Educational outcomes of agriculture education on students in U.S. urban schools, a review of current literature

by

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B.S., University of Georgia, 2024

A REPORT

Submitted in partial fulfillment of the requirements for the degree

MASTER OF SCIENCE

Department of Horticulture & Natural Resources
College of Agriculture

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2026

Approved by:

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Abstract

This report examines the historical foundations and contemporary realities of urban agricultural education in the United States. Drawing on 42 scholarly and historical sources, Chapter one situates agricultural education along a continuum spanning Indigenous knowledge systems, the institutionalization of land-grant universities, and the emergence of modern Urban Agriculture (UA) initiatives. The review highlights how experiential learning has shaped agricultural knowledge transmission from Indigenous practices to Deweyan philosophy. While agricultural education has expanded through extension, national organizations, and federal funding initiatives, systemic barriers have historically limited access for BIPOC and urban populations. Contemporary programs seek to address these inequities by promoting food security, civic engagement, and student well-being. Grounded in Social Cognitive Theory and Self-determination Theory, this review argues that hands-on curricula are central to engaging and retaining urban youth within agricultural pathways.

Building on these findings, the second and third chapters document the development of a four-week, adaptable curriculum designed for use in middle-grade classrooms. This curriculum translates experiential and systems-based principles into structured lessons that emphasize career exploration, horticultural and animal science literacy, food systems analysis, and cross-curricular integration with math and science. Using the Backwards Design process, the curriculum was created through iterative cycles of planning, classroom implementation, student feedback, and revision. The curriculum serves as a testing ground for the theoretical claims advanced in chapter one. Together, the literature review and curriculum development process demonstrate that agricultural education can function as a rigorous and culturally responsive framework capable of strengthening academic skills while reconnecting urban students to the systems that sustain their lives.

Table of Contents

List of Figures

List of Tables

Definitions

For this report, the following terms and definitions were used:

Agriculture Education (AgEd): A formal, school-based instructional framework that uses a three-part model to instill agricultural knowledge into students through classroom and laboratory instruction, career and leadership development, and supervised work experiences (Croom, 2008; National FFA Organization, 2025).

BIPOC: Abbreviation describing non-white racial/ethnic groups within the United States "Black, Indigenous, People of Color" (Merriam-Webster, n.d).

Experiential Learning: A method of learning that emphasizes hands-on practice, observation, and experimentation. This approach continues to inform agricultural education practices today, including laboratory instruction and applied research projects (Croom, 2008; Kudryavtsev et al, 2012).

Urban Agriculture: Agricultural programs, including education, outreach, production, or transportation occurring within an urban population center (Philpot, 2010; Hodgson et al, 2011).

The National FFA Organization (FFA): A North America-based student organization focusing on student leadership, agricultural and environmental education, and career development. Originally founded in 1928 as an all-white, all-male organization, it was integrated in 1965 during a merger with the NFA and, after 1968, allowed both men and women (National FFA Organization,2025).

Acknowledgements

I would like to acknowledge Dr. Eleni Pliakoni for her work as my graduate advisor during my time at Kansas State University's Urban Food Systems Initiative. I would like to thank Dr. Tricia Jenkins, and Dr. Cary Rivard for their support as committee members. I would like to acknowledge my mother, Donna Bell, for her support of my educational endeavors throughout all of my life, Kristifer and Harlee Bell, for believing in my dreams when others told me "no", Dan Cornwell, for keeping my clothes warm and belly fed, and Dr. Barry Croom and Mrs. Lisa Wimberly for their unbridled support during my undergraduate studies at the University of Georgia, Tifton.

Dedication

This report is dedicated to my childhood self—a bright-eyed dreamer who couldn't wait to leave the rural south and move to the big city. And its alright, because even though he didn’t know how he’d get there, he knew something was coming on. Little did he know that finding his way to the urban jungle would mean doing exactly what he swore he'd never do again: tilling soil, raising animals, and getting his hands dirty to support the people around him. The little boy who was terrified of bugs is now the man fighting his HOA for pollinator gardens and a leaf-mulched lawns. It turns out, a love for the earth is good, and it can be strong. Congratulations Kaleb, you made it out of Nashville, only to get right back to where you started from.

Chapter 1: A Review of Current Literature in Urban Agriculture Education

Introduction

The body of literature suggests that modern urban agriculture is rooted in broader social, political, and educational movements of the 20th Century. During both World Wars, the United States Government encouraged citizens to produce their own food through initiatives such as Victory Gardens, which were popularized through educational pamphlets and other media that introduced basic agricultural knowledge to non-rural populations (Philpot, 2010). This widespread initiative is perhaps one of the earliest forms of agricultural education targeting urban and peri-urban individuals following the passage of the *Smith-Hughes National Vocational Education Act* of 1917. This federal legislation secured funding for professional education programs throughout the United States, including instruction that would lead to many of the modern agricultural classes offered in K-12 schools today.

Since its inception over 100 years ago, the programs developed under the *Smith-Hughes Act* have informed students about agricultural and environmental practices while ensuring that scholars develop the necessary skills to continue supporting the agricultural industry. As agricultural production became increasingly industrialized and geographically consolidated throughout the 20th century, food production moved farther from population centers. This transition reduced direct public engagement with agriculture and contributed to declining agricultural literacy within urban populations (Kjeldsen-Kraugh, 2007; Philpot, 2010).

The purpose of this chapter is to examine the role of urban AgEd within the broader historical and educational context. First, a historical overview of urban agriculture and AgEd is provided to situate current practices within their social and institutional foundations. Second, a systematic review of the literature is conducted to evaluate the impacts of urban AgEd programs on student outcomes, with particular attention to agricultural literacy, experiential learning, and career development. Finally, these findings are assembled in a discussion that informs the development of a practical, standards-aligned agricultural curriculum designed for use in urban secondary schools.

Historical Background

The development of agriculture in the United States cannot be separated from patterns of urbanization and industrialization. Before industrialization, food production was embedded in urban life through systems such as stockyards and household subsistence plots; however, as industrial economies expanded, agriculture largely disappeared from the urban landscape, resulting in fewer individuals working directly in food production (Philpot, 2010). Over time, geographic and cultural separation contributed to the decline of agricultural literacy in cities, reinforcing the need for deliberate AgEd initiatives within urban communities (Philpot, 2010; Russ & Gaus, 2021; Richardson et al, 2024). By introducing students to hands-on learning environments such as school gardens, mechanics laboratories, and school-based farms, vocational programs expand access to AgEd beyond rural communities, allowing students without direct access to farming resources to engage with agricultural science and production systems (Duncan et al, 2016; Hand et al, 2023; Lauzon 2023).

This pedagogical structure was strongly influenced by progressive educational scholars, namely John Dewey (2009), whose experiential model encourages hands-on learning to prepare students for life outside the classroom. Literature reveals that the progressive education model shaped contemporary vocational education and remains central to modern practice. Using experiential learning practices, students develop knowledge through observation, experimentation, and application, rather than through lectures alone (Croom, 2008; Dewey, 2009; Hand et al, 2023).

The Institutionalization of Agricultural Education

In response to an industrializing economy, federal leaders recognized a growing need identified the need for skilled laborers who could successfully perform vocational trades; the Smith-Hughes Act of

1917 marked a critical turning point by providing sustained funding for school systems across the United States to implement vocational education programs, including agriculture (Smith-Hughes Act, 1917). The implementation of Smith-Hughes funding facilitated the expansion of experiential learning (Smith-Hughes Act, 1917; Croom, 2008). These foundations remain relevant within AgEd; today, educational initiatives such as school gardens, greenhouses, and community-based, student-led agricultural programs are paramount for providing the opportunities needed to develop urban residents who are well-informed regarding their food system (Croom, 2008; Hand et al, 2023; Rose et al, 2018; Russ & Gauss, 2021).

Indigenous Agricultural Knowledge Systems

While formal agricultural education in the United States is often traced to early 20th-century policy, many of its foundational principles predate these systems, and are rooted in Indigenous agricultural knowledge systems (Mt. Pleasant, 2016; Croom, 2018). Indigenous communities practiced sophisticated, localized food production, which emphasized sustainability, biodiversity, and intergenerational knowledge transfer long before the institutionalization of AgEd in the United States. (Mt. Pleasant, 2016; Croom, 2018). Historic documentation provides evidence of these systems. For example, John White's 1585 depiction of the Secotan Village illustrated organized agricultural landscapes featuring tobacco, corn, and gourds (White, 1585; Croom, 2018) (Figure 1).

Figure 1. Village of Secotan, John White, 1585

Another example, the “Three Sisters” intercropping technique, involves planting maize, beans, and squash plants together in the same rows. This intercropping method demonstrates advanced knowledge of plant relationships, soil fertility, and resource efficiency. In this system, maize provides structural support for beans, beans contribute nitrogen to the soil, and squash suppresses weeds and conserves moisture, resulting in higher productivity compared to monoculture systems (Mt. Pleasant, 2016).

From an educational standpoint, these systems function as informal yet effective learning environments (Mt. Pleasant, 2016; Croom, 2018). Agricultural knowledge was disseminated through practice and mentorship, aligning closely with the principles of experiential learning used today. (Mt.

Pleasant, 2016; Croom, 2018). Practices such as polyculture, land stewardship, and community-based knowledge closely mirror the sustainability-oriented and place-based frameworks that define many modern Urban Agriculture initiatives (Hodgson et al, 2011; Kudryavstev et al, 2012; Mt. Pleasant, 2016; Croom, 2018; Opitz, 2018; Richardson et, al 2024). Recognizing this continuity challenges the assumption that Urban Agriculture is a novel response to modern urban challenges and suggests that it is part of a longer tradition of localized, adaptive food production which operates within a complex social, economic, and policy landscape (Jones et al, 1998; Kudryavstev et al, 2012; Mt. Pleasant, 2016; Duncan et al, 2016; Croom, 2018).

Extension and Progressive Education Models

Progressive education is a pedagogical theory that asserts student knowledge is best attained through experiential learning and hands-on application of skills to real-world problems (Dewey, 2009). Research demonstrates that AgEd depends on this hands-on approach as a core instructional strategy. Early programs through land-grant institutions, such as Michigan Agricultural College, demonstrate how knowledge developed and was then shared through collaboration between researchers, educators, and farming communities (Lauzon, 2023). During the Post-Industrial Era, Michigan Agricultural College worked to standardize farming practices through early extension efforts, including traveling "railroad institutes", extension bulletins, and public demonstrations, which brought agricultural instruction directly to communities across the United States (Lauzon, 2023). While these programs were predominantly rural in scope, classroom instruction educated those immediately present, while extension bulletins disseminated "[the data] to thousands" (Lauzon, 2023). These initiatives demonstrate that AgEd has developed as a public-facing enterprise grounded in community engagement.

This model helped to define experiential learning as a predominant feature of AgEd, shaping how the subject would later be taught in more traditional educational settings (Croom, 2008; Lauzon, 2023; National FFA Organization, 2025). Even though they were originally designed for rural audiences, the frameworks established by Michigan's extension program enabled AgEd to expand into new contexts, such as Urban Agriculture, where progressive educational ideologies continue to guide educational practices (Croom, 2008; Duncan et al, 2016; Hand et al, 2023; Lauzon, 2023; Lawrence, 2025). Building on this historical context, the following section outlines the materials and methods used to conduct a review of current literature related to student outcomes in urban AgEd.

Materials And Methods

This literature review was composed in partial fulfillment of a Master of Science in Horticulture with an emphasis in Urban Food Systems from Kansas State University under the advisement of Dr. Eleni Pliakoni. Apart from the historical background, this review encompasses 22 sources: one government publication, two organizational manuscripts, two dissertations, four literature reviews, and 13 peer-reviewed studies. Sources were catalogued using the Zotero reference management system. Sources were identified through searches in the ProQuest database and Google Scholar. Publications from 1990–2025 were prioritized, with particular emphasis on those published in the past 10 years.

The keywords were urban agriculture, agriculture or agricultural education (AgEd), urban schools & agriculture, student perceptions & agriculture or horticulture, vocational program, FFA & urban students, minority engagement in agriculture or horticulture, mental health & horticulture or agriculture, student or adolescent wellbeing & horticulture or agriculture, horticulture curriculum, and agricultural curriculum. A total of 65 articles were initially screened, including those used in the background portion of this report.

27 works were excluded from the review. Studies that reference, but do not relate to AgEd and urban agriculture, as well as duplicate publications and non-English studies, were excluded from the body of work. Manuscripts were initially analyzed for their relevance to the topic of the review. Relevant studies were reviewed and synthesized to include both qualitative and quantitative methods. Special attention was given to resources focused on BIPOC and urban populations. Coding occurred through an

inductive process as the literature revealed a chronological pattern in the development of agriculture education programs in the United States. Table 1 summarizes the findings of the literature included in this review.

Limitations

This literature review was conducted by a single researcher, which introduces the potential for bias in the selection, coding, and synthesis of source material. Although systematic search procedures were used, the lack of multiple reviewers limits the opportunities for the quantity of material that could be reviewed, as well as interrater reliability. Non-English publications were excluded, potentially limiting international perspectives on urban AgEd. Additionally, the researcher is a full-time middle grades agricultural educator in an urban school setting. While this professional background provides valuable contextual understanding, it may also introduce internal bias in interpreting findings related to student engagement and curriculum effectiveness. The researcher took steps to practice objectivity throughout the review process to mitigate any risks of bias.

Table 1. Literature Summary Table

Themes	1. Student Motivation, Inclusion, and Agricultural Career Pathways					
Author (Year)	**Context**	**Design**	**Sample / Program**	**Key Findings**	**Limitations**	**Relevance**
Barber (2024)	U.S.	Mixed Methods	MANRRS alumni	Lower perceived competence; motivation & psychological needs predict inclusion	Self-report; cross-sectional	Connects belonging → persistence in ag careers
Hand et al. (2023)	U.S.	Qualitative	Urban HS students (n=9)	Mentors critical; ag seen positively but not as career; FFA inclusion issues	Small, single-site sample	Highlights gap between experience and career choice
Jones & Bowen (1998)	Southeastern U.S.	Mixed Methods	HS students (n=380)	Negative perceptions among African American students; teacher influence key	Non-random sample	Emphasizes role of perception & teacher attitudes
Zahry & Besley (2017)	U.S.	Quantitative	HS & college students (n=1,340)	Interest driven by norms, career impact, and perceptions of professionals	Self-reported data	Guides recruitment messaging for ANR fields
2. Urban Agriculture & Experiential Learning						
Duncan et al. (2026)	Southern U.S.	Quantitative	School garden (n=31)	Students preferred cooking over cultivation; prior experience increased interest	Low response rate	Supports integrating culinary components

Kudryavtsev et al. (2012)	New York, NY	Quantitative (Pre/Post)	5-week urban env. program	Increased ecological understanding; no change in place attachment	Short duration	Shows limits of short-term interventions
Russ & Gaus (2021)	U.S.	Literature Review	Urban ag youth programs	Builds civic engagement, leadership, social awareness	Limited long-term data	Supports UA as civic development tool
Richardson et al. (2024)	Northeastern U.S.	Mixed Methods	Urban growers (n=123)	Challenges: cost, land, labor; focus on community impact	Sampling limitations	Informs program/policy needs
Lawrence (2025)	U.S.	Government Report	Extension programs	Improves food security, skills, community resilience	Descriptive (non-empirical)	Shows real-world impact of extension programs
3. Horticulture & Mental / Emotional Health						
Hall & Knuth (2019)	—	Literature Review	Multiple studies	Plants reduce stress, anxiety, depression; improve cognition	Dependent on prior studies	Strong synthesis of plant benefits
Hitter et al. (2019)	Romania	Mixed Methods	TH program (n=24)	Reduced depression; improved biomarkers (KYNA)	Small sample; no control	Supports clinical horticulture benefits
Lee et al. (2018)	South Korea	Mixed Methods	Elementary students (n=20)	Reduced stress and cortisol levels	Small, gender-	Physiological evidence of benefits

					limited sample	
Oh et al. (2020)	South Korea	Quantitative (Pre/Post)	Students (n=582)	Improved emotional intelligence, resilience, self-efficacy	No control group	Large-scale support for school-based programs
4. Agricultural Education Systems, FFA, and Historical Foundations						
Croom (2008)	U.S.	Literature Review	AgEd model	3-component model evolved over time; no single origin	Historical interpretation	Foundational AgEd framework
Martin et al. (2023)	U.S.	Qualitative (Critical Theory)	FFA organization	Structural inequities rooted in traditions	Non-empirical	Explains diversity barriers
Rose et al. (2016)	U.S.	Quantitative	FFA members	FFA meets psychological needs; improves experience	Self-reported data	Supports student development role
Sheehan & Moore (2019)	U.S.	Secondary Data Analysis	FFA membership	Affiliation model increases participation	Data limitations	Important for recruitment strategies
National FFA Organization (2025)	U.S.	Organizational Doc	FFA programs	Defines leadership, growth, career development goals	Non-research doc	Primary structural reference
Lauzon (n.d.)	U.S. (Michigan)	Historical Case Study	Extension programs	Extension built support for formal ag education	Context-specific	Historical grounding of AgEd

Hodgson et al. (2011)	North America	Qualitative Case Study	Urban ag policy	UA supports community but needs policy backing	Non-generalizable	Policy implications for sustainability
Opitz et al. (2016)	Global North	Literature Review	UA vs peri-urban ag	Distinct roles in food systems	Limited empirical data	Theoretical foundation for UA
5. Agricultural Education Exposure & Perception Change						
Jean-Philippe et al. (2017)	Knoxville, TN	Quantitative (Pre/Post)	HS students (n=122)	Improved perceptions of ANR careers; increased awareness	Short-term intervention	Supports recruitment programming

A Review of Current Literature & State of Practice

Current literature suggests that Urban Agriculture in the United States occupies a distinct niche within the broader agricultural sector. Urban Agriculture is characterized by larger trends to engage with the urban populace, prioritizing education and localized food production and outreach, compared to the large-scale commodity production within conventional agriculture (Hodgson et al, 2011; Opitz et al, 2016). While some urban agriculture initiatives do act as commercial farms, food hubs and farmers' markets, many programs prioritize social and educational interactions rather than just agricultural output (Hodgson et al, 2011; Opitz et al, 2018; Russ & Gaus, 2021).

Literature suggests that urban agriculture programs offer a unique opportunity to integrate agricultural literacy into the school curriculum. School gardens and other youth agricultural programs provide experiential learning environments where students engage directly with horticultural and agricultural sciences (Croom et al, 2008; Duncan et al, 2016; Hand et al, 2023). In doing so, urban AgEd helps bridge the gap between urban populations and agricultural knowledge, particularly for students who may have limited exposure to agricultural systems in their daily lives.

Responses to Barriers in Urban Agriculture Education

Despite their potential, research illustrates a range of structural barriers that shape the implementation and sustainability of urban agricultural programs. Richardson et al. (2024) contextualize these needs in their profile of Urban Agriculture growers within the northeastern United States, identifying several recurring challenges within Urban Agriculture systems. In this study, 394 subjects were screened for participation regarding issues related to their Urban Agricultural endeavors, with 123 respondents completing the survey (Richardson et al, 2024). Richardson et al (2024) reveal that land tenure, funding constraints, and regulatory barriers are common challenges affecting community-based urban agriculture. These findings are supported by other works, which indicate similar constraints across urban ag programs (Hodgson et al, 2011; Lawrence, 2025). Given their place geographically, it can be extrapolated that urban AgEd programs face similar issues, concerning funding and regulatory barriers.

Land access remains a primary constraint within densely developed urban environments; those programs that do have access may encounter challenges relating to soil contamination or zoning regulations that limit agricultural activity (Richardson et al, 2024). In some cases, nearby green spaces may exist, but remain inaccessible due to liability concerns of municipal or educational policy limitations (Hodgson et al, 2011; Duncan et al, 2016; Wolf & Waitt, 2023; Richardson et al, 2024; Lawrence, 2025). Funding and institutional support also present challenges for urban AgEd. In many school systems, agricultural science may not be perceived as a core academic priority, limiting the ability of educators to secure the resources necessary to fund their classrooms. These constraints are particularly evident in underserved school districts, which must already balance competing educational needs (Jones et al, 1998; Duncan et al, 2016; Hand et al, 2023).

Recently, land-grant universities throughout the United States have begun to prioritize funding for Urban Agriculture initiatives, including providing labor and grant dollars to Urban Agriculture programs in exchange for conducting research (Richardson et al, 2024; Lawrence, 2025). One example is highlighted by the National Urban Extension Leaders program, established in 2013 to increase the capacity of cooperative extension in urban areas. In 2019, this program developed an implementation plan which sets direct goals for increasing extension presence in metropolitan areas, developing programs which suit the needs of urban residents, and empower urban advocates within USDA and other federal organizations, as well as those outside the scope of the government to promote responsive and locally relevant extension activities in urban areas (Ohio State University, 2021). Other examples of this shift toward an expanded urban focus among Land Grant Universities are highlighted by the USDA National Institute of Food and Agriculture, including programs such as Alabama A&M University's Urban Green initiative, which provides training in small-scale landscape management and backyard food production (Lawrence, 2025). Similarly, Florida A&M cooperative extension partnerships in West Palm Beach have transformed community spaces into educational gardens emphasizing water usage and composting (Lawrence, 2025). Together, this pattern reflects a structural shift within land-grant institutions to create programs that fund AgEd, research, and outreach efforts within urban centers. Taken together, the developments illustrated by the literature show the evolving role of urban agriculture within both community food systems and educational practice. While structural barriers remain significant, expanding institutional support and growing interest in experiential environmental education suggest that school-based agricultural programs will continue to play an important role in shaping urban AgEd in the years ahead. (Richardson et al, 2024; Lawrence, 2025).

Implications of Urban Agriculture Production Models for Education

This shift underscores the need for urban AgEd programs that equip students with both practical and conceptual knowledge of food systems; urban AgEd must move beyond simple food awareness and emphasize skill-building and career-readiness so that students may engage with food systems and their communities in meaningful ways (Duncan et al, 2016; Hand et al, 2023).

The scale of food production can vary greatly, from multi-thousand-acre monoculture farms to backyard plots and community gardens. Opitz et al. (2016) identified four factors impacting food production in urban agriculture systems: food quality, quantity, variety, and pest and contamination risks. From an educational standpoint, these factors can serve as scaffolding from which a culturally responsive curriculum can be drafted (Croom, 2008; Duncan et al, 2016; Hand et al, 2023). Through food production labs, students are introduced to concepts such as plot size, resource availability, and variety, which will impact the quantity of the crops being grown. Yields and conversion rates apply to mathematics and encourage students to integrate mathematical reasoning when determining planting arrangements, density, and seasonality. Food quality and pest management issues encourage students to investigate causes of disease within horticulture, including soil health, environmental pollutants, and production methods, which will help foster scientific inquiry and critical evaluation within scholars' minds (Croom, 2008; Dewey, 2009; Opitz et al, 2016; Hand et al, 2023). In addition to these, crop diversity highlights the relationship between food production and community needs. By exploring the cultural relevance, market demands, and consumer preferences of a region, students may be able to determine which crops are most marketable within their community. These four factors, in combination with one another, help shape experiential learning plans by emphasizing direct community connection and incorporating cross-curricular learning into classroom simulation. By engaging in these production practices, students not only learn the process by which food is grown, but also develop the skills needed to contribute to a more resilient community food system (Croom, 2008; Opitz et al, 2016; Hand et al, 2023).

Perceptions of Agriculture in Urban Communities

Current research promoting UA highlights the importance of understanding how urban students perceive agriculture, as perceptions can greatly influence student engagement, learning outcomes, and career interests (Jones et al, 1998; Duncan et al, 2016; Hand et al, 2023). Perceptions of agriculture among urban students have been examined through multiple methodological and disciplinary lenses, revealing complex relationships between identity, exposure, and career aspirations.

Research consistently suggests that urban populations often hold two polarized perceptions of agriculture. The first identifies agriculture as necessary for food production and the continued development of society, whereas the second lens views agriculture as something entirely negative– either seeing the industry as low status, environmentally harmful, or outdated and rooted in forced labor practices (Duncan et al, 2016; Zahry & Besley, 2017; Blackstone et al, 2023). These conflicting viewpoints are especially relevant in urban settings, where students have limited direct exposure to agricultural systems. For many students, particularly those from marginalized communities, negative perceptions of agriculture are rooted in generational trauma that associates agriculture with legacies of enslavement and Indigenous dispossession, and exploitive labor systems which continue to shape contemporary attitudes (Jones et al, 1998; Duncan et al 2016; Blackstone et al, 2023). TO remain effective and relevant, research indicates that AgEd should be implemented in ways that critically engage with the historical and social contexts of U.S agriculture rather than focusing solely on industry needs. By incorporating these perspectives, educators can position agriculture as a field connected to larger sociopolitical and economic systems, thus enhancing its relevance for urban and BIPOC learners (Jones et al, 1998, Duncan et al, 2016; Martin et al, 2023; Barber, 2024).

Research indicates that students are more likely to participate and remain in agricultural pathways when their identities are reflected in the curriculum and broader industry (Duncan et al, 2016; Barber, 2024). Structural inequities in AgEd may be shaped in part by larger demographic patterns in the agriculture industry. Approximately 95% of farm and ranch owners identify as white, despite a large BIPOC presence in the agriculture workforce (USDA, 2024; Castillo et al, 2025). 2020-2022 USDA labor statistics reveal that 70% of farm laborers, graders, or sorters identify as BIPOC, while BIPOC individuals only make up 37% of those in management positions in agriculture (Castillo et al, 2025). Historic exploitation, contemporary exposure to hard labor conditions, and a lack of ownership despite making up most of the industry's labor force may further limit BIPOC students' perceptions of agriculture (Jones et al, 1998; Duncan et al, 2016; Hand et al, 2023; Martin et al, 2023).

Urban and BIPOC students may face additional challenges in accessing mentorship and professional networks. Despite attempts at creating a more diverse agricultural association, FFA's focus inherently excludes urban and nonwhite students as they are both culturally and geographically isolated from much of the farming community; as a result, FFA's framework does not translate equitably across diverse urban contexts (Rose et al, 2016; Martin et al, 2023). Findings from Barber (2024) suggest that feelings of diminished autonomy and competence among BIPOC students align closely with self-determination theory, suggesting that culturally responsive program design includes ways to ensure that students experience belonging and representation. Understanding this relationship and developing nuance in agricultural settings that combat feelings of otherness within minorities will help foster inclusive learning environments that affirm student identity in agriculture.

As populations shift to urban and metropolitan areas, diversity and inclusivity will be integral to maintaining employment across all levels of the agricultural industry. Understanding that 89% of the US population is projected to live in urban areas by 2050, we must work to recruit individuals from varying backgrounds to account for the variation in experiences and social/cultural needs of urban and

BIPOC groups (Center for Sustainable Systems, 2025; Wolf & Waitt, 2023). Including varying perspectives within the development of these recruitment plans, we are more likely to identify obstacles to achievement and create targets that better serve the community. (Barber, 2024; Wolf & Waitt, 2023).

Student perceptions are of particular importance, as they help to determine which areas of agriculture must be addressed, as well as how to go about reshaping the general understanding of the subject within the context of an urban setting (Duncan et al, 2016; Hand et al, 2023; Jones, 1998; Kudryavstev et al, 2012). In areas where there is little traditional agricultural activity– row cropping, animal agriculture, or forestry– marketing agriculture as a STEM adjacent field may promote interest and illustrate the laboratory, biotechnical, environmental, and design and engineering work that must be done for the agricultural industry to thrive in the 21st Century (Zahry & Besley, 2017). Additionally, misunderstandings that cause students to label ANR as a non-scientific area of study suggest that further marketing of ANR as a STEM field may be needed to attract and retain students (Zahry & Besley, 2017). Positioning ANR programs within STEM frameworks may therefore improve both legitimacy and recruitment among urban students.

In urban areas, where BIPOC populations are more densely represented, many schools lack access to agricultural programs, either because of proximity to resources or funding for the curriculum. To address this issue, some institutions are partnering with Title I schools in urban areas to create agricultural initiatives in hopes of increasing urban and BIPOC recruitment, Jean-Philippe et al (2017) found that working closely with 10th grade students in an urban school system, providing information on college admissions, professional learning opportunities, and networking with university students and faculty, could encourage students to apply to the University of Tennessee. The researchers determined that exposure to topics that increased their understanding of agriculture within the framework of the STEM field could increase the likelihood that students would view agriculture more positively as a career choice. Following interactions with the curriculum, students reported that they viewed ANR as a more scientific field and believed their families would be more supportive of their endeavors should they elect to pursue an ANR career (Jean-Philippe, 2017).

Similarly, a study on the impact of AgEd on urban students in the Chicago metropolitan area revealed that exposure to local AgEd, as well as mentorships are effective at recruiting and maintaining students' engagement within AgEd. Building on the theory of self-determination as a framework, the study indicated that students value programs more whenever they align with their personal interests and emphasize the variety of careers in agriculture. In exposing them to content relevant to their lives and desires, educators enable students to relate more intrinsically with the curriculum (Hand et al, 2023; Ryan & Deci, 2000).

Modern agricultural programs rely heavily on John Dewey's progressive theory of education, which suggests that hands-on, real-world examples of a topic are one of the most pragmatic and effective means of educating a populace. While curriculum design provides the conceptual foundation for this work, its effectiveness ultimately relies on how these principles are applied in practice by the educator (Dewey,2009). One of the most prominent methods by which Dewey's model has been implemented is through co-curricular AgEd organizations. These programs extend learning outside of the classroom and allow students to more readily develop leadership and career skills that align with the culturally responsive goals of a modern agricultural education program. For example, the National FFA Organization, through its state and local chapters, has the potential to support these goals and further the success of students in Urban Agriculture education.

FFA As a Case Study

Founded in 1928, the FFA is a student-led agricultural organization serving over 650,000 members across all 50 states, Puerto Rico, and the U.S. Virgin Islands. Through career development and leadership competitions, supervised agricultural experiences, and leadership programming, FFA generates experiential learning at multiple levels—local, state, and national (Sheehan & Moore, 2019). As such, FFA provides a useful institutional case study for examining both the strengths and structural limitations of AgEd in urban contexts.

In many states, FFA has expanded membership through an affiliation model that automatically enrolls students taking agricultural classes into the organization (Sheehan & Moore, 2019). While the paid membership model is still used by approximately 70% of FFA Chapters, over 51% of all new FFA members are recruited through the affiliation model, indicating large growth for the organization through this route (Sheehan & Moore, 2019). Affiliation models lower barriers to entry and expand opportunities for student participation. This shift is particularly important in urban settings, where financial constraints and limited exposure to agriculture might prevent student involvement. By embedding membership within the classroom, FFA incentivizes members to engage with agriculture in a meaningful way (Sheehan & Moore, 2019).

Research suggests that curriculum provided by organizations such as FFA may positively influence student perceptions in conjunction with local, culturally relevant curriculum design–including mentorship opportunities–together these things help students develop a deeper understanding of agriculture (Hand et al, 2023; Kudryavstev et al, 2012). Despite their differences in methodology, Hand et al (2023) and Kudryavstev et al (2012) both examine the impact of targeted educational interventions on urban youth. In the pilot study, Hand et al. (2023) focus on the impact of AgEd on urban students of color within a Chicago, IL public school, highlighting the impacts of internal values and external barriers, such as a lack of mentorship impacts student retention. Kudryavstev et al (2012) rely on quantitative data to analyze the impacts that environmental education programs may have on students' sense of place in the Bronx. In their work, both studies indicate only partial effectiveness, as students in each study were found to increase their knowledge and appreciation of subject matter; even so, participants did not indicate a larger intention to remain invested in AgEd or Environmental Science over the long term. These findings suggest that programs may be effective at shaping student perceptions, but current implementation is not significantly effective at fostering long-term student engagement (Hand et al, 2023; Kudryavtsev, 2012).

Disparities in student engagement and attachment are compounded by structural expectations of FFA's degree advancement system, which functions as a structured merit-based progression and requires documented hours, financial earnings, and leadership engagement. While intended to reward commitment and skill development, this structure relies on access to resources such as land and capital that are unevenly distributed between urban and rural students (Martin et al, 2023). Despite these limitations, student-based organizations such as FFA may still serve as a helpful supplement to classroom instruction. The Three-Component model of AgEd integrates classroom and lab instruction in combination with supervised agricultural experiences and FFA participation to generate an educational framework that positions the organization as an integral site for leadership and career development through education (Croom, 2008).

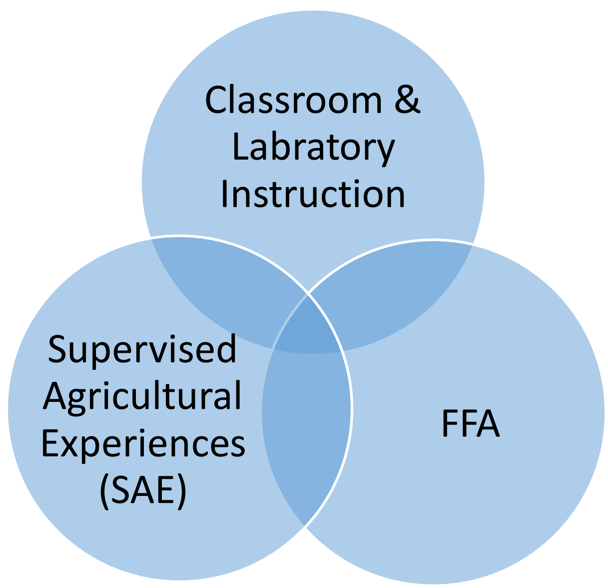

Figure 2. Diagram of the Three-Component Model of Agricultural Education

Classroom instruction provides foundational knowledge; supervised agricultural experiences facilitate applied, experiential learning; and FFA offers peer-led leadership development and professional simulation. Ideally, the interaction of these components produces a comprehensive AgEd experience (Figure 2).

Despite the documented psychological and academic benefits of agricultural programs, it is critical to recognize that student participation and perceptions are not uniform across demographics or geography. Research by Jones et al (1998) explored factors that influence African American student enrollment in secondary agricultural courses, revealing that BIPOC students hold significantly more negative attitudes towards agriculture compared to their non-BIPOC peers. The study also reveals that BIPOC students' decision to enroll in AgEd courses is heavily influenced by their perceived value and the positive attitude of adult mentors (Jones et al, 1998). Similar studies reinforce this concept, emphasizing the need to proactively address demographic barriers to foster an inclusive environment for BIPOC students in AgEd (Jones et al, 1998; Hand et al, 2023; Martin et al, 2023).

The cultural framing of FFA presents a challenge for Urban Agriculture, as symbols, traditions, and narratives within the organization draw from agrarian ideals that may fail to resonate with individuals lacking an agricultural background (Jones et al, 1998; Martin et al, 2023). Even seemingly neutral elements, such as references to historical figures and symbolism within the FFA emblem, may reflect a view of agriculture that is undesirable or even exclusionary to urban learners (Jones et al, 1998; Martin et al, 2023). When presented without context, even references to George Washington may alienate marginalized learners (Martin et al,2023; National FFA, 2025). While the first president's portrayal emphasizes fiscal responsibility, critical historical scholarship complicates this narrative by recognizing Washington as a slaveholder whose financial independence was sustained through the forced labor of others (Martin et al, 2023). In combination with statistics demonstrating disparities between agricultural labor and ownership, elements such as Washington's presence in the FFA's opening ceremonies–when presented without context– may inadvertently reinforce perceptions of agriculture as culturally unsound (Martin et al, 2023; Castillo et al, 2025).

When educators successfully generate culturally responsive programs that adapt FFA programming, the organization can serve as a powerful tool for reshaping student perceptions (Jones et al, 1998; Rose et al, 2016). FFA's impact is ultimately dependent on how its structures are implemented and contextualized within individual learning environments. FFA represents both the strengths and weaknesses of institutionalized AgEd, as it possesses a well-established framework for experiential learning, yet lacks focus on equity needed to guarantee its success within urban areas (Rose et al, 2016; Martin et al, 2023).

Student Engagement in Urban Agriculture Programs

Structured AgEd programs can offer psychological and social benefits that help bridge the gap between students and formal education. Research exploring the National FFA Organization indicates that active membership in student organizations helps to fulfill students' basic psychological needs according to Maslow's hierarchy (Rose et al, 2016). Similar to the outcomes provided by organizations like FFA, other AgEd initiatives offer complementary benefits that further enrich student experiences. Duncan et al (2016) find that experiential learning–particularly culinary experiences tied to agricultural produce positive outcomes for student engagement, with 84% of participants reporting that food-labs increase their enjoyment of the lesson. Combined with other components in the literature, these studies paint a comprehensive picture of AgEd's value: given the chance to participate in experiential learning, leadership, and career development programming, students report significant fulfillment in areas of belonging, self-esteem, and self-actualization (Duncan et al, 2016; Rose et al, 2016). Combined literature suggests that integrating AgEd into science education, through student organizations and hands-on curriculum, can significantly enhance the holistic development of the student.

The development of urban and peri-urban agricultural programs within the United States is not a new concept; more recent studies provide greater insight into how these systems function in contemporary educational contexts. School-based student associations may help to bridge the gap between students and their communities by providing access to resources, professional networks, and applied learning experiences that students may otherwise miss out on (Hand et al, 2023; Martin et al, 2023). Culturally responsive pedagogy is crucial to fostering student engagement in these settings. Instructional materials must consider intentional representation of diverse agricultural professionals, ensuring students encounter narratives that reflect their own identities (Jones et al, 1998; Duncan et al, 2016; Hand et al., 2023).

The body of work emphasizes that contemporary urban agriculture programs should emphasize student autonomy and relevance as key drivers of engagement. Intrinsic motivation is crucial to the implementation of the three-component model of AgEd (Croom, 2008 & Hand et al., 2023). The supervised agricultural experience is a self-guided method of education in which a student is mentored by a professional in their field while undertaking entrepreneurial or apprenticeship-driven goals (Croom, 2008; Hand et al, 2023; National FFA Organization, 2025). Supervised agricultural experiences are structured to provide opportunities for students to manage their own time, resources, and effort, aligning with Self-Determination Theory, which identifies autonomy, competence, and relatedness as key drivers of intrinsic motivation (Ryan & Deci, 2000). When students exercise meaningful choice in their learning, they are more likely to internalize agricultural identity and sustain engagement.

Research illustrates that student engagement in urban agriculture should extend beyond the classroom to include broader community connections. Agricultural programs frequently function as sites of civic engagement and career readiness, which may be of particular benefit to students in urban settings (Rose et al, 2016; Russ & Gaus, 2021; Hand et al, 2023). By situating learning within local food systems, students are encouraged to critically examine issues of food equity, environmental justice, and public health (Russ & Gaus, 2021). Participation in programs like FFA fosters development by providing structured opportunities for young people to cultivate their civic knowledge and communication skills (Rose et al, 2016; Hand et al, 2023). Urban Agriculture can also be observed through a lens of social and environmental activism.

Ultimately, studies indicate that student engagement in urban AgEd is driven by alignment to student identity and community relevance. Instructional approaches that reflect student identities and community needs are more likely to foster sustained participation and positive learning outcomes (Russ & Gaus, 2021). In this context, curriculum design acts as one mechanism for developing academic and civic engagement among youth (Russ & Gaus, 2021; Hand et al, 2023). Programs that prioritize self-advocacy, communication, and leadership encourage students to participate more fully in civic life (Russ & Gaus, 2021). By embedding these elements, urban AgEd can extend beyond skill development and work to support active, community-driven citizenship. At the same time, this emphasis on identity, agency, and community has important implications for students' overall well-being (Russ & Gaus, 2021; Hand et al, 2023). The following section examines how participation in AgEd influences student well-being in the urban environment.

Impact on Student Wellbeing

Beyond academic and civic outcomes, emerging research suggests that engagement in horticulture and green-space programming yields measurable psychological benefits for children and adolescents. While evidence linked directly to school-based urban agriculture remains limited, related research on therapeutic horticulture indicates that interactions with horticultural activities are associated with reductions in anxiety and depressive symptoms, improvements in attention, and increased stress recovery (Hodgson et al, 2011; Hall & Knuth, 2019; Hitter et al, 2019; Lee et al, 2018; Oh et al, 2020). Access to urban green spaces, such as gardens, can lead to better performance in the academic setting (Hall and Knuth, 2019). Under the AgEd umbrella, findings indicate that ag-related learning environments may indirectly support student achievement by improving the cognitive and emotional conditions required for students to learn (Hodgson et al, 2011; Hall & Knuth, 2019; Hitter et al., 2019; Lee et al, 2018; Oh, et al, 2020). Working outdoors, or pursuing of other agricultural endeavors, may help to regulate stress levels in students, as suggested by Hall and Knuth (2019).

Studies generated in this field often utilize a mixed methods approach to data collection, relying on qualitative interviews, quantitative surveillance, and direct measurement of hormones associated with stress production in the body. Using this approach, researchers can generate measurable impacts of therapeutic horticulture on depression and anxiety. Both Hitter et al, and Lee et al use this approach to identify the impact of therapeutic horticulture on depression and anxiety, respectively. Despite small sample sizes (n= 20 & n=20), both reports found measurable decreases in biomarkers for stress and depression, as measured by blood or saliva samples, post exposure to therapeutic horticultural activities (Hitter et al, 2019; Lee et al, 2018). Even with these promising implications, a lack of longitudinal, program-specific studies limits the application of this data to contemporary Urban AgEd practice.

Cultural differences shape how urban populations engage with green spaces. Research suggests that collectivist cultural groups may prefer socially oriented, activity-based environments (e.g., picnic areas, sports facilities), whereas individualistic users may gravitate toward solitary recreation (Wolf & Waitt, 2023). Designing urban agriculture spaces that accommodate diverse patterns of use may therefore enhance accessibility and meaningful participation from urban youth.

To understand the full scope of this impact, we must examine both the macro-level planning required to create these spaces and the micro-level outcomes they produce for people interacting in them. Hodgson et al (2011) provide a framework for integrating urban agriculture into local zoning and land-use planning. The report highlights the effectiveness of reclaiming vacant land for agriculture at growing local economies and increasing neighborhood resilience. Intentionally crafted green spaces provide communities with a site for outdoor and agricultural education (Hogson et al, 2011; Duncan et al, 2016; Hall & Knuth, 2019). Beyond their educational scope, the need for green spaces is supported by literature, which validates the use of therapeutic horticultural activities, particularly for youth and urban residents.

Related work in therapeutic horticulture reinforces the potential connection between environmental engagement and student well-being. Therapeutic horticulture involves structured participation in activities that engage the user with the natural environment, promoting psychological health benefits (Hitter et al, 2019; Lee et al, 2018; Oh et al, 2020). Although this research is typically situated apart from educational programs, activities such as garden maintenance can serve as an effective means of stress relief while simultaneously enforcing course content and skill development. For example, Oh et al (2020) demonstrated that participation in a multi-session horticultural therapy program significantly improved emotional intelligence, resilience, and self-efficacy of primary school students. This research is validated by similar findings across age groups measured by biomarkers of stress and psychological questionnaires (Lee et al, 2018; Hitter et al, 2019).

Although urban agriculture is not a comprehensive solution to all challenges related to student well-being, existing evidence suggests that it may play a supportive role in improving student learning environments (Hitter et al., 2019; Lee et al, 2018; Oh et al, 2020). Further studies that investigate the impact of therapeutic horticulture and urban agriculture on student well-being represent one potential area for future research.

Discussion

The body of literature suggests that urban AgEd is a globally recognized strategy for promoting youth engagement, improving perceptions of agriculture, and fostering civic and community connections. Even so, variability in methodology, context, and program design complicates efforts to generalize findings (Jones et al, 1998; Kudryavstev et al, 2012; Duncan et al, 2016; Jean-Philippe et al, 2017; Zahry et al, 2017 Russ & Gaus, 2021; Hand et al, 2023; Lauzon, 2023). Despite these constraints, four major findings emerge from the literature.

First, experiential learning in urban agriculture consistently improves student perceptions of ANR careers. Across studies, researchers position AgEd as a tool that intersects workforce preparation, food security, environmental literacy, identity development, and social belonging (Jones et al, 1998; Kudryavstev et al, 2012; Duncan et al, 2016; Jean-Philippe et al, 2017; Zahry et al, 2017 Russ & Gaus, 2021; Hand et al, 2023; Lauzon, 2023). These outcomes can be explained through social cognitive theory, which emphasizes the role of self-efficacy and social context in shaping student interests (Lent et al, 1994).

Second, student engagement in urban AgEd is strongest when programs are culturally responsive and place-based. Studies indicate that engagement increases when agriculture is framed as relevant to student identities and life experiences (Jones et al, 1998; Kudryavstev et al., 2012; Rose et al., 2016; Zahry & Besley, 2017; Hand et al., 2023; Barber, 2024). Intentional representation within curriculum, instruction, and access to mentorships serve as important mediating factors that strengthen student connections to the agriculture industry (Duncan et al, 2016; Jean-Philippe et al).

Third, student outcomes in relation to urban AgEd are promising despite a lack of depth within studies, which prevents broader generalizability. Research on therapeutic horticulture and green-space exposure suggests that there may be psychological benefits to engaging with horticultural practices, including potential for reduced stress, increased attention span, and improved academic performance (Hodgson et al, 2011; Hall & Knuth, 2019; Hitter et al, 2019; Lee et al, 2018; Oh et al, 2020). Further, several studies indicate that AgEd may impact civic awareness, place attachment, and understanding of agricultural systems. Through comprehensive leadership and communication training, and STEM education, agricultural and environmental science programs prepare students for future civic engagement through engagement in relevant social justice procedures within their own communities, such as canned food drives, school garden programs, and environmental awareness measures (Kudryavstev et al., 2012; Duncan et al., 2016; Russ & Gaus, 2021; Lauzon, 2023).

This leads to the fourth finding that methodology largely limits the generalizability of findings from within the literature. Most studies surveyed relied on short-term interventions, small sample sizes, pre-post perception surveys, or a combination of the above. Outcome measures varied widely among studies, making cross-comparison difficult and limiting the ability to determine causal relationships. While the existing body of research suggests positive trends between student engagement and culturally responsive AgEd, a lack of long-term studies on the subject leaves the field underdeveloped.

Taken collectively, the body of literature suggests that urban AgEd functions as more than an elective or enrichment activity. AgEd has the potential to be used as a tool for sustained engagement among urban students, particularly when students are exposed to experiential learning and meaningful interactions with agricultural professionals (Jones et al, 1998; Kudryavstev 2012; Rose et al, 2016; Zahry 2017; Hand et al, 2023; Barber, 2024). The effectiveness of these programs is dependent on curriculum design, context, and the ability of the educator to reflect the identities of the populations being served. Urban schools face unique constraints, such as limited land access, variable funding, and skepticism about the relevance of urban agriculture (Kudryavstev, 2012; Richardson et al, 2024;

Lawrence, 2025). As such, programs that align themselves to community needs may demonstrate stronger engagement outcomes than those that do not (Jones et al, 1998; Jean-Phillippe et al, 2017; Kudryavstev et al, 2012; Hand et al, 2023).

Conclusion

This literature review examines the historical precedent, current practice, and impact of AgEd on urban and suburban school programs. Agricultural education in the United States is rooted in both native practices and progressive educational reforms, which helped shape modern curricula. This study situates AgEd within the lens of experiential and systems-based learning practices. In doing this, it highlights both the persistence of hands-on learning and the need to adapt this pedagogical approach to best fit the needs of diverse urban populations.

The findings suggest several consistent patterns within urban AgEd. Namely, experiential learning is a guiding principle for mitigating student perceptions and increasing interest in ANR pathways. This concept is reinforced by the second finding that student response is best strengthened when programs act with cultural awareness and ground themselves in local interests. Doing so allows students to connect Urban Agriculture to their own identities and communities, increasing self-efficacy and place attachment. Further findings suggest that participation in AgEd supports civic engagement and student well-being, although the latter findings are emerging and require further exploration. Apart from these findings, limitations in methodology, including a lack of long-term studies, may complicate efforts to assess the prolonged benefits of these programs.

These findings must be considered within the historical context of AgEd in the United States. Indigenous practices like intercropping, as represented by John White's 1585 painting of Secotan, illustrate that agricultural knowledge systems predate formal education and reflect a sophisticated understanding of environmental processes. The establishment of land grant universities in the 19th Century and the passage of the *Smith-Hughes Act* of 1917 formalized agricultural education in academia. Even so, contemporary urban AgEd programs must consider the historical and exclusionary practices that limited access for marginalized populations, and address issues related to equity, representation, and cultural relevance.

The modern urban agriculture movement demonstrates the adaptability of AgEd into new contexts. As urbanization accelerates, urban AgEd must respond to address issues such as food security, environmental issues, and student wellbeing. Current urban agriculture endeavors not only produce food; they also provide spaces for civil engagement, mental health support, and relationship building. By including principles from social cognitive theory and the theory of self-determination, urban AgEd can empower students to develop the skills and confidence necessary to contribute to their communities and beyond.

The implications of this work are relevant both for practice and research. For educators and program coordinators, current literature underscores the need for experiential learning and cultural relevance to generate sustainable urban agriculture programs. There still exist a need for rigorous, long-term, and comprehensive population studies to examine the sustained impacts of participation in AgEd on urban student outcomes. AgEd continues its long-standing role as a connector, linking students to the natural environment, their communities, and the systems that maintain humanity's livelihood. Programs that recognize the field's nuanced history while adapting to modern realities are best positioned to prepare learners to engage with the agricultural challenges of the 21st century.

Chapter 2. The Curriculum Development Process

Introduction to the Curriculum Framework

The development of meaningful and rigorous educational programming requires more than the assembly of engaging lessons; it necessitates a theoretically grounded design process that aligns instructional practices with clearly defined learning outcomes (Jensen et al, 2017). As established in Chapter 1, AgEd holds the potential to function as both a catalyst for academic rigor and a conduit for systems literacy, particularly among urban student populations who are often disconnected from agricultural systems despite their daily reliance on them. However, a gap exists between this theoretical potential and the availability of practical, adaptable curriculum resources suitable for implementation in urban schools (Kudravstev et al, 2012; Duncan et al, 2016; Hand et al, 2023).

In response to this gap, a four-week, modular “curriculum in a box” was designed for use in middle school classrooms. The curriculum emphasizes accessibility, requiring few materials and avoiding activities that may be infeasible in urban settings, such as live animal demonstrations or large-scale agricultural production systems. Instead, all lessons are designed to be implemented within a traditional classroom environment using readily available resources. To ensure coherence and intentionality in its design, the curriculum was structured using the Backward Design framework (Figure 3). This model, recognized in curriculum development literature, shifts instructional planning away from a linear progression of activities and toward a goal-oriented approach (Jensen et al, 2017). Rather than beginning lessons in mind, Backwards Design asserts that curriculum should be developed with the end-goal at the forefront (Jensen et al, 2017). The process is organized into three stages: (1) identifying desired results, (2) determining acceptable evidence of learning, and (3) planning instructional experiences and learning activities (Jensen et al, 2017).

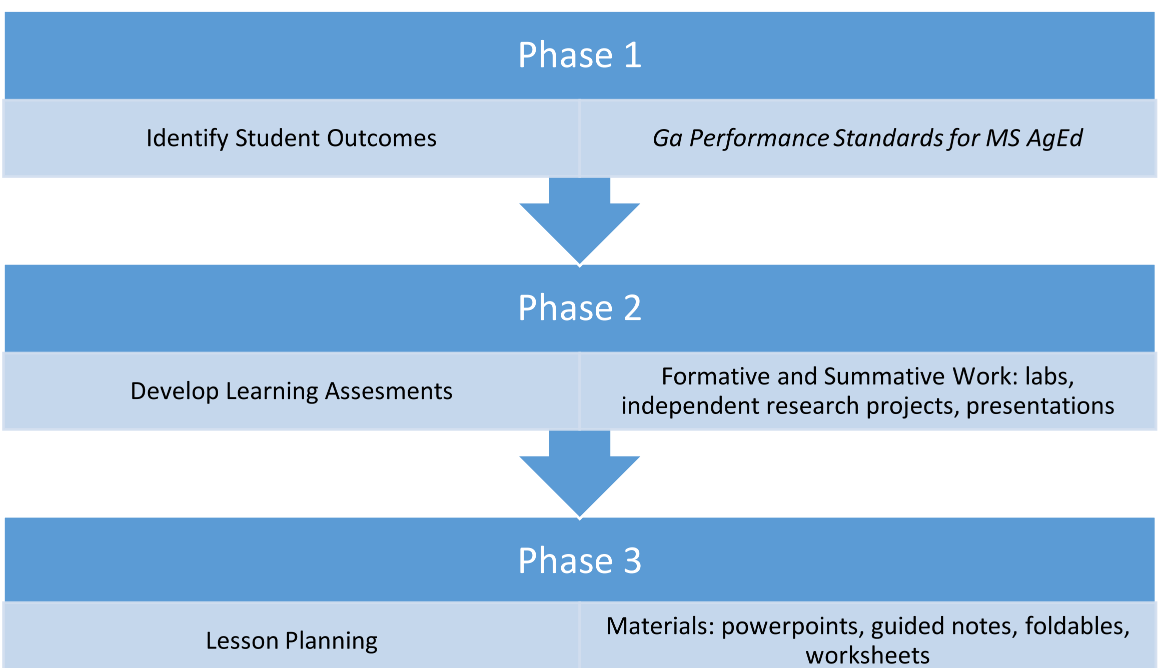

Figure 3. Backwards Curriculum Model & Application to Curriculum

This chapter documents the development of the curriculum through these three stages while also highlighting the iterative nature of the design process, using the WHERE framework for lesson planning, which asks educators to establish clear objectives and goals for each phase of the instructional plan (Cho & Trent, 2005; Wiggins & McTighe, 1998) (Table 2).

Table 2 WHERE Instructional Model (Cho & Trent, 2005; Wiggins & McTighe, 1998)

WHERE Model				
W- Where are we headed [goals and objectives for the lesson]	H- Hook the student through active questioning and entry points	E- Explore the topic and enable students to investigate further	R- reflect on the lesson [what went well, or could be improved on]	E- Exhibit artifacts and evaluate student mastery

Teaching with the "end goal" in mind allows for educators to establish clear pacing and objectives for student success based on major curricular or instructional concerns (Jensen et al, 2017). These objectives can then be adjusted as needed to account for the social and cultural needs of the target audience. The curriculum did not emerge as a static product but evolved through cycles of implementation, reflection, and revision, in congruence with the WHERE and Backwards development process. Throughout this process, theoretical principles—including experiential learning, systems thinking, and cross-curricular integration—were continually reconciled with the practical realities of teaching in an urban classroom, such as varying literacy levels, limited resources, and challenges in student engagement.

Stage 1: Identifying Desired Results and Standards-Based Outcomes

The first stage of the Backward Design process required the identification of clear and measurable learning outcomes (Jensen et al, 2017). These outcomes were informed by both the theoretical framework established in Chapter 1 and the Georgia Agriculture Education Performance Standards for middle school programs. Collectively, these sources guided the development of objectives that emphasized agricultural literacy, systems thinking, and interdisciplinary skill development.

At the core of the curriculum is the objective of helping students recognize agriculture as an integrated system that influences their daily lives, rather than as an isolated or exclusively rural industry. This objective aligns with Georgia standards for Middle School Agriculture, Grades 6-8, with each unit expressively designed to meet the standards-based desired outcomes for the student (Table 3). By grounding the curriculum in state-based academic standards, the developer ensured that the content maintained academic legitimacy while remaining relevant to students' lived experiences. In this way, other educators can cross-reference their own state's academic standards to ensure fidelity when integrating these lessons into their own classrooms.

Table 3. Georgia Performance Standards Alignment By Grade Level

Unit	Focus Area	Grade 6 Standard	Grade 7 Standard	Grade 8 Standard
Unit 1: Agricultural Literacy & Career Exploration	Commodities, daily life connections, careers, systems awareness	AFNR-MSAGED6-2.1: Describe and explain the impact of agriculture on daily life; AFNR-MSAGED6-7 Investigate aspects of agriculture careers	AFNR-MSAGED7-3.2 Expand leadership goals, personal growth, and career success through Agriculture Education	AFNR-MSAGED8-2.4 Apply Career Development Event and Leadership Development Event concepts relating to employability to career readiness
Unit 2: Plant Science & Horticulture Foundations	Plant anatomy, physiology, horticulture, biological literacy	AFNR-MSAGED6-5.2: Examine the horticulture industry and the role it plays within the agriculture industry; AFNR-MSAGED6-5.3 Identify the four areas of the horticulture industry…	AFNR-MSAGED7-4.1 Explain the relationship between vegetative components of a plant through analysis of their functions	AFNR-MSAGED8-4 Describe, illustrate, and apply information pertaining to current events, trends, research, and careers in Plant Science
Unit 2 (Cont.): Food Systems & Sustainability	Food deserts, distribution, environmental impact, systems thinking	AFNR-MSAGED6-2.3 Identify the sources of different types of food and fiber	AFNR-MSAGED7-2.3 Explain the global economic impact of agriculture in meeting human needs for food, fiber, and natural resources.	AFNR-MSAGED8-3.1 Describe and discuss how agriculture provides basic human needs.
Unit 3: Animal Science & Applied Agricultural Math	Animal systems, nutrition, ratios, real-world application	AFNR-MSAGED6-6.2: Analyze the role, importance, and scope of livestock and companion animals; AFNR-MSAGED 6-6.3 Identify products and byproducts from livestock animals.	AFNR-MSAGED7-5.3 Analyze the role, importances, and scope of the dairy, beef, pork, equine, and small ruminant animal industries.	AFNR-MSAGED8-6 Describe, illustrate, amd apply information pertaining to current events, trends, research, and careers in Animal Science; AFNR-MSAGED 8-6.3 Create a feed ration for livestock or companion animals.

A second major outcome centers on the development of systems thinking. Students are expected to move beyond identifying individual components of agriculture—such as plants, animals, or products—

and instead understand how these components interact within broader systems of production, distribution, and consumption (Georgia Department of Education, 2022). This objective reflects both the literature on systems-based education and standards related to analyzing agricultural processes and their societal implications.

A third outcome involves the integration of cross-curricular skills, particularly in literacy and mathematics. The curriculum incorporates research-based assignments, written reflections, and data interpretation activities to support literacy development, while also embedding mathematical reasoning through activities such as ratio calculations in animal nutrition. These elements align with broader CTAE goals and reinforce the standard AFNR-MSAGED 8-4 and AFNR-MSAGED8-6, which address the analysis of technological and scientific applications in agriculture (Georgia Department of Education, 2022).

In addition to cognitive outcomes, the curriculum also targets affective development, particularly student self-efficacy and engagement. Drawing on Social Cognitive Theory and Self-Determination Theory, the curriculum is designed to foster intrinsic motivation by allowing students to explore personal interests, make choices in their learning, and engage in hands-on, meaningful tasks (Lent et al, 1994; Barber, 2024). For example, the decision to begin the curriculum with an agricultural careers unit reflects an intentional effort to connect content to students' identities and future aspirations.

This phase also required careful consideration of sequencing. While traditional curriculum design is linear, begin with foundational concepts, this curriculum intentionally begins by establishing goals for the student and hooking their attention to secure engagement, in accordance with Backwards Design and the WHERE model (Cho & Trent, 2005; Jensen et al, 2017; Wiggins & McTighe, 1998). By introducing students to agricultural careers and everyday connections to agriculture before moving into more technical content, the curriculum builds a conceptual bridge between students' existing knowledge and new learning. This approach reflects the understanding that engagement is a prerequisite for deeper cognitive development, particularly among middle school learners (Lent et al, 1994; Rose et al, 2016; Russ & Gaus, 2021; Zahry & Beasley, 2017).

Stage 2: Determining Acceptable Evidence of Learning

Rather than relying on traditional testing methods, the curriculum emphasizes performance-based and formative assessments that capture students’ ability to apply knowledge in meaningful contexts. Evidence of learning is collected through a variety of student-generated products, including research projects, visual representations, collaborative discussions, and hands-on activities.

One of the primary forms of assessment used in the curriculum are self-paced research activities which serve as a diagnostic and assessment tool. One example is the agricultural careers research project. Initially, this assignment revealed a significant limitation in its design: students struggled to select and research careers due to a lack of direction. This challenge prompted a revision in which a career aptitude quiz from the National FFA Organization was incorporated into the lesson. This modification not only provided structure but also increased student engagement by aligning career exploration with personal interests. The revised assignment serves as both a formative assessment of research skills and an indicator of student engagement and self-efficacy.

Within the horticulture unit, assessments take on a more creative and student-centered form. The horticultural zine project allows students to explore topics of their choice within plant science and present their findings in a personalized format (Figure 4). This summative project assesses both content knowledge and the ability to synthesize and communicate information. However, implementation revealed that students sometimes prioritized aesthetics over substance, highlighting the importance of clear rubrics and expectations in performance-based assessments.

Hands-on activities such as flower and seed dissections also function as formative assessments. While these labs initially produced surface-level observations, the incorporation of structured questioning transformed them into opportunities for higher-order thinking. By prompting students to analyze differences between their drawn diagrams and real specimens or to consider the functional significance of plant structures, the instructor was able to assess deeper conceptual understanding (Figure 5).

The food systems WebQuest and accompanying board game serve as additional assessment tools. The WebQuest evaluates students' ability to analyze complex systems, including food deserts and distribution networks, while the board game provides a dynamic, informal assessment of conceptual understanding. Observations during gameplay—such as student discussions and problem-solving strategies—offer insight into students' comprehension of systems thinking.

Finally, the animal science unit incorporates both conceptual and quantitative assessments. Activities such as the animal product matching game assess foundational knowledge, while the animal feed lab and Pearson Square calculations evaluate students' ability to apply mathematical reasoning in an agricultural context (Figure 6). These assessments demonstrate the curriculum's emphasis on cross-curricular learning and provide evidence of students' ability to transfer skills across domains.

Stage 3: Planning Instructional Experiences and Learning Activities

With learning outcomes and assessments established, the final stage of the Backward Design process involved the development of instructional experiences designed to prepare students for success (Jensen et al, 2017). These experiences were sequenced to build from engagement and relevance to deepen student understanding. The curriculum was divided into 3 digestible units, which could be easily applied to the learning needs of students based on the desires of the instructor.

- Unit 1: Career Exploration and Agricultural Connections establishes agricultural literacy and a connection to AgEd through commodity and career research activities (Table 3).
- Unit 2: Horticulture and Food Literacy more deeply explores topics related to plant science, including plant physiognomy, reproduction, and horticultural systems, as well as food systems and systems thinking (Table 3).
- Unit 3: Animal Science follows a similar process as Unit 2, it focuses on sectors within animal agriculture, products and byproducts of animals, and prioritizes math integration through feed ration modeling and a feed production "Pearson Square" lab (Table 3).

These units are discussed in greater detail in Chapter 3.

Chapter 3: Curriculum Roadmap And Reflections

Building on the instructional framework established using the Backwards Design process, this chapter provides a detailed examination of the curriculum's structure and implementation. Each of the three units are broken down to illustrate how learning objectives, assessments, and instructional plans were used in practice. In addition to outlining the curriculum, this chapter includes a reflection from the researcher, offering insight into the decision-making process, instructional changes, and difficulties encountered during development. Together, the roadmap and reflection provide a clearer view of how the curriculum was designed to translate theoretical principles into meaningful classroom practices.

Unit 1: Career Exploration and Agricultural Connections

The curriculum begins with a focus on agricultural careers and everyday connections to agriculture. This unit serves as an entry point, designed to capture student interest and establish relevance. Activities such as the "Career Research" project and accompanying career aptitude quiz encourage students to explore their own interests while simultaneously building foundational knowledge.

By providing guided questioning for students to research beyond careers based on their interests and goals, this project reinforces systems thinking, as many of the careers that students identify will require knowledge of multiple disciplines and require formal education of some degree. This approach reflects an understanding of adolescent development, as students are actively engaged in identity formation (Lent et al., 1998; Barber, 2024). By connecting agricultural content to students' personal interests and potential career paths, the curriculum increases intrinsic motivation and engagement.

Unit 2: Horticulture and Food Literacy

The second and third weeks of the curriculum shift toward horticulture and food production. Initially, these units were designed using a more traditional, lecture-based approach. However, reflection revealed that this structure contradicted the principles of experiential learning emphasized in the literature. As a result, the units were redesigned, adhering more closely to the Backwards Design process to prioritize hands-on and student-centered activities and meet the end goals established by Georgia Performance Standards (2022) and reflected in Table 3.

Figure 4. Horticulture Zine Project

Instructional strategies in this unit include interactive foldables, dissections, and the horticultural zine project (Figure 4). These activities allow students to construct knowledge through exploration and creativity while also reinforcing key concepts related to plant biology. The horticultural zine project emerged from this revision process. Rather than assigning students identical content, students working on the zine project select their own areas of horticulture to research. This format allows for increased ownership of the work, as well as greater ability for students to express themselves during the activity (Figure 5). The inclusion of low-cost, accessible activities—such as paper foldables and the use of sidewalk chalk diagrams—demonstrates a commitment to equity and practicality (Figure 4; Figure 5). These strategies ensure that the curriculum can be implemented in a wide range of classroom settings without requiring specialized resources.

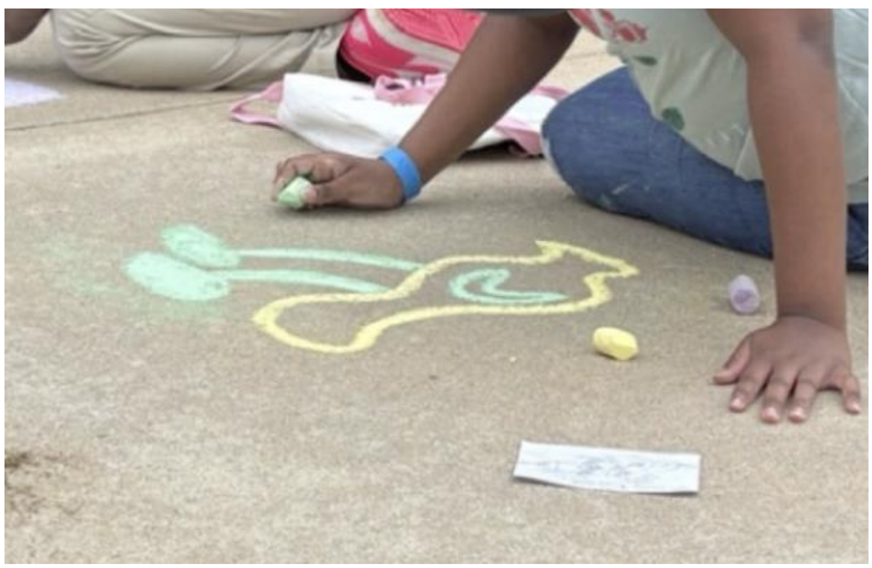

Figure 5. Chalk Flower Diagrams

Systems Thinking and Food Systems Integration

As the curriculum progresses, the focus expands from individual organisms to broader systems. The food systems WebQuest introduces students to concepts such as production, distribution, and food access, with a particular emphasis on local relevance. The use of real-world data, such as food desert maps, helps students connect abstract concepts to their own communities (Jones et al, 1998; Kudravstev et al 2012; Hand et al 2024).

To address challenges related to cognitive overload, the WebQuest was revised to include more structured prompts and curated resources. This adjustment highlights the importance of balancing rigor with accessibility in curriculum design. The accompanying board game reinforces these concepts through experiential learning. By simulating real-world scenarios and encouraging collaboration, the game provides an engaging platform for reviewing and applying knowledge.

Unit 3: Animal Science and Cross-curricular Integration

The final unit extends systems thinking into animal science and nutrition. Instruction begins with foundational concepts before progressing to more complex applications, such as feed formulation and nutritional analysis. In the beginning segment of this unit, students explore animal agriculture by identifying sectors within the industry: Beef, Dairy, Swine, Equine, Aquaculture, Apiculture, and Poultry (Figure 6). Students then work together to investigate products and byproducts within the industry. This reinforces. concepts gained during Units 1 and 2 as students revisit agricultural products and food systems.

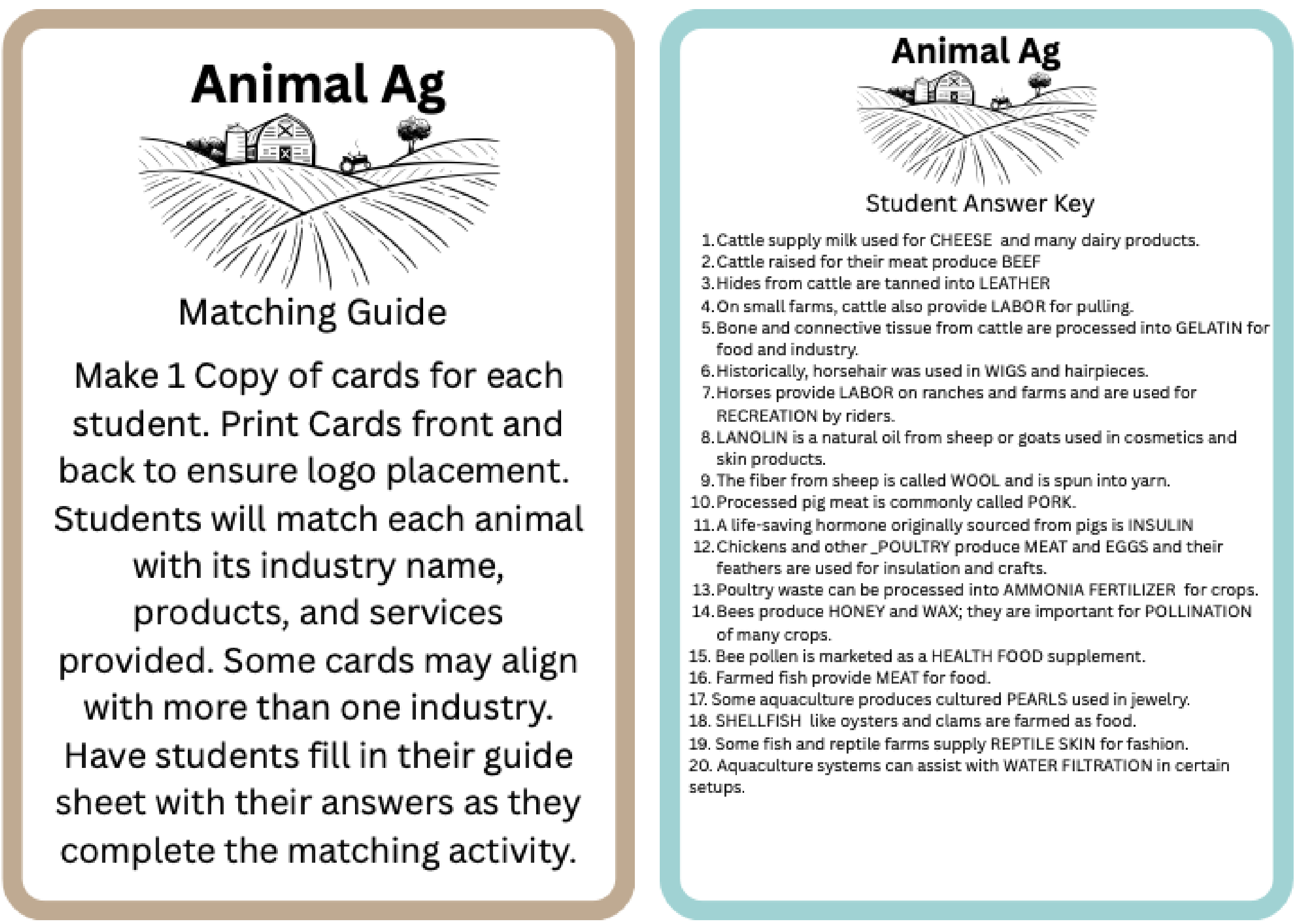

Figure 6 Animal Matching Worksheet

The animal feed lab serves as a key experiential activity, allowing students to physically construct balanced diets using common materials. This activity bridges the gap between abstract concepts and tangible experiences, reinforcing both scientific and mathematical understanding. The Pearson Square activity further integrates mathematics into the curriculum, demonstrating the practical applications of ratios and proportions. This lesson exemplifies the curriculum's commitment to cross-curricular learning and provides students with a meaningful context for mathematical concepts.

Reflection on Curriculum Design

Through the literature review, AgEd emerges as a discipline uniquely positioned to bridge academic rigor and real-world relevance, narrowing the gap between urban students' conceptual understanding and practical application of agricultural systems. The findings in Chapters 2 and 3 reinforce that achieving this balance is not incidental but the result of deliberate design, ongoing reflection, and responsiveness to student needs. Initial implementation consistently revealed discrepancies between intended and actual outcomes, with few lessons functioning as designed in their first iteration. Consequently, iterative refinement became central to the curriculum development process, often requiring multiple revisions to align instructional goals with student understanding.

From an instructional standpoint, this curriculum reinforces three takeaways for students:

- Students are capable of deep engagement with scientific and mathematical concepts when that work is applied in a hands-on format
- Cross-curricular connections between math, literacy, and science help to strengthen student understanding and retention.
- Examples of real-world applications of mathematical skills help to increase self-determination in students struggling with certain concepts.

The curriculum materials presented in the appendix serve not only as instructional tools but also as documentation of this iterative process. Each unit originated from prior experiences or conceptual models and was adapted to meet the specific needs of the classroom context. While the resulting program introduces core agricultural concepts in a streamlined and engaging format, its implementation also highlighted variability in students' literacy and mathematical preparedness. These differences underscore both a limitation and an opportunity: while uneven skill levels may constrain pacing and depth, they also position AgEd to reinforce foundational academic skills. Future iterations of the curriculum should incorporate more intentional scaffolding, particularly in reading comprehension, quantitative reasoning, and structured writing, to better support diverse learners.

The conclusions drawn from Chapter 2 further emphasize the practical application of key theoretical frameworks identified in the literature, including experiential learning, systems thinking, and cross-curricular integration. Experiential learning proved highly effective in fostering engagement, particularly during hands-on activities such as seed dissections, collaborative projects, and applied labs. However, classroom observations indicate that engagement alone does not ensure conceptual understanding. Without structured opportunities for reflection, guided questioning, and explicit connections to learning objectives, hands-on activities risk remaining isolated experiences rather than contributing to deeper knowledge construction. This finding suggests that future instructional design must more intentionally embed reflective practices to maximize the cognitive impact of experiential learning.

Similarly, systems thinking became increasingly evident as students began to articulate connections across agricultural concepts, particularly in units addressing food systems, sustainability, and career pathways. Students demonstrated an emerging ability to link production, distribution, and societal factors, indicating that agricultural education can serve as an effective entry point for exploring complex socioeconomic and environmental systems. The integration of literacy across the curriculum also contributed to increased academic rigor. Embedding research tasks, discipline-specific vocabulary, and presentation opportunities within agricultural content challenged the perception of AgEd as a peripheral or purely elective subject. Instead, the curriculum functioned as a platform for applied academic skill development. Student work and participation patterns suggest that this integration can enhance engagement and promote a sense of ownership over learning.

While these observations are promising, they remain largely anecdotal and would benefit from more systematic assessment measures in future research. The absence of formalized assessment data limits the ability to draw definitive conclusions regarding skill development, representing a key limitation of the study. These factors constrain the generalizability of the findings and highlight the need for more rigorous data collection methods, including pre- and post-assessments, longitudinal tracking, and comparative analyses across different educational settings.

Overall, this project demonstrates that agricultural education can function as a dynamic and rigorous instructional framework when grounded in research and refined through practice. The curriculum reflects an approach that positions agriculture as an applied science capable of integrating experiential learning, systems thinking, and academic skill development within an urban context. Continued refinement of this work should focus on strengthening assessment practices, expanding scaffolding for diverse learners, and validating outcomes through more systematic research. In doing so, future iterations can move beyond demonstrating potential to providing stronger empirical evidence for the role of agricultural education in supporting student learning and engagement.

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Appendix A - Curriculum Map & Lesson Plans

Introduction

This curriculum packet is designed for teachers of traditional academic subject areas, grades 6–8, looking for ways to integrate agricultural and horticultural concepts into their curriculum. The lessons are designed to be used during a 45–60 minute class session but can be adapted for use in a 90-minute session as well. The matrix is broken down into 4 weeks, each with a key Unit/Theme. The individual units may be used alone or together for a more comprehensive educational experience. Lessons are written with Georgia Performance Standards for Middle School Agriculture, Grades 6,7, and 8 in mind but may be used or adapted to state or local standards.

This curriculum matrix was created by Kaleb Bell, B.S Agriculture Education, in partial fulfillment of an M.S. in Horticulture with an emphasis in Urban Food Systems through Kansas State University, and serves as supplementary work in accompaniment with the Master's Report *"Seeds of Change: Educational Outcomes of Agriculture Education on Students in U.S. Urban Schools, A Review of Current Literature" by Kaleb Bell.* This work is original in nature, and any similarity to other curricula or published materials is purely coincidental and unintentional. All photos in presentations or other materials are either the creator's own, or stock images used under fair-use/no-attribution licensing.

This curriculum is not affiliated with, endorsed by, or associated with The National FFA Organization, Farm Bureau, or any other agricultural organization. All lessons were designed, arranged, and tested in a 6-8 grade agricultural classroom by an educator certified in agricultural education, prior to inclusion in this curriculum packet. For more information, or for access to materials, please fill out the google form:

Table 1. Georgia Performance Standards Alignment By Grade Level

Unit	Focus Area	Grade 6 Standard	Grade 7 Standard	Grade 8 Standard
Unit 1: Agricultural Literacy & Career Exploration	Commodities, daily life connections, careers, systems awareness	AFNR-MSAGED6-2.1: Describe and explain the impact of agriculture on daily life; AFNR-MSAGED6-7 Investigate aspects of agriculture careers	AFNR-MSAGED7-3.2 Expand leadership goals, personal growth, and career success through Agriculture Education	AFNR-MSAGED8-2.4 Apply Career Development Event and Leadership Development Event concepts relating to employability to career readiness
Unit 2: Plant Science & Horticulture Foundations	Plant anatomy, physiology, horticulture, biological literacy	AFNR-MSAGED6-5.2: Examine the horticulture industry and the role it plays within the agriculture industry; AFNR-MSAGED6-5.3 Identify the four areas of the horticulture industry…	AFNR-MSAGED7-4.1 Explain the relationship between vegetative components of a plant through analysis of their functions	AFNR-MSAGED8-4 Describe, illustrate, and apply information pertaining to current events, trends, research, and careers in Plant Science
Unit 2 (Cont.): Food Systems & Sustainability	Food deserts, distribution, environmental impact, systems thinking	AFNR-MSAGED6-2.3 Identify the sources of different types of food and fiber	AFNR-MSAGED7-2.3 Explain the global economic impact of agriculture in meeting human needs for food, fiber, and natural resources.	AFNR-MSAGED8-3.1 Describe and discuss how agriculture provides basic human needs.
Unit 3: Animal Science & Applied Agricultural Math	Animal systems, nutrition, ratios, real-world application	AFNR-MSAGED6-6.2: Analyze the role, importance, and scope of livestock and companion animals; AFNR-MSAGED 6-6.3 Identify products and byproducts from livestock animals.	AFNR-MSAGED7-5.3 Analyze the role, importances, and scope of the dairy, beef, pork, equine, and small ruminant animal industries.	AFNR-MSAGED8-6 Describe, illustrate, amd apply information pertaining to current events, trends, research, and careers in Animal Science; AFNR-MSAGED 8-6.3 Create a feed ration for livestock or companion animals.

Week 1: Agriculture Literacy & Career Exploration

Performance Standards:

AFNR-MSAGED6-2.1: Describe and explain the impact of agriculture on daily life; AFNR-MSAGED6-7 Investigate aspects of agriculture careers

AFNR-MSAGED7-3.2 Expand leadership goals, personal growth, and career success through Agriculture Education

AFNR-MSAGED8-2.4 Apply Career Development Event and Leadership Development Event concepts relating to employability to career readiness

Learning Objectives:

By the end of this week, students will be able to identify and explain the connections between agriculture and their daily lives, including the sources of food, fiber, and other products they consume. Students will demonstrate the ability to research and analyze agricultural careers, using tools such as the Ag Explorer Quiz and library or online resources to evaluate career options that align with their skills, values, and interests. They will develop and organize information into a 5-slide presentation or poster, effectively communicate their findings to peers, and provide constructive feedback on others' work. Additionally, students will practice reflective thinking, public speaking, and collaborative skills throughout the series of activities.

Lesson Goals:

The overarching goal for this week is to deepen students' understanding of how agriculture impacts daily life and to introduce them to the diversity of careers within the agricultural industry. Through hands-on and research-based activities, students will explore personal connections to agriculture, investigate career options, and create presentations to share their findings. The lessons aim to foster critical thinking, engagement, and communication skills while promoting self-awareness of students' interests and strengths in relation to potential career pathways. By the end of the week, students will not only have gained knowledge about agricultural systems and careers but will also have practiced the skills needed to research, synthesize, and present information effectively.

Day 1: Agriculture Connections

Lesson Focus and Goals: Students will explore connections between their daily life and agriculture in order to investigate the relationships between the agricultural industry and everyday life.

Materials Needed: Connections to Agriculture PPT, "Ag Connection" handout, Library or Internet Access.

Opener: Introduce the lesson by asking an opening question such as " What is one thing you have used, worn, or ate today; where did it come from?" or "If agriculture were to disappear tonight, what would be the first thing you believe you would notice?" Have students record their responses and share answers.

Lesson (15 Minutes): Review the connections to agriculture powerpoint, emphasizing the sources of agricultural projects (farm, field, factory)

Activity (20 minutes): Distribute "Ag Connections" handout. Students will select a single product to research and study further. Group students based on product type: animal, fruit/vegetable, fiber, etc. Allow students to work in groups to complete the handout using their resources.

Closer (5-10 minutes): As students complete the activity and group their products, encourage them to share with one another their findings.

Ticket Out the Door: Reflecting on Agriculture in Daily Life

How many people, steps, or systems do you think were involved in getting your item to you?

How has this lesson changed the way you think about the things you consume every day?

What questions do you still have about where your food, clothes, or other everyday items come from?

Assessment (formative): Review student activity sheets for accuracy during grouping. Ask students to reflect on their connection to agriculture and the wider implications for consumption of food, fiber, and other material goods.

Day 2: Introductions to Careers in Agriculture

Lesson Focus and Goals: Students will explore careers in agriculture and determine what careers best suit their interests and skills. Students will research a career of their choosing and compose a 5-slide powerpoint to present their findings to the class. Students will then provide feedback to one another, practicing their presentation and communication skills

Materials Needed: Careers in Agriculture Powerpoint, Ag Explorer Career Quiz, Library or Internet Access, Project and Feed Back Rubrics

Opener (10-15 minutes): Prompt students by asking them to envision their "Dream Job", have students either write or share verbally their ideal career, as well as why they believe this career suits them. Collect Responses on a dry erase board or other visual for further discussion.

Lesson (15 minutes): Review the Careers in Agriculture Powerpoint with Students, pausing periodically to answer questions regarding career background of ties to academia.

Activity (15 minutes): Reflect on the diversity of careers in agriculture. Guide students to the Ag Explorer Quiz for completion. Students will spend the remainder of the class period completing the quiz. Students will record their results for research during day 2. Encourage students to read each question slowly and answer truthfully and with intention. If students answer too quickly their results may be skewed.

Closer (5-10 minutes): Using a quick write, have students reflect on the presentation and their results to the career quiz. Prompt students by asking leading questions such as :

How did your Ag Explorer quiz results compare to the "dream job" you described at the beginning of class? What surprised you?

What did today’s lesson and quiz teach you about the variety of paths available in agriculture?

How might your skills, values, or passions influence your future career—even if it’s not in agriculture?

Assessment (formative): review student quickwrites during closing session of lesson 2. How did your Ag Explorer quiz results compare to the “dream job” you described at the beginning of class? What surprised you? What did today’s lesson and quiz teach you about the variety of paths available in agriculture? How might your skills, values, or passions influence your future career—even if it’s not in agriculture?

Day 3-4: Careers in Agriculture Research

Lesson Focus and Goals: Students will investigate further a career of their choosing based on their results from lesson 2. Students will research a career of their choosing and compose a 5-slide powerpoint to present their findings to the class. Students will then provide feedback to one another, practicing their presentation and communication skills

Materials Needed: Careers in Agriculture Quiz Results, Library or Internet Access, Project and Feed Back Rubrics, Powerpoint or poster paper & supplies (crayons, colored pencils, markers, printer access, etc.)

Opener (5-10 minutes): Prompt students to review their quiz results and identify why they believe the results do (not) match their skills or interests.

Activity (30-35 minutes): Using the provided rubric, students research their career and create either a 5-slide powerpoint or poster containing the following elements: career title & overview, daily responsibilities, education or training required, skills & traits needed, reflection on why the career fits the student. For added depth, require students to find a college or university which provides the major or certification required.

Closer (5-10 minutes): Exit ticket: Progress Check:

How much work were you able to accomplish today?

What is one thing you learned about your career?

What surprised you about the career you've been researching?

Day 4 Continuing Research Projects

Opener: (5-10 minutes): Reflect on projects so far. Answer any clarifying questions

Activity (30-35 minutes): Continue working on projects to ensure they fit the rubric.

Closer: (5-10 minutes): Reflect on your career project. What grade would you assign yourself? Why?

Assessment (formative): review student quickwrites during closing session of lesson 3.

Day 5-6: Presenting Career Findings

Note: Day 5 will be used for presentations. Be sure that all students have their powerpoints or posters submitted in time to present.

Lesson Focus and Goals: Students will practice their public speaking skills by presenting their career projects to their peers. Students will provide constructive feedback to their peers. How can effectively sharing our career goals help us strengthen communication skills and learn from the experiences of others?

Materials Needed:Completed Projects, Project Rubrics for Grading, Peer-Feedback Forms, Deck of Playing Cards, jokers removed

Opener (2-5 minutes): "What is one skill you'll need in almost any career, no matter what field?" Divide your class into even groups of 4. Use that number of each card suit to create a deck of cards which has as many students as you have in your class. Distribute the cards. Students in the same suit will provide feedback for one another.

Activity (30-35 minutes): Students present their presentations, each student has 3-4 minutes to present. This may require 2 days depending on class size. Students use the peer-feedback sheets to provide commentary for their peers.

Closer (5-8 minutes): Class-wide discussion "What did you notice about the variety of careers? Which surprised you the most?

Optional Quickwrite: "One career I learned about today that I didn't know much about was______. Something about this career that stood out to me was __________.

Assessment (summative): Use the project rubrics to assign grades based on student presentations. Take into account work ethic, presenter/presentation quality, and audience participation when assigning grades.

Week 2-3: Plant Science & Horticulture Foundations

Performance Standards:

AFNR-MSAGED6-5.2: Examine the horticulture industry and the role it plays within the agriculture industry; AFNR-MSAGED6-5.3 Identify the four areas of the horticulture industry…

AFNR-MSAGED7-4.1 Explain the relationship between vegetative components of a plant through analysis of their functions

AFNR-MSAGED8-4 Describe, illustrate, and apply information pertaining to current events, trends, research, and careers in Plant Science

Learning Objectives:

By the end of Weeks 2 and 3, students will be able to define key horticultural terms, including horticulture, olericulture, pomology, viticulture, ornamental horticulture, and landscape design, and provide examples of each. They will identify and describe the parts of seeds, distinguish between monocot and dicot seeds, and understand the functions of each part in relation to plant growth and development. Students will explore the reproductive structures of flowers, construct and label models of flowers, and explain the process of pollination and its role in plant reproduction. Additionally, students will develop research and communication skills by creating horticulture "zines" and case studies, sharing their findings with peers, and reflecting on how horticulture impacts daily life.

Lesson Goals:

The goals for these two weeks are to deepen students' understanding of the horticulture industry and plant science by connecting classroom learning to real-world examples. Students will explore the diversity of horticultural fields, investigate seed structures, and examine the reproductive components of plants. Hands-on activities, such as seed dissections, flower modeling, and horticulture zines, are designed to reinforce scientific concepts while promoting creativity and critical thinking. By completing case studies and collaborative sharing activities, students will strengthen research, organization, and presentation skills. Overall, these lessons aim to help students appreciate the role of horticulture in daily life, understand plant growth and reproduction, and build foundational knowledge for further study in agriculture and plant sciences.

Day 1-2: Introduction to Horticulture

Lesson Focus and Goals: Students will explore connections between their daily life and the horticulture industry, investigating various aspects of the horticulture industry.

Students will define horticulture, olericulture, pomology, viticulture, ornamental horticulture, Landscape design, and provide examples of each.

Materials Needed: Horticulture PPT & Guided Notes, Horticulture Industry ZINE Activity, Student stations notes

Opener (10-15 minutes): Introduce the lesson by asking an opening question such as " What did you eat for breakfast/lunch today? What steps did it take to get on your plate? Have students record their responses and share answers.

Lesson (15 Minutes): Review the horticulture powerpoint, emphasizing the sources of agricultural products, and the terminology used to connect products to their source of origin

Activity (25 minutes): Distribute "Horticulture ZINES" handout. Students will select type of horticulture to research further, creating a booklet that explores the history of the form, the origin of the word, examples of crops/products which relate to the form, and the industry's worth

Closer (5 minutes): Ask students to reflect on their response to the opener. Has their answer changed?

Day 2 Presenting Horticulture Zines

Opener (15-20 min): Provide time for students to finish their zines.

Activity (20 min): Put students in groups of 4, each with a different type of horticulture. Students will share their zine with their peers, teaching them about each concept.

Closer (5 min): Ticket out the Door: Students create a pneumonic device to recall the types of horticulture industry. Example " Onions = Olericulture, Pomegranates = Pomology, Viticulture = Grape "Vines", Ornamental Horticulture = Heather, Landscape Design = Lillies

Assessment (formative): Review student Zines during small-group sharing. Review student pneumonic devices for accuracy/clarity.

Day 3: Types of Seeds & Seed Parts

Lesson Focus and Goals: Students will investigate types of seeds and their parts, understanding the function of each part and their relationship to seed growth and development.

Materials Needed: Types of Seeds/Seed Parts Powerpoint, Guided Notes, Review Activity Powerpoint

Opener (5-10 minutes): Introduce the lesson by asking an opening question such as " What did you eat for breakfast/lunch today? What steps did it take to get on your plate? Have students record their responses and share answers.

Lesson (15-20 Minutes): Review the seeds powerpoint, emphasizing the differences between monocot and dicot seeds and their parts.

Activity (10-15 minutes): Students will participate in the review game/activity identifying monocot and dicot plants and seed parts.

Closer (5 minutes): Ask students to reflect on their response to the opener. Has their answer changed? Complete ticket out the door: "Monocot and Dicot" plants differ in some of the functions and structures that that contain. Identify one difference between monocot and dicot seeds and explain their functions.

Assessment (formative): Review student guided notes and monitor student success in the review game. Distinguish between monocot and dicot plant parts, types of plants, and seeds and their parts.

Day 4: Dicot Seed Dissection

Lesson Focus and Goals: Students will identify parts of dicot seeds, understanding the function of each part and their relationship to seed growth and development.

Materials Needed: Dried & Presoaked Beans (large limas), Lab Notes, Paper Plate or Paper Towels, Forceps/tweezers (optional)

Opener (5-10 minutes): Start by showing the whole dicot seed to the class and ask:
"Now that we know the parts of a dicot seed, what can we discover by looking inside it ourselves?"

Encourage students to make predictions about what they will see in real life versus the textbook images. Emphasize that today's lab is about observing and connecting the structures they've learned to a real seed, noticing details that diagrams may not show.

Activity (20-30 minutes): Students will complete the lab, comparing a dry bean and a soaked bean in order to identify the parts of a dicot seed structure. Students are to fill in their lab packet, drawing the dicot seed and labeling the parts.

Closer (5 minutes): After students complete the dissection, have them reflect and record.
Assessment (formative): Review Ticket out the door, addressing student questions or concerns
Ticket out the door:

What did you notice in a real seed that was different from the diagrams?"
"How do the structures you observed support the seed's growth in ways we might not have fully appreciated before?"

Invite a few students to share their insights aloud. Reinforce that hands-on observation deepens understanding of seed structures and their roles in germination and plant development.

Day 5: Plant Parts & Structures

Lesson Focus and Goals: Students will identify and describe the major parts of plants, including roots, stems, leaves, flowers, and their respective functions. They will organize this information into a foldable, reinforcing their understanding through a hands-on, visual study tool.

Materials Needed: Plant structures ppt & Foldable, Scissors, Colored pencils or crayons

Opener (5-10 minutes): Begin by showing students a live plant or a clear image of a plant and ask:"Why do you think each part is important for the plant's survival?" Encourage students to share observations and predictions. Explain that today they will learn more about each plant part's structure and function and organize their knowledge into a foldable to help visualize and remember these connections.

Lesson (20-30 Minutes): Review plant parts powerpoint with students. As they proceed, the students will fill in their foldable with the definitions for each part

Closer (5 minutes): After completing the foldable, have students reflect by answering the closers below:

Ticket out the door: "Which plant part do you think is most important and why?"

"How does creating a foldable help you remember the structure and function of each plant part?"

Assessment (formative): Review flower foldables for accuracy. Ensure they are cut/colored and labeled correctly w/ definitions included inside.

Day 6-7: Flower Parts

Lesson Focus and Goals: Students will explore the reproductive components of a flower, then construct a model flower by either drawing or sculpting each part. The student will then label the parts of the flower and describe their functions.

Materials Needed: Parts of a flower PPT & Guided Notes, Paper & Drawing Supplies or clay (2D model), Construction paper, scissors, glue/tape (3D model)- Rubric, Lined Paper or doc.

Opener (5-10 minutes): Ask students to recall what process must occur for seeds to be made–reflect on content from the last lesson.

Lesson (15 Minutes): Review powerpoint and guided notes of flower parts and functions.
Activity (25 minutes): Begin creating flower models. Students can construct either 2D or 3D models of flowers, depending on time and materials. Students will use the rubric to draw/sculpt and label their flower parts using drawing materials, clay, or paper-crafts

Closer (5 minutes): Review functions of flower parts through active questioning/verbal review.
Alternatively, discuss functions of pollen and pollinators, such as
What is pollination? Why is it essential for plant life to function?

DAY 7:

Opener (5-10 minutes): Review flower parts " What part of the flower makes pollen? Which contains the eggs/ovule?"

Activity: (25 minutes): Finish flower models, following the rubric. Ensure that students have included and labeled all parts included in the rubric.

Closer: Students will elaborate on the form and function of flowers, describing each part and their relationship to the whole, completing the ticket out the door for day 7.

Ticket out the door: "Each part of a flower has a role in helping plants make seeds. Pollinators like bees, butterflies, and even the wind help move pollen so this process can happen. Imagine you are a bee visiting a flower. Describe what you see, what you collect, and how you help the flower. Why are the flower's parts important in this process?"

Assessment (Summative): Students will submit completed flower models for grading. The student will submit an accompanying narrative explaining the functions of each part of the flower.

Day 8: Flower Dissection

Lesson Focus and Goals: Students will dissect then identify the reproductive components of a flower, using knowledge gained from prior lessons to connect learning concepts to the physical world.

Learning Objectives: identify and explain the parts of a flower: petals, sepal, anther, filament, stamen, stigma, style, ovary, pistil

Materials Needed: Paper Plates/towels, Flowers to dissect (lilies, tulips, alstroemeria work best), Dissection Lab Sheet, Tweezers/forceps (optional), Handlens (optional), Scissors/Scapel (optional)

Opener (5-10 minutes): Prompt students to recall the names and functions of the flower parts. Ask leading questions such as "What is the function of the anther?" or "How do the stigma, style and ovary work together for pollination?"

Activity (25 minutes): Distribute lab sheets, paper products, flowers, and tweezers (optional) to students/groups. Review Lab instructions with students before beginning the dissection. Depending on the age/skill level of the students, dissections may take place independently or as a class. Younger students may require assistance separating the components of the flower without damaging the structures. Students will separate the structures and draw them on their lab sheet, then answer the questions on the sheet for review. Provide students time to dispose of their flowers and excess materials in the trash

Closer (5-10 minutes): Review the lab questions with students, answering any clarifying questions and checking for accuracy. Students can answer their TOTD on the back on their lab sheet to turn in as class is dismissed.

Ticket Out the Door: Prompt students with open ended questioning such as "What structure within the flower is the most important? Why do you feel this way?" There is no singular answer to this question, encouraging students to reflect on their reasoning and justify their answers by building upon past knowledge.

Assessment (Summative): Students will be assessed based on their ability to identify the flower structures and explain their functions

Day 9-10: Food Systems

Performance Standards:

AFNR-MSAGED6-2.3 Identify the sources of different types of food and fiber

AFNR-MSAGED7-2.3 Explain the global economic impact of agriculture in meeting human needs for food, fiber, and natural resources

AFNR-MSAGED8-3.1 Describe and discuss how agriculture provides basic human needs.

Lesson Focus and Goals: Using their knowledge of the horticulture industry and plant parts, students will investigate food systems, then review.

Learning Objectives: identify core components of food systems and explore their relationship to the horticulture industry

Materials Needed: Food Systems Guided Reading Article, Webquest Activity Sheet, Horticulture Unit Review Game, 1 copy per group of 4 students.

Opener (5-10 minutes): Prompt students to recall something they ate in the last 24 hours. Select one or two products to discuss, determining their path from farm to fork.

Lesson/Activity (25-30 minutes): Distribute food systems web-quest activity. Instruct students to go to the USDA website and watch the two videos, answering questions as they go.

Closer: (5 minutes): Reflect on the sustainability concepts from USDA. What does it mean to live sustainably?

Day 10 Opener: Review the sectors of the horticulture industry.

Lesson/Activity: Distribute pre-cut board game cards, pieces, and dice. Distribute 1 board game per group of 4 students. Review horticulture and food systems using the game board. Monitor groups as they play the review games, answering any clarifying questions as you go.

Assessment (Summative): Students will be assessed based on their ability to complete the webquest based on factual information from the USDA and various educational sources. Formative review will be conducted when students conduct review. Educators will monitor student performance during webquest and review.

Week 4: Animal Science & Applied Agricultural Math

Performance Standards:

AFNR-MSAGED6-6.2: Analyze the role, importance, and scope of livestock and companion animals;

AFNR-MSAGED 6-6.3 Identify products and byproducts from livestock animals.

AFNR-MSAGED7-5.3 Analyze the role, importances, and scope of the dairy, beef, pork, equine, and small ruminant animal industries.

AFNR-MSAGED8-6 Describe, illustrate, amd apply information pertaining to current events, trends, research, and careers in Animal Science; AFNR-MSAGED 8-6.3 Create a feed ration for livestock or companion animals.

Day 1: Introduction to Animal Science

Lesson Focus and Goals: Students will investigate the roles of animal agriculture in human life. Students will be able to recognize common animals and animal products and byproducts, and basic vocabularly related to animal science

Learning Objectives: Define “animal science”.Identify ways which animals contribute to human life. Match Animals to the products/services they provide

Materials Needed: Animals& Products Presentation, Animal Products/Cards, Exit Ticket Slips (index cards)

Opener (5-10 Minutes): What are some common animals we see in our everyday life? What do we get from them?

Lesson/Activity: Animal Science Powerpoint w/ guided notes.Group Activity: Animal Matching Activity. Students work with a partner to match the animal cards with their name, products, and services.

Closer (5-10 minutes): Distribute index cards. Students will complete a 3-2-1 exit ticket, listing 3 things they learned, 2 things they want to research further, and 1 thing you don't understand or have lingering questions for.

Assessment (formative): Review student exit tickets to monitor learning and interests. Use the questions and uncertainties students have to lead opening questions on subsequent days.

Day 2-3: Animal Needs Webquest

Lesson Focus and Goals: Students will research the needs, breeds, and roles of animals in agriculture using structured inquiry. Students will develop a short presentation about animal needs to demonstrate their understanding.

Learning Objectives: Identify basic needs of animals. Describe common agricultural species and their uses. Explore careers in animal science.

Materials Needed: Computers/tablets (or printed WebQuest stations), Guided worksheet, Headphones (if digital stations have video/audio), Poster Paper & Supplies or Powerpoint

Opener (5 min): Show a short animal care image (e.g., dairy cow in a barn). Ask: "What do you think this animal needs to stay healthy?" Record observations as a class.

Lesson/Activity (35 Minutes): Distribute Student Webquest worksheets. Allow students to work alone, or with a partner to explore the needs of animals, various breeds, animal welfare and rights.

Closer: Think, Pair, Share "Which segment of the webquest did you find most interesting? What is one thing you want to explore more?

DAY 3 Opener (5 Min): Ask: "If you could be responsible for caring for one animal species, which would you choose and why?"

Lesson/Activity (35 min): Divide students into pairs. Students select one animal species from their research and create a poster or single slide including its habitat, diet, uses, and needs.

Closer: Student pairs join to make groups of 4. Each pair spends 1-2 minutes sharing their presentation with the other group.

Assessment (formative): Opener, Closer, and completed webquests.

Assessment (Summative): Poster/ 1-slide presentation.

Day 4-5 Digestion and Nutrition:

Lesson Focus and Goals: Students will identify essential nutrients in animal feed and differentiate between the key ingredients in animal feed and fodder.

Learning Objectives: Define the 6 major nutrient groups: carbohydrates, proteins, fats, vitamins, minerals, and water

Materials Needed: Animal Feed presentation. Animal feed lab sheets, ziploc bags, cereal, cheese crackers (goldfish) or peanuts, m&ms, popcorn/kettle corn seasoning or cinnamon sugar, large bowl or drum, measuring cups

Day 4 Opener (2-5 minutes): Display different photos of feeds: corn, hay, alfalfa, soybeans, oyster shells, etc. Ask students "How do these feeds differ? Which ones provide energy? Which provides protein to build muscles?

Activity (30-35 minutes): Display examples of animal feed compositions, explaining that each ingredient is listed in a ratio that lets farmers know the nutrients their livestock is receiving. Distribute lab activity sheets. Assemble "animal feed snack mix" based on lab directions, placing in bags for the students to enjoy. Explain the ratios, and that each ingredient represents a key nutrient that animals receive from their feed. carbohydrates (cereal), proteins (cheese/peanuts), fats(m&ms), vitamins & minerals (seasoning). Students spend the remainder of the class practicing nutrient rations and answering lab analysis questions.

Closer (5-8 minutes): If you were tasked with preparing a feed for a dairy cow, what nutrients would be most important and why? list 2 and explain. (answers may vary)

Day 5 Opener (5 minutes): Why do different animals eat different things? Can animals eat different things at different times in their life? Give an example.

Lesson (20-25 min): Review Pearson Square PPT with students, using guided notes. Solve the group problem(s) together step-by-step on the board with students.

Activity (10-15 minutes): Provide students with several Pearson Square problems to practice on their own. Connect to math basics: ratios, multiplication, division. Check the problems as a group.

Closer (5 min): Why is it important for a farmer or animal nutritionist to balance their feed rations?

Assessment (summative): Students will be assessed based on their understanding of animal nutrient needs, as indicated by the lab demo analysis and ratio questions. If students struggle to understand the importance of various feed components, regroup/reteach emphasizing the function of each nutrient (proteins build muscles, carbohydrates provide energy, etc.)

Appendix B - Example: Career Exploration Worksheet

Agriculture Career & College Research Activity Sheet

Name: ___________________________ Class Period: _______________ Date: _______

Objective:

This activity is designed to help you explore different careers in the agricultural industry. You will research an agriculture-related job or major, the education required, potential salary, and career pathways.

Find Your Agriculture Career or Major

Take the Ag Explorer Quiz. List your Quiz results below.

Career or Major: ______________________________________

Next, find schools or institutions that offer a degree or certification in your field. This can be a college, university, or trade school. Write the name of the school, location, and the type of program (degree/certification).

School Name: ____

Location (City, State): ___________________________________

Degree/Certification Program Offered: ____________________________

Research how many years of study are required to earn a degree or certification in your chosen field. List the number of years it takes and any specific courses or subjects that are often required in this program.

Number of Years Required: ___________________________

Typical Courses/Subjects:

-
-
-
-

Job Description and Responsibilities

Write a brief description of the job or role you would hold once you complete your education. What are the main tasks and responsibilities of someone in this career?

Job Description:

Salary and Job Outlook

Research the average salary for the career you chose. Additionally, look up the job outlook—how many job openings are expected in the next few years in this field? What is the demand for this job?

Average Salary: ____________________________

Job Outlook (e.g., Growth Rate, Number of Openings):

Skills Needed for Success

List the key skills and personal traits that will help you succeed in this career.

Skills/Traits Needed:

Additional Information

Write any additional relevant information about your career choice, such as career advancement opportunities, professional organizations, or internships.

Additional Information:

Reflection

Answer the following questions:

Do you believe the survey accurately reflects your interests? Why or why not?

How do you think this career fits with your personal interests and strengths?

Appendix C - Example: Horticulture Zine Project

Horticulture Zine Project

Name:___________________Date:___________________Class:___________________

A zine is a mini-book that you create yourself using only 1 sheet of paper! Zines are meant to spread a message, and typically contain words, pictures and drawings that express the creator's thoughts.

Project Overview

Select one type of horticulture from the presentation: olericulture, floriculture, pomology, etc. to research.

Create an 8-page zine using the folding guide from *Sedgwick Museum of Earth Science*, then fill your zine with information based on the rubric below.

Zine Requirements

Page	What to Include
Cover	Title + Illustration (Make it creative!)
Page 1	Definition of your horticulture sector (in your own words)
Page 2	Word Origin – What does the word mean? Where did it come from?
Page 3	History/Background – When and where did this practice begin?
Page 4	Examples – List 3+ crops/products that fit in this category
Page 5	Why it Matters – Industry value, careers, or why it's important
Page 6	Fun Fact or Diagram – Something surprising, funny, or visual
Page 7	Ticket Out the Door: Write what you learned from your peers after group sharing

Day 2: Your teacher will separate you into groups so that no two people with the same topic are in the same group. You will share your zine with your group in a round-table discussion to teach them what you learned about your sector.

Using the last page in your zine, you will reflect on what you learned from your peers, filling in your final page.

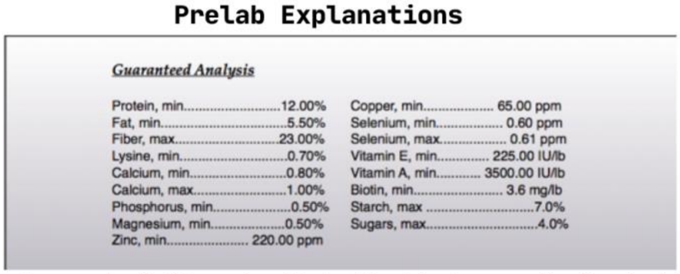
Appendix D - Example: Pearson Square Lab

Food for Thought: Understanding Animal Feed Composition and Nutrition

Objective: Define the 6 major nutrient groups: carbohydrates, proteins, fats, vitamins, minerals, and water

Research Question	What ingredients make up a typical livestock feed ration?
Materials	Grain Cereal (fruit loops or cheerios) Peanuts or Cheese Crackers (goldfish) M&M's or chocolate chips Popcorn Seasoning Ziploc Bags (1 per student) Large Mixing Bowls (1 per group) Measuring Cups/Scoop

Prelab Explanations



Guaranteed Analysis

Protein, min......12.00%	Copper, min...... 65.00 ppm
Fat, min......5.50%	Selenium, min...... 0.60 ppm
Fiber, max......23.00%	Selenium, max...... 0.61 ppm
Lysine, min......0.70%	Vitamin E, min...... 225.00 IU/lb
Calcium, min......0.80%	Vitamin A, min...... 3500.00 IU/lb
Calcium, max......1.00%	Biotin, min...... 3.6 mg/lb
Phosphorus, min......0.50%	Starch, max 7.0%
Magnesium, min......0.50%	Sugars, max......4.0%
Zinc, min...... 220.00 ppm	

figure 1. example of a "Guaranteed Analysis" nutrient composition in animal feed

Animals require 6 key nutrients in order to live and grow:

- Carbohydrates- Major source of immediate energy
- Proteins- muscle growth and body development
- Fats- Minor immediate energy; major source of slow release energy
- Vitamins & Minerals- physiological and metabolic life functions, bone and organ system health
- Water- hydrations and essential life functions

All animal feeds are required to have a nutrient breakdown, illustrating what percentages of crude fats, proteins, and essential vitamins and minerals they contain. This way, farmers and ranchers can ensure they provide their ideal feed to their livestock.

Evidence of Understanding

1. If you doubled your recipe, how many cups of each nutrient would you need?

____
____
____

2. Which nutrient provides immediate energy? Which helps to build muscles and tissue? What ingredients were used to represent them?

____
____
____
____

3. If a farmer wanted to create 100lbs of feed ration that was 77% Carbohydrates, 18% Protein,3% Fat, and 2% Vitamins and Minerals, how many pounds of each nutrient would they need?

- Carbohydrates= ________________ lbs
- Protein= ________________ lbs
- Fat = ________________ lbs
- Vitamins and Minerals ________________ lbs

The farmer was pleased with the outcome of this feed on his livestock growth! They now want to create another 2500 lbs of animal feed with the same composition. How many pounds of each nutrient would they need?

- Carbohydrates= ________________ lbs
- Protein= ________________ lbs
- Fat = ________________ lbs
- Vitamins and Minerals ________________ lbs

4. If a farmer wanted to create 750 lbs of feed ration that was 74% Carbohydrates, 13% Protein,8% Fat, and 5% Vitamins and Minerals, how many pounds of each nutrient would they need?

- Carbohydrates= ________________ lbs
- Protein= ________________ lbs
- Fat = ________________ lbs
- Vitamins and Minerals ________________ lbs

5. How was this activity similar to the work that real farmers or animal nutritionists do?

____
____

Evidence of Understanding

1. If you doubled your recipe, how many cups of each nutrient would you need?

   ____
   ____
   ____

2. Which nutrient provides immediate energy? Which helps to build muscles and tissue? What ingredients were used to represent them?

____
____
____
____

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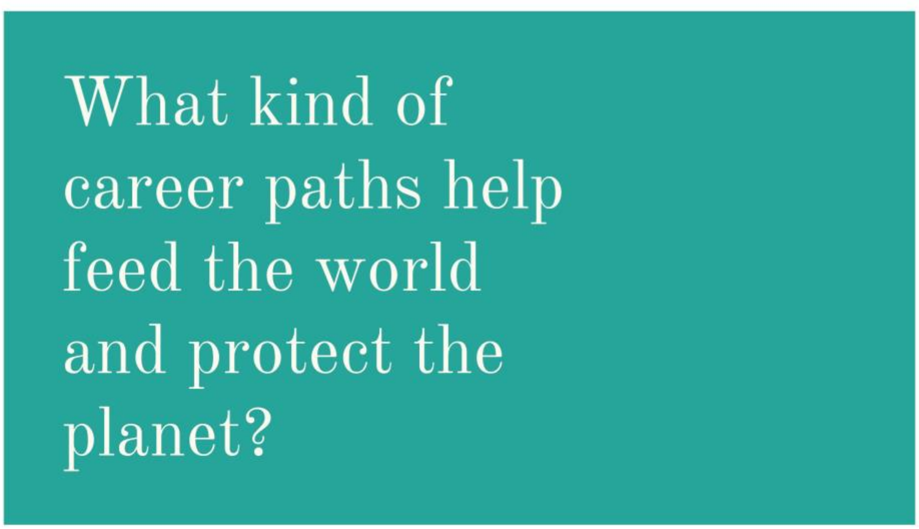
- Fat = ________________ lbs
- Vitamins and Minerals ________________ lbs

5. How was this activity similar to the work that real farmers or animal nutritionists do?

____
____

Appendix E - Example Presentation: Careers in Agriculture




Why These Careers Matter
Careers in agriculture and environmental science impact most aspects of our world!
Food Security
Environmental Health
Economics
Climate Resilience


Why These Careers Matter
1 in 10 U.S jobs are related to agriculture (USDA)

Plant Science

Crop Production & Agronomy

- Agronomists, Horticulturalists, Greenhouse Managers, Plant Geneticists
- Improve plant health and develop new varieties or methods of production
- Skills: Biology, Problem Solving, Data-Analysis

Animal Science

Animal Care & Veterinary Medicine

- Nutritionists, Livestock Management, Wildlife Biology, Veterinarians
- Maintain animal health, improve production, protect biodiversity
- Skills: Animal Science, Observation, Critical Thinking

ENR

Environmental & Natural Resources

- Environmental Engineering, Conservation Officers, Water Quality Specialists, Foresters
- Protect ecosystems and manage/monitor natural resources
- Skills: Ecology, GPS mapping, data collection

Agribusiness

Business, Technology, and Economics

- Ag Economists, Food Systems Planner, Supply Chain Management, Ag Sales
- Manage production, improve efficiency, connect producers to consumers
- Skills: Management, communication, technological competence

Education

Childhood & Adult Education, Career Readiness

- Agriculture Education, Extension Agents, Academics, Trade-School Instructors
- College & Trade-School Options; educate students on relevant topics
- Skills: Class management, communication, scheduling, industry-specific methods, pedagogy

Where will your passion lead you?

Take the Ag. Explorer Quiz to find out?

Use your results from the Ag Explorer Quiz to create a 5-slide presentation. Be sure to include:
Title Slide
Slide 1: Career description*
Slide 2: Salary/hourly wages*
Slide 3: degree requirements + colleges that offer the degree*
Slide 4: Job Prospects (is the field growing or shrinking)*
Slide 5: What a day in the life of this career looks like*
References Slide
*needs pictures

Resources

- National FFA Organization(N,D) “Ag-Explorer”.https://agexplorer.ffa.org/
- Oregon State University(2015). College of Agricultural Sciences. “Careers in Agricultural Sciences & Natural Resources”. https://agsci.oregonstate.edu/education/careers/careers-agricultural-sciences-and-natural-resources

Appendix F - Example Presentation: Horticulture

Types of Horticulture

Horticulture can be broken down into several categories:

- Olericulture
- Pomology
- Floriculture
- Ornamental Horticulture
- Landscape Horticulture
- Forestry

Growth for Food

Horticultural Products grown for consumption typically fall into one of two main categories:

- Olericulture- the growth of vegetables such as leafy greens and root vegetables
- Pomology- the growth of fruits, such as apples, tomatoes, tropical fruits, berries, etc.

Growth for Use and Aesthetics

Other types of horticulture exist for crops to be grown for our use or enjoyment:

- Floriculture- the growth of flowers for beauty
- Ornamental Horticulture- growing potted plants and greenery
- Landscape Horticulture-growth of shrubs, trees, and turfgrass
- Forestry- the cultivation of forests to harvest trees for their lumber, sap, or another use.

Horticulture In the United States

In 2020, the USDA reported a total of $13.8 billion of sales in horticulture within the U.S.

Horticulture In the United States

According to the USDA, the top commodities in U.S. horticulture sales in 2019 were:

- Nursery stock, $4.55 billion
- Annual bedding/garden plants, $2.24 billion
- Sod, sprigs and plugs, $1.27 billion
- Potted flowering plants, $1.2 billion
- Potted herbaceous perennials, $923 million,
- Propagative horticultural materials, bareroot, and unfinished plant materials, $720 million
- Food crops under protection, $703 million

Jobs in Horticulture

Jobs in horticulture vary widely in terms of activity, degree requirements, and salary. Some common jobs in horticulture include:

- Food Scientists
- Agronomy/Crop Specialists
- Landscape Architects
- Nursury & Greenhouse Managers
- Turfgrass Care Specialists/ Mowing Technicians
- Landscape Field Supervisors

Activity

Day 1: Using the handout provided, select one sector of the horticulture industry to explore further. Create a “zine” using the folding guide in order to make a booklet to record your information.

Day 2: Finish your zine, then in your groups share the information your learned with one another. Use the last page of your zine as a “ticket out the door” to record what you learned from your peers

References

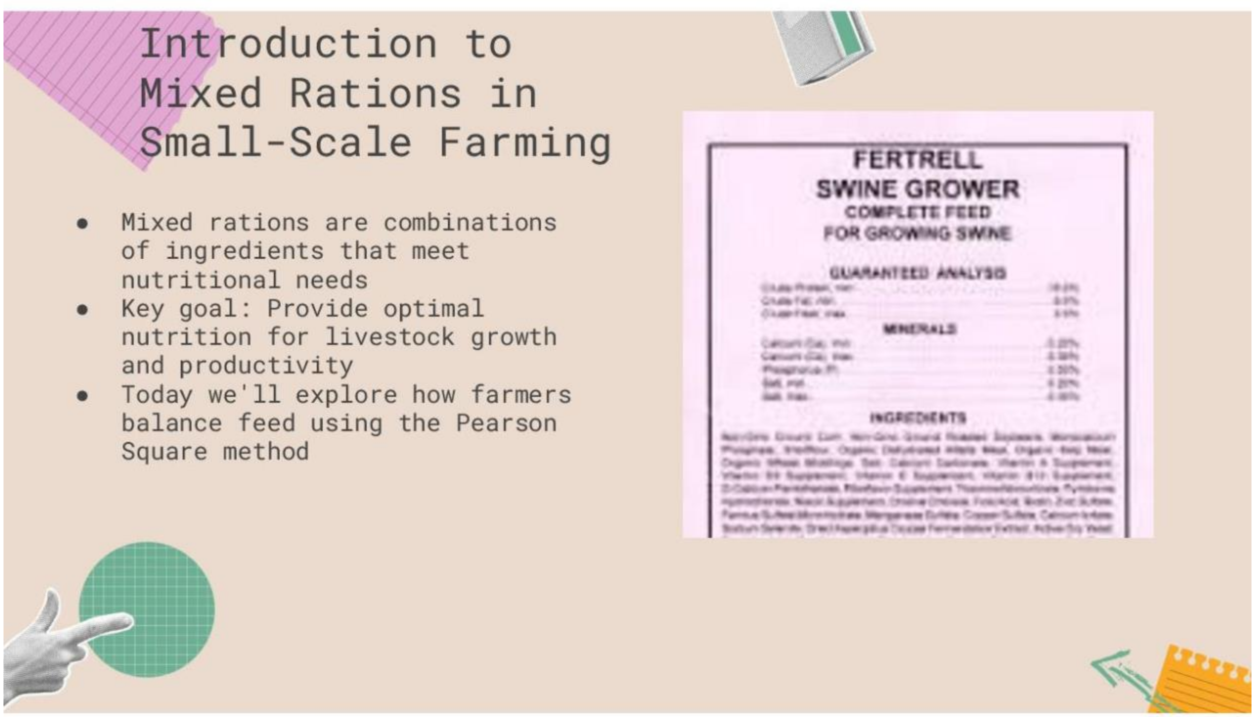
https://www.britannica.com/science/horticulture

https://levelgreenlandscaping.com/about/culture-landscaping-careers/contemplating-a-career-in-horticulture-jobs-salaries-and-other-considerations

https://plantspeopleplanet.au/origins-of-horticulture/

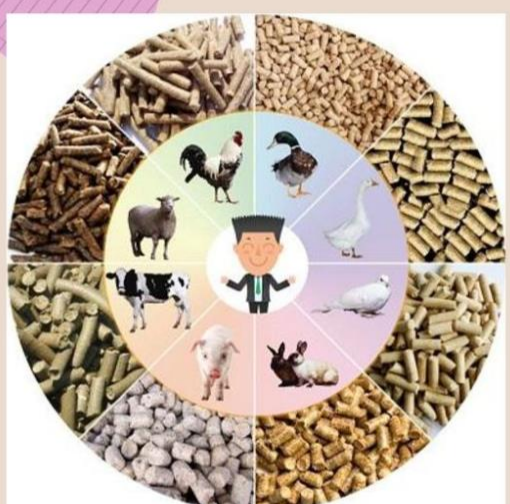
https://www.nass.usda.gov/Newsroom/archive/2020/12-08-2020.php

Appendix G - Example Presentation: Pearson Squares



What is a Mixed Ration?

- A combination of ingredients that provides complete nutritional requirements
- Each ingredient brings unique nutritional value
- 4 major nutrients: Protein, Carbohydrates, Fat, Vitamins/Minerals, and Water.
- Crude Protein (CP) is a critical focus for livestock producers
- Helps build muscle and supports animal growth



What is a Mixed Ration?

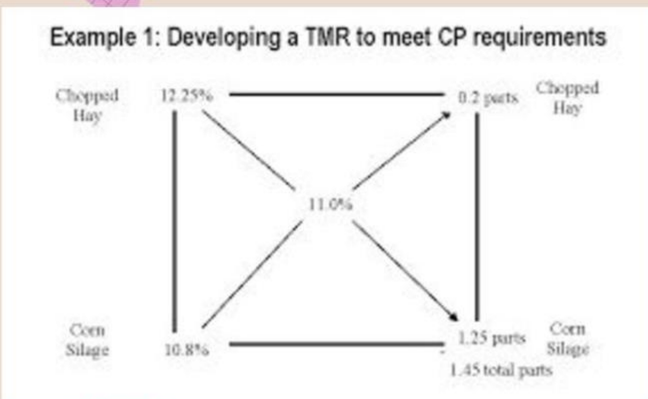
- Water sustains life, it is the most important need for animals
- Proteins allow for animal growth and development
- Carbohydrates provide immediate energy for life functions
- Fats provide stored energy and allow for vitamin and mineral absorption
- Vitamins and Minerals support bodily functions

Why Balance Feed Rations?

- Improve average daily weight gain
- Increase farm productivity
- Precise control over livestock nutrition
- Cost-effective feeding strategies
- Supports overall animal health

Understanding Crude Protein (CP)

- Protein percentage is crucial in feed selection
- Helps determine muscle development
- Different feeds have varying protein levels
- Farmers can adjust protein content by mixing feeds



What is The Pearson Square

- A mathematical tool for balancing feed rations
- Works best with two ingredients
- Helps calculate precise feed mixture
- Converts complex nutrition math into simple calculations

Pearson Square: Step-by-Step Process

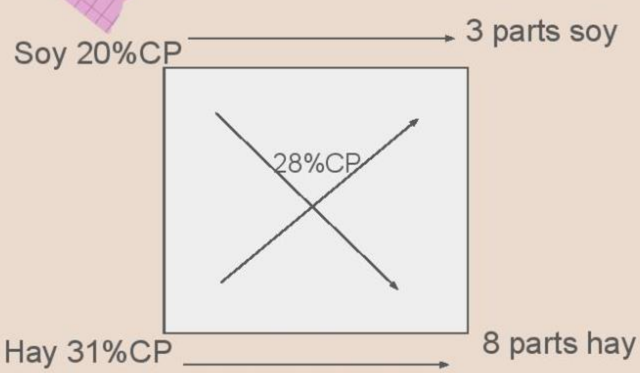
- Step 1: List two feed ingredients with protein percentages
- Step 2: Place desired protein percentage in the center
- Step 3: Cross-subtract ingredient values
- Step 4: Calculate proportion of each ingredient
- Step 5: Verify total ration equals 100%

Practical Example

A Farmer needs 1100lbs of feed for his cattle.

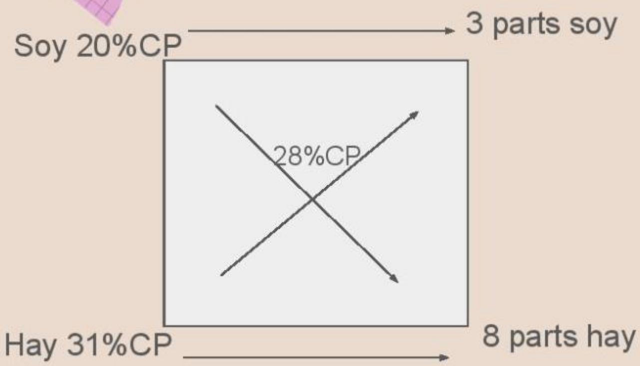
- Soybeans: 20% crude protein
- Chopped Hay: 31% crude protein
- Desired protein level: 28%
- Use Pearson Square to determine exact mixture (how many parts of each)
- Calculate precise amounts of each feed (how many lbs of each)

Calculation Breakdown



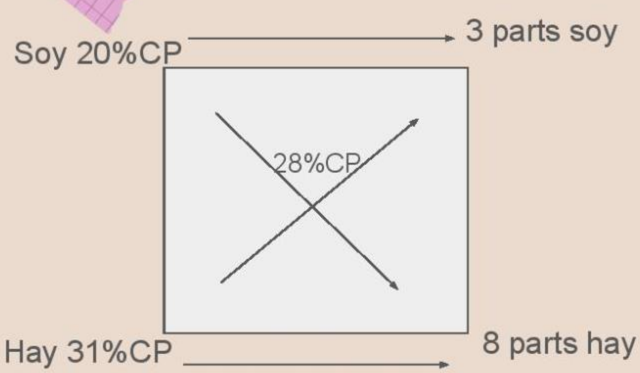
- Subtract the base percents from the final percent, ignoring negative numbers (20-28=8) (31-28=3)
- Your difference is your ratio for each ingredient (3 parts soy, 8 parts hay)
- Total Ratio is 3:8. Now we must determine how much of each feed we need to equal 1100lbs (the amount the farmer needs)

Calculation Breakdown

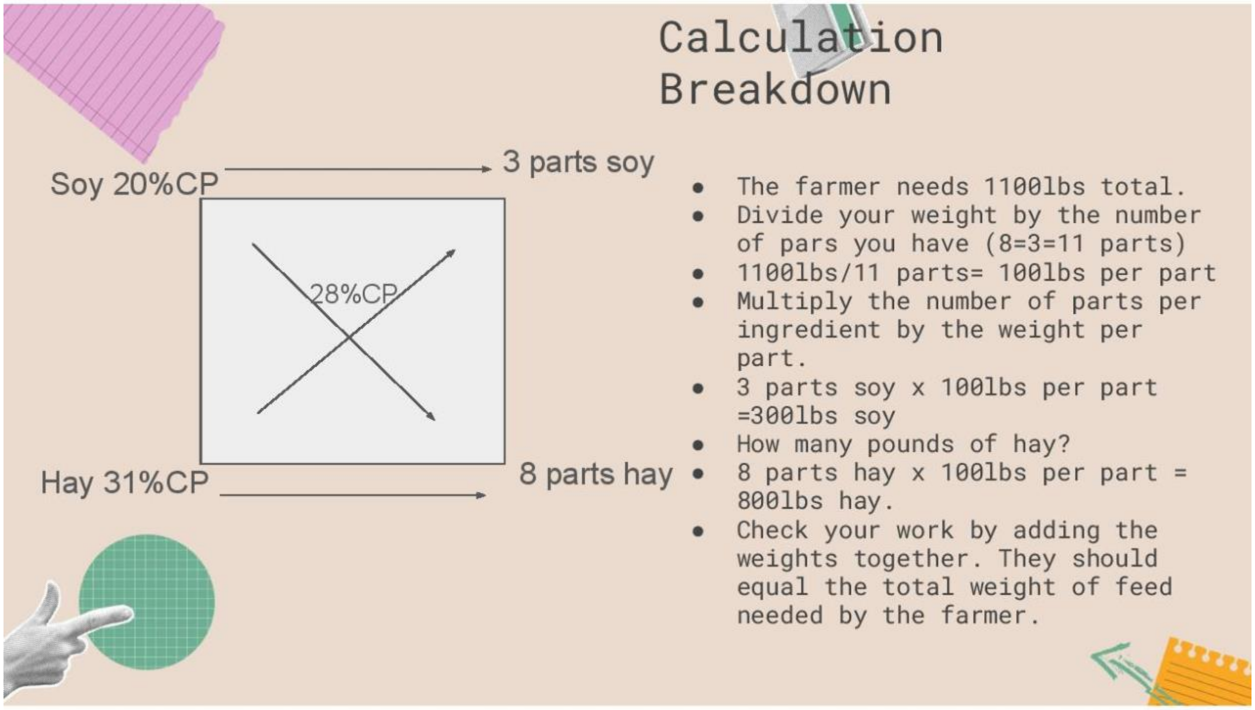


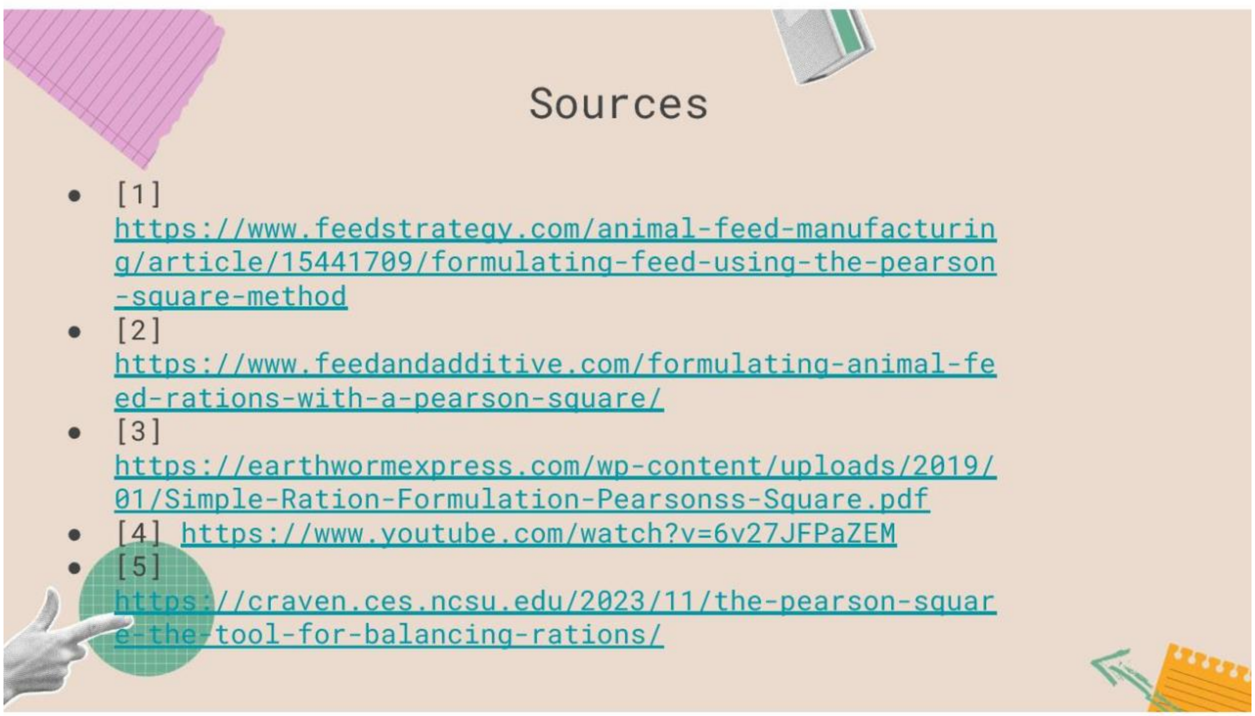
- The farmer needs 1100lbs total.
- Divide your weight by the number of pars you have (8=3=11 parts)
- 1100lbs / 11 parts = ?

Calculation Breakdown



- The farmer needs 1100lbs total.
- Divide your weight by the number of pars you have (8=3=11 parts)
- 1100lbs/11 parts= 100lbs per part
- Multiply the number of parts per ingredient by the weight per part.
- 3 parts soy x 100lbs per part =300lbs soy
- How many pounds of hay?


Calculation
Breakdown
Soy 20%CP
3 parts soy
28%CP
Hay 31%CP
8 parts hay
• The farmer needs 1100lbs total.
• Divide your weight by the number of pars you have (8=3=11 parts)
• 1100lbs/11 parts= 100lbs per part
• Multiply the number of parts per ingredient by the weight per part.
• 3 parts soy x 100lbs per part =300lbs soy
• How many pounds of hay?
• 8 parts hay x 100lbs per part = 800lbs hay.
• Check your work by adding the weights together. They should equal the total weight of feed needed by the farmer.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