 – Engr Design and Ethics	2	PHYS 251 – Gen Phys I Lab	1
		CHEM 117 - Gen Chem II Lab	1
Total	14	Total	16
SECOND YEAR			
CAEE 231 Mechanics I- Statics**	3	CAEE 232 Engineering Solid Mechanics I**	3
MATH 231 Calculus III**	4	CAEE 334 Engineering Mechanics II**	3
PHYS 242 General Physics II**	3	MATH 431 Introduction to Differential Equations**	3
PHYS 252 General Physics II Lab	1	BIOL 221 General Microbiology	4
BIOL 101 Concepts of Biology	4	GEEN 161 Computer Programming in MatLab	2
African/American Studies, Elective	3	*MEEN 260 Materials Science*	2
Total	18	Total	17
THIRD YEAR			
CHEN 200 Chemical Process Principles	4	Global Studies, Elective	3
CAEE 362/MEEN 416 Engineering Fluid Mechanics & Hydraulics**	3	ECEN 340 Electrical Circuits and Systems**	3
INEN 360 Engineering Economy	2	BIOE 330 Engineering Systems Analysis & Design	4
CHEN 312 Thermodynamics	4	CHEM 221 Organic Chemistry	3
BIOE 440 Engineering Properties of Biological Materials	3	CHEM 223 Organic Chem Lab	2
Total	16	Total	15
FOURTH YEAR			
Statistics Elective	3	BIOE 425 Bio-instrumentation	3
BIOE 422 Bioprocess Engineering	3	BIOE 423 Fundamentals of Renewable Energy Systems	3
BMEN 411 Transport Phenomena	4	BIOE 502 Engineering Design II (capstone)	2
Humanities, Elective	3	BIOE Electives	3
BIOE 501 Engineering Design I (Capstone)	1	Social Behavioral Science, Elective	3
CAEE 400 General Engineering Topics Review	1		
Total	15	Total	14
		Grand Total	126

**A grade of "C" is required.

BIOE Electives:

BIOE 404, *BIOE 432*, BIOE 426, BIOE 505, BIOE 510 CHEN 422, CIEN 310 or other senior level courses approved by the faculty advisors

Statistics Electives:

MATH 224, ECON 305, INEN 370, and CAEE 304

NORTH CAROLINA AGRICULTURAL AND TECHNICAL STATE UNIVERSITY
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CURRICULUM
B.S. AGRICULTURE AND ENVIRONMENTAL SYSTEMS
CONCENTRATION IN ENVIRONMENTAL STUDIES

REQUIRED MAJOR COURSES

AGED 607	BIOL 410	ENVS 610	NARS 599	WMI 333
ASME 275	ENVS 201	NARS 520	POLI 415	WMI 617
				WMI 629

A minimum grade of "C" must be earned in the above requirements

FRESHMAN YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
FRST 100 University experience I	1	FRST 101 University experience II	1
ENGL 100 Ideas and their expression I	3	ENGL 101 Ideas and their expression II	3
NARS 110 Intro to Urban and Comm Horticulture	3	BIOL 101 Concepts in Biology	4
MATH101/Fund of Algebra & Trig	4	CHEM 104 General Chemistry IV	3
CHEM 100 Physical Science	3	CHEM 114 General Chemistry IV Lab	1
NARS 100 Orientation	1	MATH 102 Fund of Algebra & Trig	4
	15		16

SOPHOMORE YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
HPED 200 Personal Health	2	HIST 202 African American Hist since 1877	3
ENVS 201 The Earth's Environment[1]	1	PHYS 101 Intro to Astronomy	3
HIST 201 African American History to 1877	3	ASME 275 Weather Systems [3]	3
HIST 220 History of Science & Tech[4]	3	MATH 224 Intro to Probability and statistics	3
SPCH 250 Speech Fundamentals[5]	3	GEOG 200 Principles of Geography[4]	3
	14		

JUNIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
WMI 333 Waste Mgmt Capstone Seminar[2]	1	ENVS 209 Physical Geology[1]	3
BIOL 410 Ecology[2]	4	NARS 520 Seminar[2]	1
PHYS 110 Survey of Physics	3	POLI 415 Environmental Policy[2]	3
PHYS 110 Survey of Physics Lab	1	BIOE 216 Geog Info Systems[1]	3
PSYC 320 General Psychology[4]	3	Major Electives[1]	6
Major Electives[1]	4		16
	16		

SENIOR YEAR

First Semester	*Credit*	*Second Semester*	*Cred*
ENVS 610 Sustainable Earth[3]	3	AGED 607 Environmental Education[2]	3
NARS 599 Internship Capstone[2]	3	WMI 617 Environ Ethics and Phil[2]	2
WMI 629 Hazmat Training[2]	3	Major Electives[1]	6
Major Electives[1]	6	Electives (Non Major)	6
	15		17

MATH 111/112; CHEM 106/116; CHEM 107/117 - Recommended for students who may wish to pursue graduate work

Total Credit Hours: 124

The environmental studies concentration is a combination of interdisciplinary courses in which students develop their creativity, analytical skills and imagination by discovering alternative ways of applying basic concepts of science, coupled with their liberal education to environmental problem solving and sustainability issues. The concentration incorporates breadth and depth in interdisciplinary courses in which students learn to integrate analytical perspectives in a focus area of student's interest.

Core Courses ENVS 201-Earth's Environment, ASME 275- Weather System, WMI 333-Waste Management Capstone Seminar, BIOL 410-Ecology, POLI 415-Environmental Policy, AGED 607-Environmental Education, ENVS 610-Sustainable Earth, WMI 617-Environmental Ethics & Philosophy, WMI 629-Hazmat Training, NARS 520-Seminar, NARS 599-Internship Capstone; **Major Elective Courses**[1] , **Agricultural Science Courses** (Interdisciplinary Courses Focused on the Environment)
AGEC 440-Resource Economics, BIOE 216-Geographic Information Systems, BIOE 323-Fundamentals of Renewable Energy Systems, ANSC 413-Sanitation & Disease of Farm Animal, ANSC 637-Environmental Toxicology, ANSC 641-Disease Management Livestock, ANSC 665-Techniques in Biotechnology, LASC 261-Medical Terminology, LASC 365-Biology Diseases & Care, LASC 462-Principles of Medical Science, LASC 636-Principles of Toxicology, SLSC 338-Fundamentals of Soil Science, SLSC 517-Soil Fertility, SLSC 632-Soil Physics, SLSC 633-Soil Genesis & Land Use, SLSC 634-Soil Environmental Chemistry, SLSC 640-Wetland Management, NARS 608-Special Problems in Natural Resources, HORT 612-Integrated Pest Management, HORT 613-Principles of Entomology, LDAR 230-Environmental Ecology, FCS 644-Food Microbiology and Biotechnology, FCS 600-Quality Foods, FCS 631-Food Chemistry, FCS 651-Food Safety and Sanitation;
Environmental Science Courses[2] (Interdisciplinary Courses Providing Breath of Environmental Perspectives) Case Studies in Environmental Issues, Contemporary Issues in Energy Uses and Sources: ENVS 209-Elements of Physical Geology, ENVS 230-Elements of Weather and Climate, ENVS 344-Environmental Issues, ENVS 622-Env Plan/Waste Mgt., ENVS 444-Problem Solving in Earth Science, ENVS 466-Earth System Science, ENVS 699-Environmental Problems, HORT 608-Environmental Horticulture Epidemiology, BIOL 220-Basic Microbiology, ASME 440-Atmospheric Chemistry; Environmental Related Courses3 (Interdisciplinary Courses Focused on Safety): OSH 201-Introduction to Occupational Safety and Health, OSH 210-Industrial Accident Prevention, OSH 230-Trans Hazardous Material, OSH 312-ACC Prev Analy & Record, OSH 393-Safety Management, OSH 394-Environmental Health & Safety, OSH 411-Hazard Materials for the Safety Professional, OSH 413-Industrial Hygiene I, OSH 415-Standards and Regulations in Occupational Safety and Health, OSH 416-Industrial Hygiene II, OSH 516-OSH Management, OSH 517-Mat. Handling for the Safety Professional, OSH 600-Occupational Toxicology

North Carolina Agricultural and Technical State University
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Curriculum
B.S. Agriculture and Environmental Systems
Concentration in Urban and Community Horticulture

REQUIRED MAJOR COURSES

ABM 330	HORT 301	HORT 350	MGMT 425
AGRI 400	HORT 610	HORT 351	NARS 110
BIOL 240	HORT 611	HORT 620	NARS 520
ENVS 210	HORT 330	HORT 612	NARS 599
FCS 357	HORT 334	LDAR 103	SLMG 200

A minimum grade of C must be obtained in all above requirements.

Freshman year

First semester		*Credit*	*Second semester*		*Credit*
ENGL100	Ideas and their Expression	3	ENGL 101	Ideas and their Expression	3
MATH101	Fundamentals of Algebra and Trigo	3	MATH 102	Fundamentals of Algebra and Trigo	3
FRST 100	University experience 1	1	FRST 101	University experience 2	1
HIST 130 or HIST 207	The world since 1945 Or Modern World History	3	CHEM 106	General Chemistry	3
SPCH 102	Lang Skills Comm professionals	3	CHEM 116	Lab chemistry	1
NARS 100	Orientation	1	BIOL 101	Concepts in Biology I	4
NARS 110	Intro to Urb. Comm. Horticulture	3			
		17			15

Sophomore year

First semester		*Credit*	*Second semester*		*Credit*
HFA Elective	Chose from General Education Req. in Humanities / Fine Arts	3	HFA Elective	Chose from General Education Req. in Humanities / Fine Arts	3
HIST 201, 202 or 203	Chose from General Education Req. in SBS – AA	3	MATH 224	Intro Probability and Statistics	3
CHEM 107	General Chemistry	3	PHYS 110	Survey of Physics	2
CHEM 117	Lab chemistry	1	PHYS 111	Survey of Physics Lab	1
ENVS 210	Intro to Environmental science	3	BIOL 240	General Botany	4
SLMG 200	Fund in Soil Science	4	LDAR 103	Environmental Design Ethics	2
		17			15

Junior year

First semester		*Credit*	*Second semester*		*Credit*
ENGL331	Writing Science and Technology	3	ABM 330	Intro to Agricultural economics	3
HORT 610	Season Extension in Sustainable Prod.	2	FCS 357	Introduction to Human Nutrition	3
HORT 611	Practice in Season Ext. in Sustainable Prod.	1	HORT 301	Disease Management Strategies in Urban & Community Hort.	3
HORT 334	Plant Propagation	3	HORT 330	Plant Nutrition	2
HORT 350	Factors affecting Urb. Comm. Hort.	3	HORT 351	Practice in Sustainable Horticulture	2
NARS 520	Undergraduate Seminar	1	HORT 620	Vegetables for Small Scale Prod.	3
	(Major) Elective	3			
		16			16

Senior year

First semester		*Credit*	*Second semester*		*Credit*
NARS 599	Internship (Capstone)	3	MGMT 425	Entrepreneurship	3
HORT 612	Integrated Pest Mngmt Systems	3		Major Elective	3
AGRI 400	Sustain Agri Food Nu Com Hu Fu	3		Major Elective	3
	Major Elective	3		Elective	3
	(Major) Elective	3		(General, Major) Elective	3
		15			15

Total Credit Hours = 126

Major Electives: BIOE 415, HORT 600, HORT 602, HORT 603, HORT 527, HORT 412, HORT 302 (LDAR202), HORT 303 (LDAR203), NARS 400, NARS 601, NARS 603, NARS 608, NARS 618, SLMG 300

Electives: AET 225, ABM 434, BIOE 114, BIOE 216, BIOE 522, BIOL 410, BIOL 432, ENVS 622, FCS 245, FCS 398, FCS 423, FCS 455, NARS 250, SLMG 350, SLMG 450

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B.S. AGRICULTURE AND ENVIRONMENTAL SYSTEMS
CONCENTRATION IN SUSTAINABLE LAND MANAGEMENT

REQUIRED MAJOR COURSES

SLMG200	SLMG300	SLMG301	SLMG350	SLMG400
NARS618	HORT612	NARS599	NARS608	BIOE216

Students majoring in SLM must pass the above courses with a minimum grade of "C".

Bold letters indicate courses needed to meet the University 33-credit hour General Education requirement.

Freshman Year

First Semester	Credit	Second Semester	Credit
ENGL 100 (WC)[1] Ideas & their Expr I	3	ENGL 101 (WC)[1] Ideas & their Expr II	3
CHEM 106 (SR)[2] General Chemistry VI	3	CHEM 107 General Chemistry VII	3
CHEM 116 (SR)[2] General Chem VI Lab	1	CHEM 117 General Chem VII Lab	1
MATH 111 (MLAR)[3] College Alg & Trig	4	MATH 110 (MLAR)[3] Pre-Calculus	4
African American Studies Elective[4]	3	Global Awareness Elective[6]	3
FRST 100 (SS)[5]	1	FRST 101 (SS)[5]	1
NARS 100	1	Semester Total	15
Semester Total	16		

Sophomore Year

First Semester	Credit	Second Semester	Credit
CHEM 221 Organic Chemistry	3	BIOL 101 General Biology	4
CHEM 223 Organic Chemistry Lab.	1	MATH 224 Probability & Statistics	3
SPCH 250 Fund Speech Com (HFA)[7]	3	PHYS 110 (SR)[2] Survey of Physics	2
SLMG 200 Soil Science	*4*	PHYS 111 (SR)[2] Survey of Phys Lab	1
SBS/HFA Elective[8]	3	GEOG 200 Principles of Geography	3
AGED 101 Intro to Agriscience Ed	1	BIOE 216 Geographic Info Syst (GIS)	3
Semester Total	15	Semester Total	16

Junior Year

First Semester	Credit	Second Semester	Credit
SLMG 300 Soils & Soil Management	**3**	**SLMG 350 Land & Water Cons Mgmt**	**3**
SLMG 301 Soils & Soils Mgmt. Lab.	**2**	HORT 612 Int. Pest Mgmt Systems	3
NARS 618 Principles of Agroforestry	3	NARS 520 Seminar	1
BIOL 240 General Botany	4	Major Area Elective[9]	3
Major Area Elective[9]	3	Major Area Elective[9]	3
Semester Total	15	General Elective	3
		Semester Total	16

Senior Year

First Semester	Credit	Second Semester	Credit
SLMG 400 Environ Quality Assess	**4**	NARS 608 Special Problems	3
NARS 599 Internship	3	**SLMG 450 Sust Land Mgmt Systems**	**3**
Major Area Elective[9]	3	Major Area Elective[9]	3
Major Area Elective[9]	3	Major Area Elective[9]	3
General Elective	3	General Elective	3
Semester Total	16	Semester Total	15

Total Credit Hours: 124

[1]These courses meet the General Education / Written Communication (WC) requirement of 6 credit-hours.
[2]Courses used to meet the General Education / Scientific Reasoning (SR) requirement of 7 credit-hours.
[3]Courses used meet the General Education/Mathematical, Logical, and Analytical Reasoning requirement of 6 credit-hours.
[4]Select a 3 credit-hour course from the university approved list General Education / African American Culture and History.
[5]Courses used meet the General Education/Student Success (SS) requirement of 2 credit-hours.
[6]Select a 3 credit-hour course from the university approved list General Education / Global Awareness.
[7]Courses used to meet the General Education/Humanities and Fine Arts (HFA) requirement of 6 credit-hours.
[8]Select a 3 credit-hour course from the university approved lists General Education / Social Behavioral Sciences (SBS) or Humanities and Fine Arts (HFA).

North Carolina Agricultural and Technical State University
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Curriculum
B.S. Food and Nutritional Sciences
Concentration in Food Science

FRESHMAN YEAR

Fall Semester	Credit	Spring Semester	Credit
ENGL 100 Ideas and their Expression I[1]	3	*ENGL 101 Ideas & Their Expression II*[1]	3
BIOL 100 Biological Sciences	4	*FCS 150 Food Prep/Meal Management*	*2*
FCS 160 Introduction to FCS[6]	2	**FCS 151 Food Prep/Meal Management Lab**	*1*
MATH 111 College Alg & Trig I[2]	4	CHEM 107 General Chemistry VII[3]	3
CHEM 106 General Chemistry VI[3]	3	CHEM 117 General Chemistry Lab	1
CHEM 116 General Chemistry Lab[3]	1	Elective	2
Total Hrs	17	MATH 112 Calculus for Non-Math Majors[2]	4
		Total Hrs	**16**

SOPHOMORE YEAR

Fall Semester	Credit	Spring Semester	Credit
SPCH 250 Speech Fundamentals[5]	3	*ENGL 230 World Literature*[5]	3
FCS 245 Introduction to Food Science	3	PHYS 110 Survey of Physics I	2
OSH 201 Occupational Safety and Health	3	PHYS 111 Survey of Physics Lab	1
BIOL 220 Basic Microbiology	4	CHEM 221 Organic Chemistry I	3
HIST 201 African American History[4]	3	CHEM 223 Organic Chemistry Lab	2
Total Hrs	**16**	FCS 260 Introduction to Human Development	3
		MATH 224 Intr. Probability and Statistics	3
		Total Hrs	**17**

JUNIOR YEAR

Fall Semester	Credit	Spring Semester	Credit
CHEM 251 Biochemistry	2	FCS 346 Food Safety and Sanitation	3
CHEM 252 Biochemistry Lab	1	FCS 347 Food Engineering	3
FCS 345 Food Chemistry	3	FCS 455 Cultural Aspects of Food	3
SOC 100 Principles of Sociology[4]	3	FCS 357 Introduction Human Nutrition	3
FCS 445 Food Preservation	3	ANSC 312 Meat and Meat Products	3
AGEC 434 Marketing Agricultural Products	3	Elective	2
Total Hrs	**15**	**Total Hrs**	**17**

SENIOR YEAR

Fall Semester	Credit	Spring Semester	Credit
WMI 333 Waste Management Seminar	1	FCS 442 Food Analysis	*3*
FCS 440 Food Microbiology & Biotechnology	3	FCS 560 Integrative Approach to FCS[7]	3
FCS 441 Food Product Development	4	FCS 443 Sensory Evaluation of Foods	3
FCS 460 Applied Research in FCS	3	FCS 444 Food Laws & Regulations	3
Elective	3	**Total Hrs**	**12**
Total Hrs	**14**	**TOTAL HOURS**	**124**

[1]WRITTEN COMMUNICATION – 6 HOURS [2]MATHEMATICAL, LOGICAL, ANALYTICAL REASONING– 6 HOURS
[3]SCIENTIFIC REASONING - 7 HOURS [5]HUMANITIES/FINE ARTS – 6 HOURS (3 GLOBAL OR AFR-AM STUDIES)
[4]SOCIAL/BEHAVIORAL SCIENCES (3 GLOBAL OR AFRICAN AMERICAN STUDIES) – 6 HOURS
[6]STUDENT SUCCESS – 2 HOURS
[7] Capstone Course (FCS 461): Each student is required to take a senior level course focused on interdisciplinary perspectives. This course requires 30 volunteer hours

Faculty Senate Approval: November 2012

North Carolina Agricultural and Technical State University
School of Agriculture and Environmental Sciences
Department of Family and Consumer Sciences
Curriculum
B.S. Food and Nutritional Sciences
Concentration in Pre-Medicine Nutrition

FRESHMAN YEAR

Fall Semester	Credit	Spring Semester	Credit
FCS 160 Introduction to FCS [6]	2	*HIST 201 African American History* [4]	3
ENG 100 Ideas and their Expression [1]	3	*ENG 101 Ideas & their Expression II* [1]	3
BIOL 100 Biological Science	4	MATH 112 Calculus for Non-Math Majors[2]	4
HPED 200 Personal Health	2	Pre-Med Option[8]	3
MATH 111 College Alg. And Trig. I[2]	4	CHEM 106 General Chemistry VI[3]	3
Total Hrs	**15**	CHEM 116 General Chemistry VI Lab[3]	1
		Total Hrs	**17**

SOPHOMORE YEAR

Fall Semester	Credit	Spring Semester	Credit
CHEM 107 General Chemistry VII[3]	3	CHEM 221 Organic Chemistry I	3
CHEM 117 General Chemistry VII Lab	1	CHEM 223 Organic Chemistry I Lab	2
ENG 201 Survey of Humanities II [5]	3	FCS 357 Introduction to Human Nutrition	3
ENG 230 World Literature I [5]	3	FCS 260 Introduction to Human Development	3
FCS 245 Introduction to Food Science	3	ENGL 331 Writing for Science or Technology **OR** BUED 360 Business Communications	3
MATH 224 Introduction to Probability and Statistics **OR** SOCI 203 Social Statistics I	3		
Total Hrs	**16**	**Total Hrs**	**14**

JUNIOR YEAR

Fall Semester	Credit	Spring Semester	Credit
Pre-Med Option[8]	3	*SOC 100 Principles of Sociology* [4]	3
Pre-Med Option[8]	2	Pre-Med Elective[9]	3
Pre-Med Option[8]	3	FCS 403 Family Finance	3
Pre-Med Option[8]	1	Pre-Med Option[8]	3
BIOL 361 Human Anatomy and Physiology	4	Pre-Med Option[8]	3
FCS 457 Advanced Nutrition	3	Pre-Med Option[8]	3
Total Hrs	16	**Total Hrs**	**18**

SENIOR YEAR

Fall Semester	Credit	Spring Semester	Credit
FCS 452 Medical Nutritional Therapy I	4	FCS 453 Medical Nutritional Therapy II	4
FCS 359 Maternal & Lifespan Nutrition	3	FCS 458 Community Nutrition	3
CHEM 251 Elementary Biochemistry	2	Pre-Med Elective[9]	3
CHEM 252 Elementary Biochem Lab	1	FCS 560 An Integrated App. to FCS[7]	3
FCS 460 App. Research in FCS	3	Pre-Med Elective[9]	3
Total Hrs	**13**	**Total Hrs**	**16**
		TOTAL HOURS	**125**

[1]WRITTEN COMMUNICATION – 6 HOURS [2]MATHEMATICAL, LOGICAL, ANALYTICAL REASONING– 6 HOURS
[3]SCIENTIFIC REASONING - 7 HOURS [5]HUMANITIES/FINE ARTS – 6 HOURS (3 GLOBAL OR AFR-AM STUDIES)
[4]SOCIAL/BEHAVIORAL SCIENCES (3 GLOBAL OR AFRICAN AMERICAN STUDIES) – 9 HOURS
[6]STUDENT SUCCESS – 2 HOURS
[7] Capstone Course (FCS 560): Each student is required to take a senior level course focused on interdisciplinary perspectives. 50 volunteer hours required.
[8]Pre-Med Option: each student is required to select courses from the Pre-Med Option area
[9]Pre-Med Electives: each student is required to select courses (9 credits) from the Pre-Med Electives area

Faculty Senate Approval: November 2012

Food and Nutritional Sciences

PRE-MEDICINE NUTRITION CONCENTRATION

The Dietetics Pre-Medicine concentration is designed to provide academic preparation for students who plan to attend medical school after graduation. Students should consult an advisor in the FNS Dietetics area to plan the appropriate sequence of courses from the options below.

I. Pre-medicine Option Required Courses

		Credits	
FCS 135	Food and Man's Survival	(3)	
CHEM 222	Organic Chemistry II		(3)
CHEM 224	Organic Chemistry II Lab	(2)	
PHY 241	General Physics	(3)	
PHY 251	General Physics Lab		(1)
PHY 242	General Physics	(3)	
PHY 252	General Physics Lab		(1)
FCS 640	Geriatric Nutrition		(3)
Total			19 Hours

II. Pre-Medicine Electives (Choose 9 credit hours)

BIOL 220	Basic Microbiology
BIOL 401	Molecular Biology
BIOL 462	Intro Cell Physiology
BIOL 466	Principles of Genetics
BIOL 690	Intro to Epidemiology
BIOL 671	Principles and Practice of Immunology
BIOL 465	Histology
LASC 261	Medical Terminology
FOLA 104	Elementary Spanish I
FOLA 105	Elementary Spanish II
CHEM 451	Biotechniques in Biochemistry
FCS 456	*Nutrition Education*
FCS 455	*Cultural Aspects of Food*

Plan of Studies for University of Arkansas-Pine Bluff

CURRICULUM FOR BACHELOR OF SCIENCE IN AGRICULTURE SCIENCES (PLANT AND SOIL SCIENCE OPTION)

FALL SEMESTER				SPRING SEMESTER			
				FRESHMAN YEAR			
English Composition I	ENGL	1311	3	English Composition II	ENGL	1321	3
Biological Science	BIOL	1450	4	Plant Science	AGRI	1421	4
Science of Animals	AGRI	1321	3	Intro. to Soc. Science	SOCI	1320	3
Humanities	HUMN	2301	3	Career & Life Planning	BAS	1120	1
Personal & Soc. Dev.	BAS	1210	2	College Algebra	MATH	1330	3
Physical Education	HLPE	1110	1	Personal Health/Safety	HLPE	1310	3
			16				17
				SOPHOMORE YEAR			
American Government	PSCI	2312	3	U. S. History	HIST	2315	3
Intro. to Ag. Eng. Tech	AGRI	2311	3	Elective	MATH		3
Oral Communication	SPCH	2390	3	Physical Science	CHEM	1411	4
Prin. Agri. Economics	AGRI	2312	3	Intro. to Literature	ENGL	2300	3
Physical Education	HLPE	1111	1	Music History App. Or	MUSI	2330	
General Psychology	PSCY	2300	3	Art History App.	ART	2340	3
			16				16
				JUNIOR YEAR			
Intro. to Soil	AGRI	2331	4	General Chemistry II	CHEM	1440	4
General Chemistry I	CHEM	1430	3	Elective (Plant Science)	AGRI	1421	4
Soil & Water Mgmt	AGRI	3324	3	Intro. Entomology	AGRI	3327	3
Weed Science	AGRI	3306	3	Soil Fertility	AGRI	3301	3
Plant Pathology	AGRI	2310	3	Soil or Plant Elective	AGRI		3-4
			16				17-18
				SENIOR YEAR			
Elective	BIOL/CHEM		4	Electives	BIO/CHEM		4
Soil Elective*	AGRI		3-4	Senior Seminar	AGRI	4201	2
Plant Physiology	AGRI	4304	3	Man, Env & Pollution	AGRI	3399	3
Plant Science Elective	AGRI		3	Soil & Plant Analysis *	AGRI	4301	3
				Agriculture Elective	AGRI		3
			13-14				15

* Students with horticulture interest may choose horticulture elective with consent of the advisor

CURRICULUM FOR BACHELOR OF SCIENCE IN AGRICULTURE SCIENCES
(ANIMAL SCIENCE OPTION)

FALL SEMESTER				SPRING SEMESTER			
FRESHMAN YEAR							
English Composition I	ENGL	1311	3	English Composition II	ENGL	1321	3
Biological Science	BIOL	1450	4	Plant Science	AGRI	1421	4
Science of Animals	AGRI	1321	3	Intro. to Soc. Science	SOCI	1320	3
Humanities	HUMN	2301	3	Career & Life Planning	BAS	1120	1
Personal & Soc. Dev.	BAS	1210	2	College Algebra	MATH	1330	3
Physical Education	HLPE	1110	1	Personal Health/Safety	HLPE	1310	3
			16				17
SOPHOMORE YEAR							
American Government	PSCI	2312	3	U. S. History	HIST	2315	3
Intro. To Ag. Eng. Tech	AGRI	2311	3	Elective	MATH		3
Oral Communication	SPCH	2390	3	Physical Science	CHEM	1411	4
Prin. Agri. Economics	AGRI	2312	3	Intro. to Literature	ENGL	2300	3
Physical Education	HLPE	1111	1	Music History App. Or	MUSI	2330	OR
General Psychology	PSCY	2300	3	Art History App.	ART	2340	3
			16				16
JUNIOR YEAR							
Introduction to Soils	AGRI	2331	3	Poultry Production	AGRI	1322	3
General Chemistry I	CHEM	1430	4	General Chemistry II	CHEM	1440	4
College Grammar	ENGL	3301	3	Intro. to Entomology	AGRI	3327	3
Elective (AGRI, SCI, MATH)			3	Man, Env. & Pollution	AGRI	3399	3
Elective (Computer Sci.)			3	Physiology of Reproduction	AGRI	4353	3
			16				16
SENIOR YEAR							
Organic Chemistry	CHEM	3410	4	Genetics	AGRI	3440	4
Farm Management	AGRI	4411	4	Vertebrate Physiology	AGRI	4450	4
Qual/Assur/ Meat/Grain	AGRI	4321	3	Special Problems	AGRI	4V00	3
Animal Nutrition	AGRI	3310	3	Livestock Production	AGRI	3341	3
Elective	AGRI		3	Senior Seminar	AGRI	4202	2
			17				16

*Recommended Elective

NOTE: For students interested in pre-veterinary medicine, one year of Physics, Organic Chemistry II, (CHEM 3420) and/ or two higher level courses in mathematics are required.

CURRICULUM FOR BACHELOR OF SCIENCE IN AGRICULTURE SCIENCES (REGULATORY SCIENCE-AGRICULTURAL SCIENCE OPTION)

FALL SEMESTER				SPRING SEMESTER			
FRESHMAN YEAR							
English Composition I	ENGL	1311	3	English Composition II	ENGL	1321	3
Principles of Biology	BIOL	1455	4	General Zoology	BIOL	1460	4
College Algebra	MATH	1330	3	Plant Science	AGRI	1421	4
Physical Education	HLPE	1110	1	Personal and Social Dev.	BAS	1210	2
Science of Animals	AGRI	1321	3	Physical Education	HLPE	1111	1
Reg. Science Seminar	AGRI	1101	1	Intro. to Social Sci.	SOCI	1320	OR
Career & Life Planning	BAS	1210	2	Intro to Sociology	SOCI	2310	3
			17				17
SOPHOMORE YEAR							
General Chemistry I	CHEM	1430	4	General Chemistry II	CHEM	1440	4
Music App. & History Or	MUSI	2330	Or	Humanities	HUMN	2340	3
Art App. & History	ART	2340	3	American Government	PSCI	2312	3
Personal Health & Safety	HLPE	1310	3	Oral Communication	SPCH	2390	3
U.S. History to 1865 Or	HIST	2315	OR				
U.S. History Since 1865	HIST	2318	3				
Intro to Literature	ENGL	3350	3				
			16				13

NOTE: The student must have a 2.80 G.P.A to obtain assistance with placement in the following Summer program.

SUMMER: Regulatory Internship I AGRI 3100 1

NOTE: The above Regulatory Internship is a prerequisite for the remaining courses.

JUNIOR YEAR							
Physics	PHSY	2410	4	Man, Env, & Pollution	AGRI	3399	3
Principles of Ag. Econ	AGRI	2312	3	Intro. to Epidemiology	AGRI	3352	3
Agriculture Elective	AGRI		6-7	Biostatistics	AGRI	3351	3
Admin. Law & Gov. Proc.	AGRI	3312	3	Agricultural Curr.	AGRI		3
				Agriculture Elective	AGRI		3
			16-17				15

NOTE: The student must have a 2.80 G.P.A. to obtain assistance with placement following the program.

SUMMER: Regulatory Internship II AGRE 4100 1

SENIOR YEAR							
Risk Comm. & Ass	AGRI	4331	3	Introductory to Entom.	BIOL	3327	3
Qual/Assur/Meat/Grain	AGRI	4321	3	Invest. Pro. & Tech	AGRI	4372	3
Agriculture Elective	AGRI		3	Agriculture Electives	AGRI		6
Indust. Agri. Munc. Poll	AGRI	4385	3	Senior Seminar	AGRI	4202	2
Codes Spec. & Law	TECH	2318	3	Interper. Skills*	AGRI	4361	3
			15	*Spring, Odd Years			17

CURRICULUM FOR BACHELOR OF SCIENCE IN AGRICULTURE SCIENCES (REGULATORY SCIENCE-ENVIRONMENTAL BIOLOGY OPTION)

FALL SEMESTER				SPRING SEMESTER			
			FRESHMAN YEAR				
English Composition I	ENGL	1311	3	English Composition II	ENGL	1321	3
Principles of Biology	BIOL	1455	4	General Zoology	BIOL	1460	4
College Algebra	MATH	1330	3	General Botany	BIOL	1470	4
Physical Education	HLPE	1110	1	Trigonometry	MATH	1340	3
Intro. to Soc. Sci or Soc.	SOCI		3	Personal Health and Safety	HLPE	1310	3
Reg. Science Seminar	AGRI	1101	1	Career and Life Planning	BAS	1120	1
Personal and Social Dev.	BAS	1210	2				
			17				18
			SOPHOMORE YEAR				
General Chemistry I	CHEM	1430	4	General Chemistry II	CHEM	1440	4
Humanities	HUMN	2340	3	Art App. & History	ART	2340	Or
Fisheries Technique	AQFI	2347	3	Music App. & History Or	MUSI	2330	3
U.S. History to 1865 Or	HIST	2315	OR	Oral Communication	SPCH	2390	3
U.S. History Since 1865	HIST	2318	3	American Government	PSCI	2312	3
Lit 2300,2360,2361	ENGL		3				
			16				13

NOTE: The student must have a 2.80 G.P.A to obtain assistance with placement in the following Summer program:
SUMMER: Regulatory Internship I AGRI 3100 1
NOTE: The above Regulatory Internship is a prerequisite for the remaining courses.

JUNIOR YEAR

General Physics I	PHSY	2410	4	Intro Epidemiology	AGRI	3352	3
Organic Chemistry	CHEM	3410	4	General Physics II	PHYS	2420	4
Ichthyology	AQFI	2462	4	General Microbiology	BIOL	3470	4
Admin. Law & Gov. Proc.	AGRI	3312	3	Regulatory Internship I	AGRI	3100	1
			15				12

NOTE: The student must have a 2.80 G.P.A. to obtain assistance with placement following the program:
SUMMER: Regulatory Internship II AGRE 4100 1

SENIOR YEAR

Risk Comm. & Assess	AGRI	4331	3	Introductory to Entom.	AGRI	3327	3
Invertebrate Zoology	BIOL	3450	OR	Invest. Pro. & Tech	AGRI	4372	3
Biology Elective	BIOL		3-4	Ecology	BIOL	2360	3
Indust. Agri. Mun. Poll	AGRI	4385	3	Plant Taxonomy	AGRI	4350	3
Parasitology	BIOL	3360	3	Interper. Skills*	AGRI	4361	3
Regulatory Internship II	AGRI	4100	1	Senior Seminar	AGRI	4202	2
			16-17				17

*Spring Odd Years

CURRICULUM FOR BACHELOR OF SCIENCE IN AGRICULTURE SCIENCES (REGULATORY SCIENCE-INDUSTRIAL HEALTH AND SAFETY OPTION)

FALL SEMESTER				SPRING SEMESTER			
FRESHMAN YEAR							
English Composition I	ENGL	1311	3	English Composition II	ENGL	1321	3
Principles of Biology	BIOL	1455	4	General Chemistry I	CHEM	1430	4
College Algebra	MATH	1330	3	Trigonometry	MATH	1340	3
Physical Education	HLPE	1110	1	Career and Life Planning	BAS	1120	1
Ind. Safety Mgmt.	TECH	2318	3	General Psychology	PSYC	2300	3
Reg. Science Seminar	AGRI	1101	1	Intro. to Manufacturing	TECH	1360	3
Personal and Social Dev.	BAS	1210	2				
			17				17
SOPHOMORE YEAR							
General Chemistry I	CHEM	1430	4	U.S. History to 1865	HIST	2315	OR
Humanities	HUMN	2340	3	U.S. History Since 1865	HIST	2318	3
General Physics I	PHYS	2410	3	Art App. & History	ART	2340	Or
Lit. 2300, 2360, 2361	ENGL		3	Music App. & History Or	MUSI	2330	3
				Oral Communication	SPCH	2390	3
				American Government	PSCI	2312	3
				Personal & Soc. Dev	BAS	1210	2
			13				14

NOTE: The student must have a 2.80 G.P.A to obtain assistance with placement in the following Summer program:
SUMMER: Regulatory Internship I AGRI 3100 1
NOTE: The above Regulatory Internship is a prerequisite for the remaining courses.

JUNIOR YEAR							
Human Res. Mgmt.	MGMT	3318	3	Instrumentation	TECH	4376	3
Fundamentals Elec.	TECH	1332	3	Epidemiology	AGRI	3352	3
Quality Control	TECH	4307	3	General Physics II	PHYS	2420	4
Admin. Law & Gov. Proc.	AGRI	3312	3	Health & Safety Elect.	HLPE		3
Codes Spec. & Law	TECH	2318	3	Prin. of Management	MGMT	3300	3
			15				16

NOTE: The student must have a 2.80 G.P.A. to obtain assistance with placement in the following program:
SUMMER: Regulatory Internship II AGRE 4100 1

SENIOR YEAR							
Risk Comm. & Assess.	AGRI	4331	3	Occ. & Env. Health	TECH	3370	3
Organic Chemistry I	BIOL	3410	4	Invest. Proc. & Tech	AGRI	4372	3
Health & Safety Elec.	HLPE		3	Organic Chemistry II	CHEM	3420	3
Indust. Ag. Mun. Poll.	AGRI	4385	3	Man, Env. & Poll	AGRI	3399	3
Principles of Ergonomics	BIOL	3310	3	Interper. Skills*	AGRI	4361	3
				Senior Seminar	AGRI	4202	2
			16				17

* Spring Odd Years

Curriculum for Bachelor of Science Degree
in Fisheries Biology (120 hours)

FALL SEMESTER				SPRING SEMESTER			
FRESHMAN YEAR							
English Composition	ENGL	1311	3	English Composition II	ENGL	1321	3
Principles of Biology	BIOL	1455	4	General Botany	BIOL	1470	4
College Algebra	MATH	1330	3	College Trigonometry	MAT	1340	3
Personal & Social	BAS	1210	2	Career & Life Planning	BAS	1120	1
Topics in Aqua. &	AQFI	1102	1	Personal Health &	HLPE	1310	3
Intro. to Social	SOCI	1320	3	Nutrition and Wellness	HUM	1311	3
Swimming	HLPE	1112	1				
			17				14
SOPHOMORE YEAR							
Oral Communication	MCO	2390	3	Aquaculture	AQFI	2329	3
Music Appreciation	MUS	2330	or	Aquaculture Lab	AQFI	2129	1
Art Appreciation	ART	2340	3	Intro to Literature	ENGL	2300	3
Biology of Fishes	AQFI	2253	2	Intro to Humanities	HUM	2301	3
Biology of Fishes	AQFI	2153	1	General Chemistry II	CHE	1440	4
General Chemistry I	CHEM	1430	4	US History	HIST	2315/	or
General Zoology	BIOL	1460	4	American Government	PSCI	2312	3
			17				17
JUNIOR YEAR							
Limnology	AQFI	3329	3	Fisheries Management	AQFI	3371	3
Social Science			3	Technical Writing	JOUR	3350	3
Aquatic Animal Nutr	AQFI	4336	3	Ichthyology	AQFI	2462	4
Fisheries	AQFI	2247	2	Ecology	BIOL	2360	3
Fish. Techniques	AQFI	2147	1	Free Electives**			3
Free Electives**			3				
			15				16
SENIOR YEAR							
Econ of Aqua & Nat	AQFI	4321	or	Organic Chemistry	CHE	2411	4
Mkt. & Pub. Rel. in	AQFI	4322	3	Senior Seminar	AQFI	4201	2
Physics I	PHYS	2410	4	Hatchery Management	AQFI	3360	or
				Fish Genetics	AQFI	4350	3
Free electives **			5	Free electives**			3
			12				12

Aquaculture and Fisheries Internships: AQFI 2601, 2602, 2603—6 credits each*** Special Problems: AQFI 4V00 1-3 credits***

**Students take electives with advisor's consent. ***Only one 6-credit course can count towards general elective requirement.

***Variable credit course taken with consent of Instructor and Chair.

Plan of Studies for University of Maryland-Eastern Shore

CURRICULUM GUIDE FOR GENERAL AGRICULTURE
AGRICULTURE EDUCATION (Grades 7-12)[1 & 2]

FRESHMAN YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ANPT 114	4	Elective Agricultural course[3]	3
ENGL 101	3	AGME 283	3
MATH 109	3	GEN ED CURR AREA I	3
BIOL 111	3	ECON 202/H	3
BIOL 113	1	ENGL 102	3
AGNR 111	1	ENGL 001	0
	15		15

SOPHOMORE YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
PSYC 200	3	GEN ED CURR AREA I	3
ENGL 203	3	ENGL 305 or ENGL 310	3
CHEM 111	3	PSYC 303	3
CHEM 113	1	PSYC 307	3
EDCI 200	3	Elective Agricultural Course[3]	3
EDCI 201[4]	1		15
AGEC 213	3		
	17		

JUNIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
BUED 212	3	EDCI 406	3
PLSC 184	3	EDCI 409	3
PLSC 185	1	AGRI 301	1
AGED 313	3	Elective Agricultural course[3]	3
Elective Agricultural course[3]	3	Elective Agricultural course[3]	3
Elective Agricultural course[3]	3		13
	16		

SENIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
EDCI 311	3	EDCI 400	3
EDCI 427	3	EDCI 480	6
EDCI 410	3	EDCI 490	6
EDSP 428	3		15
Elective Agricultural course[3]	3		
	15		

Total Credit Hours: 120

[1]A minimum grade of "C" or better must be earned in each of these courses.
[2]A grade of "C" or better will be required in the courses taken to satisfy the Agriculture Education Concentration requirement.
[3]200-300 level agricultural courses.
[4]Does not count toward graduation.

GENERAL AGRICULTURE
AGRICULTURAL STUDIES

All General Agriculture[1] majors in the Department of Agriculture, Food and Resource Sciences with concentrations in Agricultural Studies must complete a total of 15 semester hours of Departmental Core Courses which include: AGEC 213, AGME 283, AGRI 301, ANPT 114, PLSC 184, and PLSC 185.

REQUIRED MAJOR COURSES[1]

Students must select a minimum of 27 credit hours of which one three credit-hour course must be selected from at least three current Department Programs.

CURRICULUM GUIDE FOR GENERAL AGRICULTURE
AGRICULTURAL STUDIES

FRESHMAN YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ANPT 114	4	GEN ED CURR AREA VI[1]	3
ENGL 101/H	3	ENGL 102/H	3
MATH 109	3	ENGL 001	0
PLSC 184	3	GEN ED CURR AREA VI[1]	3
PLSC 185	1	GEN ED CURR AREA III[2]	3
AGNR 111	1	GEN ED CURR AREA III[2]	1
	15	ECON 202/H	3
			16

SOPHOMORE YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
AGME 283	3	GEN ED CURR AREA II[3]	3
ENGL 203	3	Agricultural Studies Core Course[4]	3
AGEC 213	3	Agricultural Studies Core Course[4]	3
Agricultural Studies Core[4]	3	GER REQ CURR AREA I[5]	3
GEN ED CURR. AREA III	3	200-400 Level Supportive Course[6]	3
	15		15

JUNIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ENGL 305 or 310	3	AGRI 301	1
Agricultural Studies Core Course[4]	3	Agricultural Studies Core Course[4]	6
Supportive Area Course	3	200-400 Level Supportive Course	3
Supportive Area Course	3	Supportive Course	2
200-400 Level Supportive Course[6]	2	GEN ED CURR. AREA I[5]	3
	14		15

[1]Student must select an **Elective** from GEN ED CURR AREA VI.
[2]Student must select a lecture and laboratory to satisfy the GEN ED CURR AREA III requirement.
[3]Student must select an **Elective** from GEN CURR AREA II: Behavior Science.
[4]Students must select 27 credit hours of which one 3credit hour course must be selected from at least three current Department Programs.
[5]Student must select an **Elective** from GEN CURR AREA I.
[6]A minimum of 20 credit hours must be selected from the 200-400 level.
Student must select 37 credit hours to enhance and strengthen the students' chosen Food & Agricultural Science interest area.

SENIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
Agricultural Studies Core Course[4]	3	Agricultural Studies Core Course[4]	3
200-400 Level Supportive Course[6]	3	Agricultural Studies Core Course[4]	3
200-400 Level Supportive Course[6]	3	Supportive Course	3
200-400 Level Supportive Course[6]	3	Supportive Course	3
Supportive Course	3	200-400 Level Supportive Course	3
	15		15

Total Credit Hours: 120

[1]Student must select an **Elective** from GEN ED CURR AREA VI.
[2]Student must select a lecture and laboratory to satisfy the GEN ED CURR AREA III requirement.
[3]Student must select an **Elective** from GEN CURR AREA II: Behavior Science.
[4]Students must select 27 credit hours of which one 3credit hour course must be selected from at least three current Department Programs.
[5]Student must select an **Elective** from GEN CURR AREA I.
[6]A minimum of 20 credit hours must be selected from the 200-400 level.
Student must select 37 credit hours to enhance and strengthen the students' chosen Food & Agricultural Science interest area.

GENERAL AGRICULTURE
ANIMAL AND POULTRY SCIENCE BUSINESS TECHNOLOGY OPTION[1]

All General Agriculture[1] majors in the Department of Agriculture, Food and Resource Sciences with concentrations in, Animal and Poultry Science Option I (Business/Technology), Animal and Poultry Science Option II must complete a total of 15 semester hours of Departmental Core Courses which include: AGEC 213, AGME 283, AGRI 301, ANPT 114, PLSC 184, and PLSC 185.

REQUIRED MAJOR COURSES

ANPT 214	ANPT 304	ANPT 223
	ANPT 304	ANPT 313
	ANPT 424	ANPT[2]

[1]A minimum grade of "C" is required for each course.
[2]Student must select three (3) 400 level ANPT production courses

GENERAL AGRICULTURE
ANIMAL AND POULTRY SCIENCE BUSINESS AND TECHNOLOGY OPTION I

FRESHMAN YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ANPT 114	4	GEN ED CURR AREA VI[2]	3
ENGL 101/H	3	ECON 202/H	3
BIOL 111	3	BUAD 132[3]	3
BIOL 113	1	MATH 110 or Higher	3
AGNR 111	1	ENGL 102	3
GEN ED CURR AREA I	3	ENGL 001	0
	15		15

SOPHOMORE YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ANPT 223	3	AGME 283	3
CHEM 111	3	CHEM 112	3
CHEM 113	1	CHEM 114	1
PLSC 184	3	BIOL 222[3]	3
PLSC 185	1	BIOL 223[3]	1
GEN ED CURR AREA I	3	ANPT 214	4
	14		15

JUNIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
AGEC 213	3	ACCT 202[3]	3
ACCT 201[3]	3	ANPT 304	4
CHEM 331 or		AGRI 301	1
CHEM 211 ***and*** CHEM 213	4	BIOL 301 ***and*** BIOL 303 or	
ANPT 313	3	AMIC 324[3]	4
ENGL 203	3	ANPT 400 Level Elective	3
	16		15

SENIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
BUED 212[3]	3	ENGL 305	3
ANPT 400 Level Elective	3	ANPT 424	4
GEN ED CURR. AREA II[4]	3	ANPT 400 Level Elective	3
Free Elective[5]	5	300-400 level course[6]	3
300-400 level course[6]	3		13
	17		

Total Credit Hours: 120

[1]A minimum grade of "C is required for Required Major courses.
[2]Student must select an **Elective** from GEN ED CURR AREA VI.
[3] Supportive Course Requirements: ACCT 201, ACCT 202, BIOL 222, BIOL 223, BIOL 301, BIOL 303, AMIC 324, BUAD 132, BUED 212, CHEM 211, and CHEM 213.
[4]Student must select from GEN ED CURR AREA II: Behavioral Science.
[5]Students may take courses offered at the University for which they meet the prerequisite.
[6]Select 300-400 level courses from BUAD, ACCT, ECON, AGBU, or AGEC.

GENERAL AGRICULTURE
ANIMAL AND POULTRY SCIENCE PRE-VETERINARY/PRE-PROFESSIONAL
OPTION II[1]

All General Agriculture[1] majors in the Department of Agriculture, Food and Resource Sciences with concentrations in Animal and Poultry Science Option I (Business/Technology), Animal and Poultry Science Option II (Pre-Veterinary/Pre-Professional), must complete a total of 15 semester hours of Departmental Core Courses which include: AGEC 213, AGME 283, AGRI 301, ANPT 114, PLSC 184, and PLSC 185.

REQUIRED MAJOR COURSES

ANPT 214	ANPT 304	ANPT 424
ANPT 223	ANPT 313	ANPT[2]

GENERAL AGRICULTURE
ANIMAL AND POULTRY SCIENCE PRE-VETERINARY/PRE-PROFESSIONAL
OPTION II[1]

FRESHMAN YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ANPT 114	4	GEN ED CURR AREA VI[2]	3
ENGL 101	3	ENGL 102/H	3
BIOL 111	3	ENGL 001	0
BIOL 113	1	MATH 110 or Higher	3
AGNR 111	1	CHEM 112	3
CHEM 111	3	CHEM 114	1
CHEM 113	1	ECON 202/H	3
	16		16

SOPHOMORE YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ENGL 203	3	ANPT 214	4
CHEM 211	3	CHEM 212	3
CHEM 213	1	CHEM 214	1
PLSC 184	3	BIOL 222[3]	3
PLSC 185	1	BIOL 223	1
AGEC 213	3	AGME 283	3
ANPT 223	3		15
	17		

JUNIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
PHYS 121	3	PHYS 122	3
PHYS 123	1	PHYS 124	1
ANPT 313	3	ANPT 304	4
GEN ED CURR. AREA I	3	AGRI 301	1
GEN ED CURR. AREA II[4]	3	BIOL 301and BIOL 303 or	
MATH 210, MATH 260 or		AMIC 324	4
AGNR Equivalent	3		13
	16		

SENIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ENGL 305 or		ANPT 424	4
ENGL 310	3	ANPT 400 Level Elective	3
CHEM 341	3	Free Elective[5]	3
CHEM 343	1	Supportive Course[6]	4
ANPT 400 Level Elective	3		14
GEN ED CURR AREA I	3		
	13		

Total Credit Hours: 120

[1]A minimum grade of "C" is required for all Required Major Courses.
[2]Student must select an **Elective** from GEN ED CURR AREA VI.
[3]Supportive course requirements: BIOL 222, BIOL 223, CHEM 211, CHEM 213, CHEM 212, CHEM 214, CHEM 341, CHEM 343, PHYS 121, PHYS 123, PHYS 122 or PHYS 124.
[4]Student must select GEN ED CURR AREA II: Behavioral Sciences
[5]Students may take any course offered at the University for which they meet the prerequisites
[6] Student must select **one** (1) course from the following: BIOL 311, BIOL 322, BIOL 326/327, BIOL 420/421, or BIOL 426M

GENERAL AGRICULTURE
PLANT AND SOIL SCIENCE[1]

All General Agriculture[1] majors in the Department of Agriculture, Food and Resource Sciences with concentrations in Plant and Soil Science must complete a total of 15 semester hours of Departmental Core Courses which include: AGEC 213, AGME 283, AGRI 301, ANPT 114, PLSC 184, and PLSC 185.

REQUIRED MAJOR COURSES[1]

AGRN 423	BIOL 112/H	CHEM 211/H	SOIL 203
AMIC 324	BIOL 114/H	CHEM 213/H	SOIL 204
HORT 203/H	BUED 212		

[1]A minimum grade of "C" is required for each course.

CURRICULUM GUIDE FOR GENERAL AGRICULTURE
PLANT AND SOIL SCIENCE [2]

FRESHMAN YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
AGNR 111	1	GEN ED CURR AREA VI[3]	3
ENGL 101/H	3	ECON 201/H	3
MATH 109 or Higher	3	BIOL 111/H	3
CHEM 111/H	3	BIOL 113/H	1
CHEM 113/H	1	CHEM 112	3
PLSC 184	3	CHEM 114	1
PLSC 185	1	ENGL 102/H	3
	15	ENGL 001	0
			17

SOPHOMORE YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ANPT 114/H	4	SOIL 203	3
AGEC 213/H	3	AGME 283	3
HORT 203	3	BIOL 112/H	3
ENGL 203	3	BIOL 114/H	1
CHEM 211/H	3	BUED 212	3
CHEM 213/H	1	GEN ED CURR AREA I	3
	17	SOIL 204	1
			17

JUNIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ENGL 305/Online	3	AMIC 324	4
GEN ED CURR AREA I	6	AGRI 301	1
Supportive Course	3	Supportive Course	3
Supportive Course	3	Supportive Course	3
	15	GEN ED CURR AREA II[4]	3
			14

SENIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
AGRN 423/H	3	Plant and Soil Science Electives	7
Supportive Course	3	Plant and Soil Science Electives	3
Supportive Course	7	Free Elective[5]	3
	13		13

Total Credit Hours: 120

[1]Student must select a minimum of 24 credit hours from AGRI 483, AGRI 499, AGRN 333, AGNR 353, AGNR 283, AGRN 413, AGRN 499, AGNR 483, AGRN 463, ENTO 313, FDST 493, HORT 313, HORT 333, HORT 353, HORT 383, HORT 423, HORT 463, NRES 404, PLSC 283, PLSC 321, PLSC 474, PLSC 440, PLSC 484, SOIL 443, PLSC 406, and AGME.
[2]Student must select a minimum of 11credit hours from BIOL 222, BIOL 223, BIOL 402, CHEM 212, CHEM 214, CHEM 311, CHEM 312, CHEM 341, CHEM 343 or BUAD, BUED, ENVS, HUEC, MATH, PHYS with advisor's approval.
[3]Student must select an Elective from GEN ED CURR AREA VI.
[4]Student must select from GEN ED CURR AREA II: Behavioral Science.
[5]Student may take any course offered at the university for which they meet the prerequisite.

URBAN FORESTRY

DEPARTMENTAL REQUIREMENTS

Students majoring in Urban Forestry must complete a total of 120 credit hours of University courses. This includes a minimum of 42 credit hours of General Education Requirements, 15 credit hours of Departmental Core courses, 47 credit hours of Major Core courses, and 16 credit hours of supportive courses.

COMMON REQUIRED COURSES

Urban Forestry majors in the Department of Agriculture, Food and Resource Sciences must complete a total of 15 semester hours of departmental core courses which include; AGEC 213, AGME 283, AGRI 301, ANPT 114, PLSC 184 and PLSC 185.

CAREER OPPORTUNITIES

A degree in Urban Forestry prepares students to teach, to conduct research, to pursue graduate and professional degrees, to work in government and business, and numerous other related careers or jobs such as: urban forest management, commercial tree care, nutrient management, food and fiber processing, natural resource sciences, and Extension education.

REQUIRED MAJOR COURSES[1]

AGNR 323	BIOL 111	ENTO 313	HORT 333
AGNR 423	BIOL 113		
NRES 151	PLSC 321	SOIL 203	
NRES 201	PLSC 333	SOIL 204	
NRES 333	PLSC 474		
NRES 433	PLSC 484		
NRES 474			
NRES 475			

[1]A minimum grade of "C" or better must be earned in each of these courses.

CURRICULUM GUIDE FOR URBAN FORESTRY PROGRAM

FRESHMAN YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ENGL 101/H	3	ENGL 102/H	3
MATH 110 or		NRES 151	3
MATH 111	3	BIOL 111	3
PLSC 184	3	BIOL 113	1
PLSC 185	1	CHEM 112	3
AGNR 111	1	CHEM 114	1
CHEM 111	3	GEN ED CURR AREA I	3
CHEM 113	1		17
	15		

SOPHOMORE YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ANPT 114	4	SOIL 203	3
ENGL 203	3	SOIL 204	1
PLSC 333	3	AGME 283	3
NRES 201	4	NRES 475	3
Support course	3	NRES 333	3
	17	ECON 201	3
			16

JUNIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ENGL 305 or		AMIC 324	4
ENGL 310	3	GEN ED CURR AREA II[1]	3
AGEC 213	3	HORT 333	3
AGRN 423	3	NRES 474	3
AGNR 323	3		13
GEN ED CUR AREA I	3		
	15		

SENIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
AGRI 301	1	PLSC 484	3
NRES 433	3	Support courses	10
ENTO 313/PLSC 321	3		13
PLSC 474	3		
Support courses	4		
	14		

Total Credit Hours: 120

CURRICULUM GUIDE FOR DIETETICS

FRESHMAN YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
ENGL 101	3	BIOL 111	3
MATH 109 or Higher	3	BIOL 113	1
CHEM 111	3	CHEM 112	3
CHEM 113	1	CHEM 114	1
SOCI 101	3	EXSC 111[1]	3
HUEC 100	1	ENGL 001	0
	14	ENGL 102	3
		NUDT 210	3
			17

SOPHOMORE YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
BIOL 231	3	BIOL 232	3
BIOL 233	1	BIOL 234	1
CHEM 211	3	CHEM 212	3
CHEM 213	1	CHEM 214	1
ENGL 203	3	PSYC 200	3
NUDT 211	3	NUDT 212	3
GEN ED CURR AREA I	3	NUDT 305	3
	17		17

JUNIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
CHEM 341	3	ENGL 305	3
CHEM 343	1	MATH 210	3
HUEC 370	2	NUDT 392	3
NUDT 300	1	NUDT 401	3
NUDT 310	3	GEN ED CURR AREA I	3
NUDT 391	3		15
	13		

SENIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
AMIC 324 or		HUEC 464	3
BIOL 301 and	3	HUEC 487	3
BIOL 303	1	NUDT 473	3
HUEC 474	2	NUDT 475[2, 3]	4
NUDT 402	3		13
NUDT 471[3]	3		
NUDT 472	2		
	14		

Total Credit Hours: 120

[1]EXSC 111 cannot be repeated for credit.
[2]Dietitics students may substitute NUDT 475 for four (4) credits.
[3]NUDT 471 and NUDT 475 meet the Out-of-Class Experience.

CURRICULUM GUIDE FOR NUTRITION

FRESHMAN YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
CHEM 111	3	BIOL 111	3
CHEM 113	1	BIOL 113	1
ENGL 101	3	CHEM 112	3
HUEC 100	1	CHEM 114	1
MATH 109	3	EXSC 111[1]	3
SOCI 101	3	ENGL 102	3
	14	ENGL 001	0
		GEN ED CURR AREA I	3
			17

SOPHOMORE YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
BIOL 231	3	BIOL 232	3
BIOL 233	1	BIOL 234	1
CHEM 211	3	CHEM 212	3
CHEM 213	1	CHEM 214	1
ENGL 203	3	NUDT 210	3
NUDT 211	3	NUDT 212	3
GEN ED CURR AREA I	3	NUDT 305	3
	17		17

JUNIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
CHEM 341	3	CHEM 342	3
CHEM 343	1	CHEM 344	1
HUEC 370	2	ENGL 305	3
NUDT 310	3	MATH 210	3
NUDT 391	3	NUDT 392	3
PSYC 200	3		13
	15		

SENIOR YEAR

First Semester	*Credit*	*Second Semester*	*Credit*
AMIC 324 **or**	4	NUDT 473	3
BIOL 301 **and**	3	NUDT 484[2, 3]	5
BIOL 303	1	Elective	3
Elective	4	HUEC 464	3
HUEC 474	2		14
NUDT Elective	3		
	13		

Total Credit Hours: 120

[1]EXSC 111 cannot be repeated for credit.
[2]Students may substitute NUDT 484 for HUEC 399, 400 & 409 for five (5) credits.
[3]NUDT 484 (5 credits) and NUDT 499 (1-3 credits) meet the Out-of-Class Experience. Students should consult their advisor to select appropriate courses to meet the 12 credit hour requirement.

Plan of Studies for Virginia State University

DEPARTMENT OF AGRICULTURE
AGRICULTURE MAJOR
Animal Science Concentration
Bachelor of Science Degree

		Semester Hours 1st Sem	2nd Sem	Total Hours
FRESHMAN YEAR				
ENGL 110, 111	Composition I and Composition II	3	3	6
MATH 120,121	College Algebra and Trigonometry	4	3	7
BIOL 120	Principles of Biology I and Lab	4	-	4
BIOL 121	Principles of Biology II and Lab	-	4	4
AGRI 140	Introduction to Agriculture	2	-	2
ANSC 140	Principles of Animal Science	-	3	3
HPER 170	Wellness/Health	-	2	2
GEPS 124	Introduction to Psychology	3	-	3
POLI 150	United States Government		3	3
	Totals	**16**	**18**	**34**
SOPHOMORE YEAR				
PLSC 140	Principles of Plant Science	3	-	3
AGEC 142	Principles of Agricultural Economics	3	-	3
CHEM 153	General Chemistry I and Lab	4	-	4
CHEM 152	General Chemistry II and Lab	-	4	4
SPEE 214	Introduction to Public Speaking	3	-	3
BIOL 241	Introduction to Microbiology and Lab	-	4	4
ANSC 242	Principles of Poultry Production	-	3	3
AGRI 295	Contemporary Global Studies	-	3	3
AGME 242	Introduction to Agri Engineering	3	-	3
AGRI 280	Geographic Information Systems	-	3	3
	Totals	**16**	**17**	**33**
JUNIOR YEAR				
PHYS 105	Introduction to Physics	4	-	4
SOSC 242	Soil Science	4	-	4
ENGL 323	Environmental Literature	-	3	3
CHEM 305, 307	Organic Chemistry I and Lab	4	-	4
ANSC 344	Beef Cattle Production	-	3	3
ANSC 346	Physiology of Reproduction	-	3	3
ANSC 349	Veterinary Hygiene	3	-	3
__________	ANSC Elective	3	-	3
__________	ANSC Elective	-	3	3
	Totals	**15**	**15**	**30**
SENIOR YEAR				
ANSC 345	Veterinary Anatomy and Physiology	3	-	3
AQSC 405	Fish Breeding and Genetics	-	3	3
ANSC 441	Animal Nutrition	3	-	3
__________	ANSC Elective	-	3	3
__________	ANSC Elective	3	-	3
__________	Restrictive Elective	3	-	3
__________	Elective	-	3	3
__________	Elective	-	3	3
	Totals	**12**	**12**	**24**

Total hours required for graduation - 121

ANSC Electives
ANSC 246 - Equine Science (3)
ANSC 351 - Feeds and Feeding (3)
ANSC 446 - Special Topics (3)
ANSC 343 - Swine Productio3)
ANSC 346 - Dairy Production (3)
ANSC 447 - Special Problems (3)
ANSC 448 - Advance Livestock (3)

Restrictive Elective
AGRI 400 - Internship (3)
AGRI 401 - Independent Study (3)
ANCS 449 - Seminar (3)

DEPARTMENT OF AGRICULTURE
AGRICULTURE MAJOR
Animal Science Pre-Veterinary Medicine Concentration
Bachelor of Science Degree

		Semester Hours 1st Sem	2nd Sem	Total Hours
FRESHMAN YEAR				
ENGL 110, 111	Composition I and Composition II	3	3	6
MATH 120,121	College Algebra and Trigonometry	4	3	7
AGRI 140	Introduction to Agriculture	2	-	2
ANSC 140	Principles of Animal Science	-	3	3
PLSC 140	Principles of Plant Science	3	-	3
BIOL 120	Principles of Biology I and Lab	4	-	4
BIOL 121	Principles of Biology II and Lab	-	4	4
POLI 150	US Government	-	3	3
	Totals	**16**	**16**	**32**
SOPHOMORE YEAR				
AGEC 142	Principles of Agricultural Economics	3	-	3
CHEM 153	General Chemistry I and Lab	4	-	4
CHEM 152, 154	General Chemistry II and Lab	-	4	4
GEPS 124	Introduction to Psychology	-	3	3
HPER 170	Wellness/Health	2	-	2
SPEE 214	Introduction to Public Speaking	-	3	3
IOL 241	Introduction to Microbiology and Lab	-	4	4
AGRI 280	Geographic Information Systems	3	-	3
ANSC 242	Poultry Production	3	-	3
AGRI 295	Contemporary Global Studies	-	3	3
	Totals	**15**	**17**	**32**
JUNIOR YEAR				
PHYS 105	General Physics I and Lab	4	-	4
PHYS 106	General Physics II and Lab	-	4	4
SOSC 242	Soil Science	4	-	4
CHEM 305, 307	Organic Chemistry I and Lab	4	-	4
CHEM 306, 308	Organic Chemistry II and Lab	-	4	4
ENGL 323	Environmental Literature	-	3	3
ANSC 346	Physiology of Reproduction	-	3	3
ANSC 349	Veterinary Hygiene	3	-	3
	Totals	**15**	**14**	**29**
SENIOR YEAR				
ANSC 345	Veterinary Anatomy and Physiology	3	-	3
BIOL 313	General Zoology/ Lab	4	-	4
BIOL 415	Histology/ Lab	-	4	4
CHEM 422	Biochemistry/Lab	4	-	4
AQSC 405	Fish Breeding and Genetics	-	3	3
ANSC 441	Animal Nutrition	-	3	3
________	ANSC Elective	3	-	3
________	Restricted Elective	-	3	3
	Totals	**14**	**13**	**27**

Total hours required for graduation 120

ANSC Electives:
ANSC 246 – Equine Science (3)
ANSC 344 – Beef Cattle Production (3)
ANSC 351 – Feeds and Feeding (3)
ANSC 446 – Special Topics (3)
ANSC 447 – Special Problems (3)
ANSC 448 – Advance Livestock (3)

Restricted Electives:
AGRI 400 – Internship (3)
AGRI 401 – Independent Study (3)
MATH 200 – Calculus 1 (3)
STAT 210 – Statistics (3)
ANCS 449 – Seminar (3)

DEPARTMENT OF AGRICULTURE
AGRICULTURE MAJOR
Aquatic Science Concentration
Bachelor of Science Degree

		Semester Hours 1st Sem	2nd Sem	Total Hours
FRESHMAN YEAR				
ENGL 110, 111	Composition I and Composition II	3	3	6
MATH 120,121	College Algebra and Trigonometry	4	3	7
BIOL 120	Principles of Biology and Lab	4	-	4
BIOL 121	Principles of Biology II and Lab II	-	4	4
AGRI 140	Introduction to Agriculture	2	-	2
ANSC 140	Principles of Animal Science	-	3	3
GEPS 124	Introduction to Psychology	-	3	3
HPER 170	Wellness/Health	-	2	2
AGEC 142	Principles of Agricultural Economics	3	-	3
	Totals	**16**	**18**	**34**
SOPHOMORE YEAR				
PLSC 140	Principles of Plant Science	3	-	3
AGRI 150	Introduction to Environment Science/Lab	4	-	4
POLI 150	US Government	3	-	3
CHEM 153	General Chemistry I and Lab	4	-	4
CHEM 152, 154	General Chemistry II and Lab	-	4	4
BIOL 241	Introduction to Microbiology and Lab	-	4	4
AGRI 280	Geographic Information Systems		3	3
AQSC 201	Introduction to Aquiculture	-	3	3
SPEE 214	Introduction to Public Speaking	-	3	3
	Totals	**14**	**17**	**31**
JUNIOR YEAR				
PHYS 105	General Physics I and Lab	4	-	4
AGRI 295	Contemporary Global Studies	-	3	3
AGME 242	Introduction to Ag Engineering	3	-	3
SOSC 242	Soil Science	-	4	4
AQSC 301	Aquatic Culture Systems Design	3	-	3
AQSC 302	Management of Aquatic Weeds	-	3	3
ANSC 345	Veterinary Anatomy and Physiology	3	-	3
ENGL 323	Environmental Literature	-	3	3
__________	Elective	3	-	3
__________	Elective	-	3	3
	Totals	**16**	**16**	**32**
SENIOR YEAR				
CHEM 305, 307	Organic Chemistry I and Lab	4	-	4
AQSC 401	Fish Pond Management	-	3	3
AQSC 405	Fish Breeding and Genetics	-	3	3
ANSC 441	Animal Nutrition	3	-	3
_________	AQSC Elective	3	-	3
_________	AQSC Elective	3	-	3
__________	Elective	-	3	3
__________	Elective	-	3	3
	Totals	**13**	**12**	**25**

Total required for graduation 122

Electives:

AQSC 402	-	Fish Pathology (3)
AQSC 406	-	Salmonids (3)
AQSC 407	-	Fish Processing Technology (3)
ASQC 408	-	Fish Nutrition (3)
AQSC 409	-	Aquaculture Economics (3)
ANSC 351	-	Feeds and Feeding
AGRI 400	-	Internship (3)
AGRI 401	-	Independent Study (3)
ANCS 449	-	Seminar (3)

DEPARTMENT OF AGRICULTURE
AGRICULTURE MAJOR
Environmental Science Concentration
Bachelor of Science Degree

		Semester Hours 1st Sem	2nd Sem	Total Hours
FRESHMAN YEAR				
ENGL 110, 111	Composition I and II	3	3	6
MATH 120, 121	College Algebra and Trigonometry	4	3	7
AGRI 140	Introduction to Agriculture	2	-	2
PLSC 140	Principles of Plant Science	3	-	3
BIOL 120	Principles of Biology I and Lab	4	-	4
BIOL 121	Principles of Biology II and Lab	-	4	4
AGRI 150	Introduction to Environ Science and Lab	-	4	4
ANSC 140	Principles of Animal Science	-	3	3
	Totals	**16**	**17**	**33**
SOPHOMORE YEAR				
CHEM 153	General Chemistry I and Lab	4	-	4
PHYS 105	Introduction to Physics I and Lab	-	-	4
POLI 150	U.S. Government	3	-	3
AGEC 142	Principles of Agricultural Economics I	3	-	3
CHEM 152	General Chemistry II and Lab	-	4	4
HPER170	Health and Wellness	-	2	2
AGME 242	Introduction to Agricultural Engineering	3	-	3
BIOL 241	Introduction to Microbiology and Lab	-	4	4
SPEE 214	Introduction to Public Speaking	-	3	3
AGRI 280	Principles of Geographic Information Systems	-	3	3
	Totals	**17**	**16**	**33**
JUNIOR YEAR				
ECON 210	Principles of Microeconomics	3	-	3
SOSC 242	Principles of Soils	4	-	4
STAT 210	Elementary Stats I	-	3	3
AGRI 295	Contemporary Global Studies	-	3	3
CHEM 305	Organic Chemistry I and Lab	4	-	4
________	Scientific Elective	3	-	3
ENGL 323	Environmental Literature	-	3	3
AGRI 341	Research Methods in Agriculture	-	3	3
SOSC 345	Soil Fertility and Fertilizers	-	4	4
	Totals	**14**	**16**	**30**
SENIOR YEAR				
BIOL 324	Ecology and Lab	4	-	4
PADM 401	Environmental Law	3	-	3
AGRI 400/401	Internship/Independent Study	3	-	3
SOSC ___	Soil Science Elective	3	-	3
AQSC 404	Limnology	-	3	3
PLSC 444	Genetics	-	3	3
AGEC/PADM	Policy Elective	-	3	3
________	Scientific Elective	-	3	3
	Totals	**13**	**12**	**25**

Total hours required for graduation – 121

Scientific Electives

AGRI 290	-	Introduction to Remote Sensing
PLSC 353	-	Integrated Pest Mgmt Strategies
AGEC 446	-	Land Economics
PLSC 455	-	Turf Management
AQSC 405	-	Fish Breeding and Genetics

Soil Science Electives

SOSC 347	-	Soil Classification
SOSC 450	-	Problems in Soil Science
SOSC 455	-	World Soil Resources

Policy Electives

AGEC 444	-	Agricultural Policy
AGEC 446	-	Land Economics
PADM 403	-	Land Use Law and Policy

DEPARTMENT OF AGRICULTURE
AGRICULTURE MAJOR
Plant and Soil Science - Horticulture Concentration
Bachelor of Science Degree

		Semester Hours		
		1st Sem	2nd Sem	Total Hours
FRESHMAN YEAR				
ENGL 110, 111	Composition I and II	3	3	6
MATH 120, 121	College Algebra and Trigonometry	4	3	7
AGRI 140	Introduction to Agriculture	2	-	2
PLSC 140	Principles of Plant Science	3	-	3
BIOL 120	Principles of Biology I and Lab	4	-	4
BIOL 121	Principles of Biology II and Lab	-	4	4
ANSC 140	Principles of Animal Science	-	3	3
POLI 150	U.S. Government	-	3	3
	Totals	**16**	**16**	**32**
SOPHOMORE YEAR				
CHEM 153	General Chemistry I and Lab	4	-	4
PHYS 105	Introduction to Physics I and Lab	4	-	4
AGEC 142	Principles of Agricultural Economics I	3	-	3
AGME 242	Introduction to Agricultural Engineering	3	-	3
HPER170	Health and Wellness	2	-	2
CHEM 152	General Chemistry II and Lab	-	4	4
BIOL 241	Introduction to Microbiology and Lab	-	4	4
SPEE 214	Introduction to Public Speaking	-	3	3
AGRI 280	Principles of Geographic Information Systems	-	3	3
	Totals	**16**	**14**	**30**
JUNIOR YEAR				
CHEM 305	Organic Chemistry I and Lab	4	-	4
ECON 210	Principles of Microeconomics	3	-	3
SOSC 242	Principles of Soils	4	-	4
AGRI 295	Contemporary Global Studies	3	-	3
STAT 210	Statistics	3	-	3
ENGL 323	Environmental Literature	-	3	3
SOSC 345	Soil Fertility and Fertilizers	-	4	4
PLSC 353	Integrated Pest Management Strategies	-	3	3
PLSC 450	Introduction to Forestry	-	3	3
HORT 340	Landscape Design	-	3	3
	Totals	**17**	**16**	**33**
SENIOR YEAR				
HORT 353	Vegetable Production	3	-	3
HORT 352	Plant Materials	3	-	3
HORT 446	Greenhouse Crops and Management	3	-	3
HORT 449	Plant Prop/Nursery Practices	3	-	3
AGRI 400/401	Internship/Independent Study	3	-	3
AGRI 341	Research Methods in Agriculture	-	3	3
PLSC 444	Genetics	-	3	3
PLSC 455	Turf Management	-	3	3
________	Scientific Elective	-	3	3
	Totals	**15**	**12**	**27**

Total hours required for graduation - 122

Scientific Electives

AGRI 290	-	Introduction to Remote Sensing
PLSC 341	-	Field Crops Production
PLSC 352	-	Forage Crops/Pasture Mgmt
PLSC 454	-	Special Topics in Crop Science
HORT 450	-	Problems in Horticulture
SOSC 347	-	Soil Classification
SOSC 450	-	Problems in Soil Science
SOSC 455	-	World Soil Resources
AGRI 400	-	Internship

DEPARTMENT OF AGRICULTURE
AGRICULTURE MAJOR
Plant and Soil Science Concentration
Bachelor of Science Degree

		Semester Hours 1st Sem	2nd Sem	Total Hours
FRESHMAN YEAR				
ENGL 110, 111	Composition I and II	3	3	6
MATH 120, 121	College Algebra and Trigonometry	4	3	7
AGRI 140	Introduction to Agriculture	2	-	2
PLSC 140	Principles of Plant Science and Lab	3	-	3
BIOL 120	Principles of Biology I and Lab	4	-	4
BIOL 121	Principles of Biology II and Lab	-	4	4
ANSC 140	Principles of Animal Science	-	3	3
POLI 150	U.S. Government	-	3	3
	Totals	**16**	**16**	**32**
SOPHOMORE YEAR				
CHEM 153	General Chemistry I and Lab	4	-	4
PHYS 105	Introduction to Physics I and Lab	4	-	4
AGEC 142	Principles of Agriculture Economics I	3	-	3
AGME 242	Introduction to Agricultural Engineering	3	-	3
HPER170	Health and Wellness	2	-	2
CHEM 152	General Chemistry II and Lab	-	4	4
BIOL 241	Introduction to Microbiology and Lab	-	4	4
SPEE 214	Introduction to Public Speaking	-	3	3
AGRI 280	Principles of Geographic Information Systems	-	3	3
	Totals	**16**	**14**	**30**
JUNIOR YEAR				
CHEM 305	Organic Chemistry I and Lab	4	-	4
ECON 210	Principles of Microeconomics	3	-	3
SOSC 242	Principles of Soils	4	-	4
AGRI 295	Contemporary Global Studies	3	-	3
STAT 210	Statistics	3	-	3
ENGL 323	Environmental Literature	-	3	3
SOSC 345	Soil Fertility and Fertilizers	-	4	4
SOSC 347	Soil Classification	-	3	3
PLSC 353	Integrated Pest Mgmt Strategies	-	3	3
PLSC 450	Introduction to Forestry	-	3	3
	Totals	**17**	**16**	**33**
SENIOR YEAR				
PLSC 341	Field Crops Production	3	-	3
PLSC 352	Forage Crops/Pasture Mgmt	3	-	3
HORT 449	Plant Prop/Nursery Practices	3	-	3
________	Scientific Elective	3	-	3
AGRI 400/401	Internship/Independent Study	3	-	3
AGRI 341	Research Methods in Agriculture	-	3	3
SOSC 450	Problems in Soil Science	-	3	3
PLSC 444	Genetics	-	3	3
________	Scientific Elective	-	3	3
	Totals	**15**	**12**	**27**

Total hours required for graduation – 122

Scientific Electives

AGRI 290 - **Introduction to Remote Sensing**
HORT 341 - Vegetable Crop Production
HORT 352 - Plant Materials
PLSC 454 - Special Topics in Crop Science
PLSC 455 - Turf Management
SOSC 455 - World Soil Resources

Substitutions must be approved by School Dean and Department Chair

SUMMARY OF GRADUATION REQUIREMENTS

SUBJECT AREA	HOURS
General Education Courses	34
Major Requirements	54
Electives	3
Other Requirements	30
TOTAL DEGREE HOURS REQUIRED	**120**

Electives:

Science

AGRI 150 Introduction to Environmental Science and Lab
BIOL 120 Principles of Biological Science and Lab
CHEM 153 and 152 General Chemistry I and Lab
GEES181 Earth Science and Lab

History

POLI150 US Government

Social Science

PSYC 124 Introduction to Psychology
ECON 210 Principles of Microeconomics
PSYC 212 Human Growth and Development

Literature

ENGL 201 Introduction to Literature
ENGL 214 World Literature

Global Studies

AGRI 295 Contemporary Global Studies

Wellness Health

HPER 170 Health and Wellness

GENERAL EDUCATION REQUIREMENTS FOR BS DEGREE

HISTORY		**Semester Hours**
HIST 114	World History I	3
HIST 122	US History I	3
POLI 150	United States Government	3
HIST 123	US History II	3
HUMANITIES		**Semester Hours**
ENGL 311	African-American Literature	3
ENGL 323	Environmental Literature	3
ENGL/PHIL 327	Philosophy in Literature	3
FREN 110/111-212/213	Elementary/Intermediate French I, II	3
GEEN 310	Advanced Communication Skills	3
HIST 122	US History I	3
HIST 123	US History II	3
GEMU 480	Blacks in American Music	3
PHIL 140	Introduction to Philosophy	3
GERM 110/111-212/213	Elementary/Intermediate German I, II	3
PHIL 180	Critical Thinking	3
PHIL 290	Business Ethics	3
SPAN 110/111-212/213	Elementary/Intermediate Spanish I, II	3
SPEE 214	Introduction to Public Speaking	3
GLOBAL STUDIES		**Semester Hours**
AGRI295	Contemporary Global Studies	3
ECON 451	International Economics	3
FREN 110/111-212/213	Elementary/Intermediate French I, II	3
GERM 110/111-212/213	Elementary/Intermediate German I, II	3
POLI 207	International Relations	3
SPAN 110/111-212/213	Elementary/Intermediate Spanish I, II	3
ENGLISH		**Semester Hours**
ENGL 110 and 111	Composition I and II	6
ENGL 201	Introduction to Literature	3
ENGL 214	World Literature I	3
WELLNESS/HEALTH		**Semester Hours**
HPER 170	Health and Wellness	2

COLLEGE ALGEBRA AND TRIGONOMETRY		Semester Hours
MATH 120	College Algebra and Trigonometry I	3
MATH 121	College Algebra and Trigonometry II	3
MATH 122	Finite College Algebra and Trigonometry	3
MATH 130	Numbers and Operations	3
MATH 131	Algebra and Functions	3
MATH 200	Calculus I	3
MATH 201	Calculus II	3
STAT 210	Statistics	3
SOCIAL SCIENCE		**Semester Hours**
ECON 210	Principles of Microeconomics	3
ECON 211	Principles of Macroeconomics	3
FACS 210	Consumer Economics	3
POLI 150	United States Government	3
PSYC 101	Introduction to Psychology	3
PSYC 212	Human Growth and Development	3
SCIENCE		**Semester Hours**
BIOL 120	Principles of Biology I and Lab	4
BIOL 121	Principles of Biology II and Lab	4
BIOL 318	Human Anatomy and Lab	4
CHEM 153	General Chemistry I and Lab	4
CHEM 152	General Chemistry II and Lab	4
AGRI 150	Introduction to Environmental Science and Lab	4
GEES 181	Earth Science and Lab	4
PHYS 112	General Physics I and Lab	4
PHYS 113	General Physics II and Lab	4
PHYS 116	General College Physics I and Lab	4
PHYS 117	General College Physics II and Lab	4

TOTAL REQUIREMENTS SEMESTER HOURS: 34.00

A single course may simultaneously fulfill a general education requirement and a departmental or major/minor requirement. A single course cannot be used to fulfill more than one general education requirement.
Department or major/minor areas may opt to exceed the minimum credit hour requirements above.

Appendix C Career Development Survey

Career Development Survey

Sponsored by the Department of Youth Development and Agricultural Education

PURDUE
UNIVERSITY

Background Information

1. Age: ______

2. Gender: ❒ Male ❒ Female

3. Current Year in College: ❒ Freshman ❒ Sophomore ❒ Junior ❒ Senior

4. Please indicate your University: ______________________________

5. What is your current major? ______________________________

6. The following item inquires about how strongly committed you perceive yourself to pursue this major. Please choose a number that describes where you fall on the scale. For example, if you think that you are not committed at all, you would choose 1. If you think that you are completely committed, you might choose 5. If you are only moderately committed, you might choose 3, and so forth.

	Not at All Committed	Slightly Committed	Moderately Committed	Very Committed	Completely Committed
How strongly committed do you feel to pursuing this major? Select the answer..............................	1	2	3	4	5

7. Are you interested in pursuing a degree after you complete your bachelor's degree?
❒ Yes ❒ No

8. Please choose your ethnicity (check all that apply):
❒ African American
❒ Pacific-Islander
❒ American Indian
❒ Asian American
❒ Hispanic/Latino
❒ Mexican-American or Chicano
❒ White, Caucasian, European, Not Hispanic

9. Please check the box next to the **highest** level of education completed by each of your parents or guardians:

	Father/Male Guardian	Mother/Female Guardian
1. Did not complete high school..	❒	❒
2. Earned a high school diploma, GED (General Educational Development) Certificate, or equivalent..	❒	❒
3. Had some college, vocational or trade school education (including 2-year degree)..	❒	❒
4. Earned a Bachelor's degree..	❒	❒
5. Earned a Master's degree..	❒	❒
6. Earned a Doctoral or professional degree (e.g., Ph.D., J.D., M.D.)..........	❒	❒
7. At least some graduate or professional schooling after bachelor's degree	❒	❒
8. Not sure..	❒	❒

Section I

10. The items below inquire about what kind of person you think you are. Each item consists of a PAIR of characteristics, with five response categories in between. For example,

Not at all artistic : _X_ : ____ : ____ : ____ : ____ : Very artistic

Each pair describes contradictory characteristics – that is, you cannot be both at the same time, such as very artistic and not at all artistic.

The letters form a scale betweeen extremes. You are to choose a letter which describes where YOU fall on the scale. For example if you think you have no artistic ability, you would place an "X" at the first blank space on the left, as shown in the above example. If you think you have average ability, you would choose the middle category, and so forth.

How you perceive yourself:		
1. Not at all independent	: ____ : ____ : ____ : ____ : ____ :	Very independent
2. Not at all emotional	: ____ : ____ : ____ : ____ : ____ :	Very emotional
3. Very passive	: ____ : ____ : ____ : ____ : ____ :	Very active
4. Not at all able to devote self completely to others	: ____ : ____ : ____ : ____ : ____ :	Able to devote self completely to others
5. Very rough	: ____ : ____ : ____ : ____ : ____ :	Very gentle
6. Not at all helpful to others	: ____ : ____ : ____ : ____ : ____ :	Very helpful to others
7. Not at all competitive	: ____ : ____ : ____ : ____ : ____ :	Very competitive
8. Not at all kind	: ____ : ____ : ____ : ____ : ____ :	Very kind
9. Not at all aware of feelings of others	: ____ : ____ : ____ : ____ : ____ :	Very aware of feelings of others
10. Can make decisions easily	: ____ : ____ : ____ : ____ : ____ :	Has difficulty making decisions
11. Gives up very easily	: ____ : ____ : ____ : ____ : ____ :	Never gives up easily
12. Not at all self-confident	: ____ : ____ : ____ : ____ : ____ :	Very self-confident
13. Feels very inferior	: ____ : ____ : ____ : ____ : ____ :	Feels very superior
14. Not at all understanding of others	: ____ : ____ : ____ : ____ : ____ :	Very understanding of others
15. Very cold in relations with others	: ____ : ____ : ____ : ____ : ____ :	Very warm in relations with others
16. Goes to pieces under pressure	: ____ : ____ : ____ : ____ : ____ :	Stands up well under pressure

Section II

11. For each statement below, please read carefully and indicate how much confidence you have that you could accomplish each of these tasks by circling the appropriate number to the right of each statement.

Task	No Confidence at All	Very Little Confidence	Moderate Confidence	Much Confidence	Complete Confidence
1. Make a plan of your goals for the next five years.	1	2	3	4	5
2. Determine the steps to take if you are having academic trouble with an aspect of your chosen major.	1	2	3	4	5
3. Accurately assess your abilities.	1	2	3	4	5
4. Determine the steps you need to take to successfully complete your chosen major.	1	2	3	4	5
5. Persistently work at your major or career goal even when you get frustrated.	1	2	3	4	5
6. Figure out what you are and are not ready to sacrifice to achieve your career goals.	1	2	3	4	5
7. Talk with a person already employed in a field you are interested in.	1	2	3	4	5
8. Choose a major or career that will fit your interests.	1	2	3	4	5
9. Identify employers, firms, and institutions relevant to your career possibilities.	1	2	3	4	5

Section III

12. The following is a list of major steps along the way to completing a degree in the agricultural sciences. Please indicate how much confidence you have in your ability to complete each of these steps in relation to the major that you are most likely to pursue. Use the 0-9 scale below to indicate your degree of confidence.

	No Confidence				Some Confidence					Complete Confidence
1. Cope with lack of support from professors or your advisor.	0	1	2	3	4	5	6	7	8	9
2. Complete a degree in the agricultural sciences despite financial pressures.	0	1	2	3	4	5	6	7	8	9
3. Continue on in the agricultural sciences even if you did not feel well-liked by your classmates or professors.	0	1	2	3	4	5	6	7	8	9
4. Find ways to overcome communication problems with professors or teaching assistants in your agricultural sciences courses.	0	1	2	3	4	5	6	7	8	9
5. Balance the pressures of studying for agricultural sciences courses with the desire to have free time for fun and other activities.	0	1	2	3	4	5	6	7	8	9
6. Continue on in the agricultural sciences even if you felt that, socially, the environment in the classes was not very welcoming to you.	0	1	2	3	4	5	6	7	8	9
7. Find ways to study effectively for agricultural sciences courses despite having competing demands for your time.	0	1	2	3	4	5	6	7	8	9

Section IV

13. Using the 1-10 scale below, please indicate the extent to which you agree or disagree with each of the following statements.

Completing my plan of study in the agricultural sciences will likely allow me to:	Strongly Disagree									Strongly Agree
1. ... receive a job offer quickly.	1	2	3	4	5	6	7	8	9	10
2. ... earn an attractive salary.	1	2	3	4	5	6	7	8	9	10
3. ... get respect from other people.	1	2	3	4	5	6	7	8	9	10
4. ... do work that I find satisfying.	1	2	3	4	5	6	7	8	9	10
5. ... increase my sense of self-worth.	1	2	3	4	5	6	7	8	9	10
6. ... have a career that is valued by my family.	1	2	3	4	5	6	7	8	9	10
7. ... do work that can "make a difference" in peo-ple's lives.	1	2	3	4	5	6	7	8	9	10
8. ... go into a field with high employment demand.	1	2	3	4	5	6	7	8	9	10
9. ... do exciting work.	1	2	3	4	5	6	7	8	9	10
10. ... have the right type and amount of contact with other people (i.e., "right" for me).	1	2	3	4	5	6	7	8	9	10

Section V

14. Please indicate the degree to which you like or dislike the activity in each statement below by circling the appropriate numbers to the right of each statement.

I would enjoy this activity:	Very Strongly Disagree	Mostly Disagree	Slightly Disagree	Slightly Agree	Mostly Agree	Very Strongly Agree
1. Working as an astronomer.	1	2	3	4	5	6
2. Taking classes in science.	1	2	3	4	5	6
3. Visiting a science museum.	1	2	3	4	5	6
4. Listening to a famous scientist talk.	1	2	3	4	5	6
5. Solving computer problems.	1	2	3	4	5	6
6. Solving math puzzles.	1	2	3	4	5	6
7. Touring a science lab.	1	2	3	4	5	6
8. Joining a science club.	1	2	3	4	5	6
9. Reading about science discoveries.	1	2	3	4	5	6
10. Participating in a science fair.	1	2	3	4	5	6
11. Working with plants and animals.	1	2	3	4	5	6
12. Working in a science laboratory.	1	2	3	4	5	6
13. Learning about energy and electricity.	1	2	3	4	5	6
14. Taking math classes.	1	2	3	4	5	6
15. Working in a medical lab.	1	2	3	4	5	6
16. Watching a science program on TV.	1	2	3	4	5	6
17. Using a calculator.	1	2	3	4	5	6

Section VI

15. Please indicate your level of agreement with this statement using the scale below.

	Strongly Disagree	Disagree	Neither Agree Nor Disagree	Agree	Strongly Agree
It is important for me to finish my program of studies in the agricultural sciences.	1	2	3	4	5

Section VII

16. Instructions: Listed below are items that deal with various aspects of career exploration. Please read each item carefully and then circle your response. Note: For the purpose of this section, **career** is generally viewed as the collection of all work-like activities in one's lifetime (past and future). **Job** is more specific and tends to be connected to a specific company, salary, job description, etc. **Occupation** is the broader area of one's job – e.g., an occupation could be that of an engineer, while the job could be a systems engineer at Boeing.

To what extent have you behaved in the following ways over the last 3 months?	Little	Somewhat	Moderate Amount	Substantial Amount	A Great Deal
1. Investigated career possibilities.	1	2	3	4	5
2. Went to various career orientation programs.	1	2	3	4	5
3. Obtained information on specific jobs or companies related to my anticipated career.	1	2	3	4	5
4. Initiated conversations with knowledgeable individuals in my anticipated career area.	1	2	3	4	5
5. Obtained information on the labor market and general job opportunities.	1	2	3	4	5
6. Sought information on specific areas of career interest.	1	2	3	4	5

To what extent have you done the following in the past 3 months?	Little	Somewhat	Moderate Amount	Substantial Amount	A Great Deal
7. Reflected on how my past experiences and activities relate to my future career plans.	1	2	3	4	5
8. Focused my thoughts on me as a person – my skills, values, interests.	1	2	3	4	5
9. Contemplated my past.	1	2	3	4	5
10. Been retrospective in thinking about my career options.	1	2	3	4	5
11. Understood a new relevance of past behavior in my anticipated career area.	1	2	3	4	5

Section VIII

17. People face a variety of factors that may support or hinder their college and career plans. We are interested in knowing about the situations, either helpful or unhelpful, you believe you might experience in relation to one particular choice option: the decision to pursue an academic major in the agricultural sciences.

For the questions below, assume that you were to continue on in the agricultural sciences. Using the 1-5 scale, show how likely you believe you would be to experience each of the following situations.

Situation	Not at All Likely	A Little Likely	Moderately Likely	Quite Likely	Extremely Likely
1. Have access to a "role model" in this field (i.e., someone you can look up to and learn from observing).	1	2	3	4	5
2. Feel support for this decision from important people in your life (e.g., teachers).	1	2	3	4	5
3. Feel that there are people "like you" in this field.	1	2	3	4	5
4. Get helpful assistance from a tutor, if you felt you needed such help.	1	2	3	4	5
5. Get encouragement from your friends for pursuing this major.	1	2	3	4	5
6. Get helpful assistance from your advisor.	1	2	3	4	5
7. Feel that your family members support this decision.	1	2	3	4	5
8. Feel that close friends or relatives would be proud of you for making this decision.	1	2	3	4	5
9. Have access to a "mentor" who could offer you advice and encouragement.	1	2	3	4	5
10. Receive negative comments or discouragement about your major from family members.	1	2	3	4	5
11. Worry that such a career path would require too much time or schooling.	1	2	3	4	5
12. Feel that you don`t fit in socially with other students in this major.	1	2	3	4	5
13. Receive negative comments or discouragement about your major from friends.	1	2	3	4	5
14. Feel pressure from parents or other important people to change your major to some other field.	1	2	3	4	5

Section IX

18. For the following question, a "STEM-intensive" major is defined as a major where a majority of your courses are science, technology, engineering or math-related.

What factors do you consider to have been helpful (or hindering) in pursuing a STEM-intensive major in the agricultural sciences? Please write your response in the box.

Helpful Factors:

Hindering Factors:

Thank you for your participation!

VITA

VITA

Qi Ding grew up in China and developed a passion for learning as a young child. She completed her undergraduate degrees in Business English and Accounting at Jiangxi University of Finance and Economics, and finished her Master's degree at China Agricultural University. During her graduate experiences at Purdue University, Qi developed an interest in the STEM career development of underrepresented minority students. Qi has presented her research at the American Psychological Association Annual Convention and the Great Lakes Regional Counseling Psychology Conference.

Qi's research interests focus on the social cognitive factors that impact the STEM career development of underrepresnted minorities. Qi's major goal is to expand her research acumen through her contributions to innovative program assessment and evaluation.

Qi will be working as a Research Analyst in the Office of Institutional Research and Effectiveness at the University of Delaware.